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Flora Endemic Rare and Bioclimate of Palestine

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Abstract

Palestine was subject to classification study through the period from February to May 2017. This area has a characteristic of flora and biodiversity and belongs to dry, arid, semi-arid, sub-humid and humid climates, and locates in Mediterranean region. We took 400 samples of different plant species from Hebron (Idna, Althahreiyeh, Yatta villages and Hebron city); Jenin (Jenin city, Al-Yamon, Maysalon and Yabod); Jericho (Wadi Al-Qalt, Ain or Tal Sultan and Al-Nwehmeh) and Ramallah (Safa, Turmus Aya and Qibia). The absence of classification studies on the areas led us to run a statistical treatment on the 400 sampled flora of Palestine. Moreover, the classification was made following Braun-Blanquet in 1979; we transformed the Braun-Blanquet species abundance-dominance values into those of Van der Maarel in 1979. In the statistical treatment we obtained more than 53 plant species (Endemic rare) as *Paronychia palaestina Eig*, *Trifolium palaestinum Boiss.*, *Trifolium philistaeum Zohary*, *Suaeda philistaeum Zohary*and, and others, representing forests, copses, herbaceous and high shrublands influenced by climate (climatophilous), and edaphohygrophilic, and bioclimate factors as ombrotype and thermotype. However, according to study area we indicated that the flora endemic rare has 53 species, which of them 13% belong to *Compositae* family, 7.54% *Poaceae*, *Liliaceae* & *Papilionaceae* families, and 5.66% *Iridaceae* family.

Subject Areas

Plant Science

Keywords

Palestine, Classification, Biology, Endemic, Flora

1. Introduction

Palestine has a wide range of biodiversity concerns with a large variety of plants, and particular geographic location, between Asia, Africa and European and in conjunction with a series of environmental, bioclimatology and climatology factors, making it a very fertile land and unique biodiversity [1] [2]. Climate and bioclimate factors played an important role in influence on plant communities [3], flora and biological resources and plant physiology, biology and production [1]-[18]. The flora of Palestine includes 149 - 155 endemic species (6% of the total flora), of which 43% are found to be common, 27.5% are rare and 25.6% are very rare [19]. Moreover, it is the meeting ground for plant species originating from wide world regions, as Western Europe, Central Asia and Eastern Africa and other countries. Palestine is located in the Mediterranean region, being considered as one of the region of biodiversity in the world that should be subjected to conservation [20] [21]. *Flora* of Palestine is playing a role in economical important plants includes vegetables, crops and fruit trees, providing the local and international market with essential agricultural crops and it's very important used in field of medicine and research. In the other side, they are more than 2750 species of plants including 138 families that were estimated for Palestinian *flora* [3] [22] [23].

The main aims of the present study are to contribute to the knowledge of the flora of Palestine as endemic rare, and to study some of characteristics biologically and ecologically of plant in Palestine.

2. Materials and Methods

Flora of Palestine is important in medicine field and it is a role economical as fruit trees and vegetables, and to the know of flora of Palestine as endemic rare in the Mediterranean region, we selected a sampling areas in the regions of Hebron (south of Palestine); Jenin (north of Palestine); Jericho (east of Palestine and the area of Jordan valley) and Ramallah (center of Palestine), in which inventories or species were taken of 400 sampled plants in the locations previous. Forests, trees, herbaceous and shrub lands were sampled in order to obtain biological indicators for thermotype, ombrotype and to knowledge flora endemic rare at some of areas of Palestine. The inventories were made following Braun-Blanquet [24], and the Flora of Lebanon, Syria, Jordan, Negev, Sinai and Palestine were used for the floristic study. The absence of classification studies on the areas led us to run a statistical treatment on the 400 sampled of species. Moreover, we transformed the Braun-Blanquet species abundance-dominance values into those of Van der Maarel [25], and we used the classification of the earth of Salvador Rivas Martinez [26] [27] [28] [29] [30] to analyses of the bioclimate factors in Palestine, and data were used from Meteorology of Palestinian stations for the 35 years (1975-1998 and 2000-2008), addition to the vegetation was interpreted according to several methodological works in the world [31] [32] [33] [34].

2.1. Study Area

Palestine is located between longitudes 34˚15' and 35˚40' East and between latitudes 29˚30' and 33˚15' North. The geographic location of Palestine plays a major role in affecting the features of its flora and climate and the bioclimate diversity between the southern to northern parts, moreover, we selected the endemic rare species from the location of region Hebron, Jenin, Ramallah and Jericho cities, and their villages with the total area distance is 1145 km^2 as in the Figure 1, Table 1 & Table 2.

Table 1. Coordinates of location studied, and its distance and evaluation of Palestine.

Location	Area km^2	Latitude	Longitude	Elevation
Jenin	215	32˚28'N	35˚18'E	178 m
Ramallah	250	31˚89'N	35˚21'E	856 m
Hebron	570	31˚32'N	35˚06'E	1005 m
Jericho	110	31˚51'N	35˚27'E	−260 m

Km: Kilometers, N: North, and E: East.

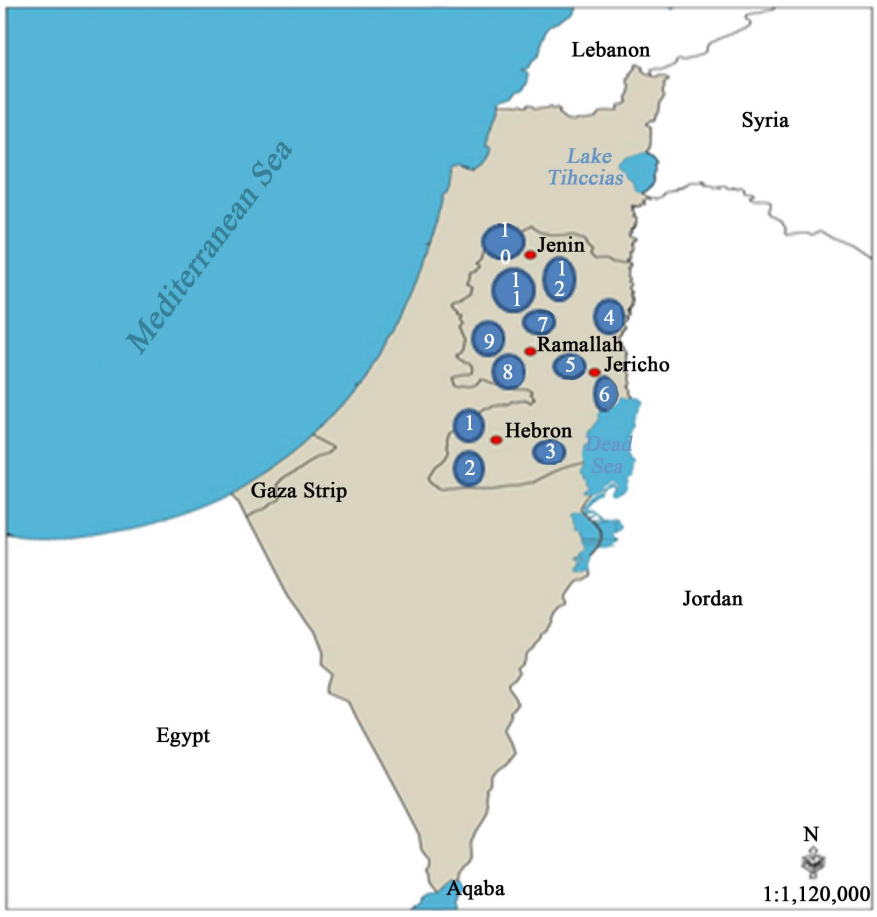

Figure 1. Details of the Furth stands chosen for vegetation analysis in the study area in Palestine. The cities of Hebron, Ramallah, Jenin and Jericho are representing red color in the figures.

Table 2. Details of the elephant stands chosen for vegetation analysis in the area study of Palestine.

Number	Location studied in the cities of Palestine	Precipitation	Elevation
1	Idna	473 mm	500 m
2	Ad-Dhahiriya	350 mm	655 m
3	Yatta	589 mm	820 m
4	Al-Nuwaimeh	190 mm	−140 m
5	Tal Sultan	180 mm	−200 m
6	Wadi Al-Qalit	170 mm	−285 m
7	Turmus'ayya	490 mm	720 m
8	Umm Safa	560 mm	630 m
9	Qibya	490 mm	250 m
10	Al-Yamon	341 mm	177 m
11	Yabod	625 mm	385 m
12	Methylone	633 mm	380 m

In the Table 2: Hebron area is representing the area study from number (1 - 3), and Jericho (4 - 6), Ramallah (7 - 9), while Jenin (10 - 12).

2.2. Targeting and Collection of Plant Materials

We studied four important areas extends from the north to the south of Palestine, in this study we took 400 samples of different species plants from Hebron (Idna, Ad-Dhahiriya, Yatta villages and Hebron city); Jenin (Jenin city, Al-Yamon, Methylone and Yabod); Jericho (Wadi Al-Qalt, Ain or Tal Sultan and Al-Nuwaimeh) and Ramallah (Umm Safa, Turmus'ayya and Qibya) (Table 2 and Table 4).

3. Results and Discussion

3.1. Bioclimatology

The location of the Palestine has given the study areas a tropical to a little humid climate [2] [3] [4], influenced by the mountains trade winds, geological and the topography of the regions, the climate is similar to that of the other Mediterranean basin. The annual average temperature is (18˚C - 22˚C), with little variation during night or day and few seasonal fluctuations. The hottest month is July and August, and the coldest is January. The annual rainfall distribution clearly reveals tow wet seasons, from September to November and November to March, while the dry season extends from June to September. The rainfall distribution reflects the direction of the trade winds, costal area, topography, temperature and the orientation of the mountain ranges, with a deceased rainfall to move from north to the south of Palestine, addition to the study area is influenced by the annual ombrothermic index value between (0.3 - 3.4), simple continentaly index value between (14.9 - 22), and compensated thermicity index value between (306/512) (Table 3), we used the following formulas to calculate the values

Table 3. Bioclimatic belts and ombrotype in study area of Palestine.

Provinces	Thermotype	Ombrotype	(I_c)	(I_o)	(I_t/I_{tc})
Ramallah	lower mesomediterranean	upper dry	4.9	3.0 - 3.4	306/306
Jericho	lower inframediterranean	upper arid	22	0.3 - 1.0	512/512
Hebron	lower mesomediterranean	upper dry	16.3	3.2 - 3.4	297/297
Jenin	lower inframediterranean	lower dry	17.0	2.0 - 2.7	468/468

Simple continentality index (Ic), ombrothermic index (Io) and compensated thermicity index (It/Itc).

of the various index Rivas Martínez (1996): Annual ombrothermic index, $I_o = P_p/T_p$; simple continentality index, $I_c = T_{\max} - T_{\min}$; thermicity index, or where applicable compensated thermicity index, $I_t/I_{tc} = (T + M + m)\,10$. P_p = positive precipitation and T_p = positive temperature (in this case equivalent to annual precipitation and average annual temperature divided by 12, as all the months have an average temperature above 0˚); P = precipitation of the months indicated; T = average temperature of the months indicated; $T_{\max}$ = maximum temperature of the averages of the warmest month of the year; $T_{\min}$ = minimum temperature of the averages of the coldest month of the year; T = Mean annual temperature; M = Mean of the maximum temperature of the coldest month of the year; and m = average of the minimum temperature of the coldest month of the year.

Nevertheless, they are variation to the altitude (−250 - 1040) meters on the sea level as temperature (−3˚C - 42˚C) and rainfall (100 - 900 millimeters). For this reason, temperatures of 0˚C can be recorded in inner valleys over 900 meters during the winter months as Hebron and Ramallah. Hurricanes and storms dramatically change the climate from June to October, especially in the south of Palestine as Hebron, and the east area at Jericho. These hurricanes originate in the tropics close in the area of Sinai desert, Negev and the Jordan valley regions.

3.2. Biogeographically & Vegetation Analysis, and Origin of the Flora

The flora of Palestine has 2.750 species [3] [22] [23] [35], of which 155 are endemic (6% of the total flora), and *Leguminaceae* family for instance with its 268 species contains 21 endemics, while among 23 species of *Iridaceae*, eight are endemic [36]. The floristic analysis reveals a great variety of influences, since a large number of species on Palestine derived, by means of migratory routes, from the floras of tropical Golf Arab, north Africa, and tropical to humid in Asia and Mediterranean basin, on the other hand, we confirmed that the flora of the occupied Palestinian territories has Euro-Siberian; Sudano-Zambesian, Saharo-Arabian; Irano-Turnian; Americas, Australia and South & north Africa; Mediterranean; and plant endemic, and it has nineteen principal plant communities such as Winter Deciduous (Montane) Forests, Carob and Terebinth Woodlands, savanna Mediterranean, Mediterranean, and sand, Maquis, Oak Woodlands, Lotus and Herbaceous Vegetation and others [36].

In the statistical treatment we obtained 53 endemic species are very rare (Figure 2), representing forests, Lotus and Herbaceous vegetation, copses and high shrub lands as:

Aegilops sharonensis Eig., *Convolvulus secundus desr.*, *Leopoldia bicolor Boiss.*, *Rumex occultans Sam.*, *Allium telavivense*, *Allium papillare*, *Anacamptis israelitica H. Baumann & Dafni*, *Anthemis brachycarpa Eig*, *Anthemis leucanthemifolia Boiss.*, *Aristida sieberiana Trin.*, *Atractylis carduus Forssk.*, *Ballota philistaea Bornm.*, *Bromus rigidus Roth.*, *Campanula sulphurea Boiss.*, *Centaurea procurrens Spreng.*, *Trisetaria koelerioides Melderis.*, *Capparis spinosa L.*, *Crocus aleppicus Baker.*, *Cutandia philistaea Boiss. Echinops philistaeus Feinbrun & Zohary*, *Erodium subintegrifolium Eig.*, *Erodium telavivense Eig.*, *Ferula samariae Zohary & P. H. Davis*, *Gagea dayana Chodat & Beauverd*, *Galium philistaeum Boiss*, *Iris atrofusca Baker*, *Iris atropurpurea Dinsmore*, *Iris vartanii Foster*, *Origanum dayi Post*, *Linaria joppensis Bornm.*, *Lupinus palaestinus Boiss*, *Lycium schweinfurthii Bot.*, *Maresia pulchella DC.*, *Onopordum telavivense Eig.*, *Paronychia palaestina Eig*, *Phlomis brachyodon Boiss.*, *Picris amalecitana Eig.*, *Plantago sarcop L.*, *Polygonum palaestinum Zohary*, *Pyrus syriaca Boiss.*, *Scandix blepharicarpa O. Cohen*, *Senecio joppensis Dinsm.*, *Silene modesta Boiss.*, *Silene papillosa Boiss.*, *Silene telavivensis Zohary & Plitmann*, *Tamarix aphylla L.*, *Tordylium aegyptiacum L.*, *Trifolium billardieri L.Trifolium palaestinum Boiss.*, *Trifolium philistaeum Zohary*, *Suaeda palaestina Zohary & Eig.*, *Onopordum carduiforme Boiss.* were influenced by climate as climatophilous, temperature, rainfall, deficit water, and sunrise, and bioclimate factors as annual ombrothermic index, compensated thermicity index, simple continentality index and soil water reserve and growing in upper inframediterranean, thermomediterranean-subhumid environments on carbonated substrates (rosary, light, and sandy soils) with neutral to a high pH; the Mediterranean woodlands and shrublands as *Convolvulus secundus desr.*, *Rumex occultans Sam.*, and *Ballota philistaea Bornm.*; Palestine, Mediterranean costal as *Aristida sieberiana Trin.*; the Mediterranean Woodlands and Shrublands, Semi-steppe shrublands as

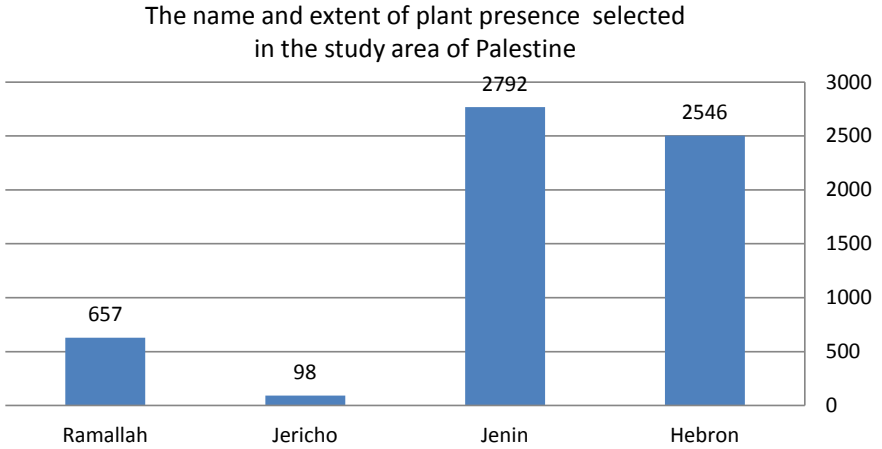

Figure 2. Repetition of the number of plants selected in the study area in Palestine.

Erodium subintegrifolium Eig.; Golan, northern valleys, Nablus desert, Jenin, Dead Sea valley, Hebron, and northern Negev as *Iris atrofusca Baker* and *Allium telavivense*; and the rest of Palestinian mountains in Hebron, Jenin, Nablus, Ramallah Jericho as *Iris atropurpurea Dinsmore*, this leads us to propose, for the areas of the eastern Mediterranean.

Furthermore, according study area we indicated that the flora endemic rare has 53 species, which of them 13% belong to *Compositae* family, 7.54% *Poaceae*, *Caryophyllaceae*, *Liliaceae* and *Papilionaceae* families, 5.66% *Iridaceae* family (**Table 4**), and the total repetition of the number of plants species selected in the study area are equals 6091, which of them 41.79% (2546 plant) in Hebron, 45.83% (2792 plant) in Jenin, 1.60% (98 plant) in Jericho and 10.78% (657 plant) in Ramallah, as in the (**Figure 2**), and *Anacamptis israelitica* H. *Baumann & Dafni*, *Anthemis brachycarpa Eig*., and *Paronychia palaestina Eig*. species were dominated and representinga high existed in the study area of Palestine (**Figure 3**). The regression coefficients (R) are equal 0.801, 0.771, 0.001, and 0.322 for Jenin, Hebron, Jericho and Ramallah respectively.

However, *Tamarix aphylla* L. should be included in the Mediterranean and Saharan-Arabian class *Nerio-Tamaricetea* [37]; and in *Tamaricetalia* [38] [39], Braun-Blanquet J. [40], the only order described to date, the absence of *Tamarix gallica* and *Tamarix Africana*, and the presence in Asiatic territories of *Tamarix tetragyna*, *T. tetrandra*, *T. jordanis* etc.

Moreover, distribution plants of the flora Palestinian area [22] comprises updated nomenclature, distribution and habit data for the species in the area covered by flora Palestinian [41]-[46]. However, we noted that the plants in Palestine are considered an important part of the plant to the Region Mediterranean basin, which is similar to many studies such as [3] [36] [47]. Nevertheless, there

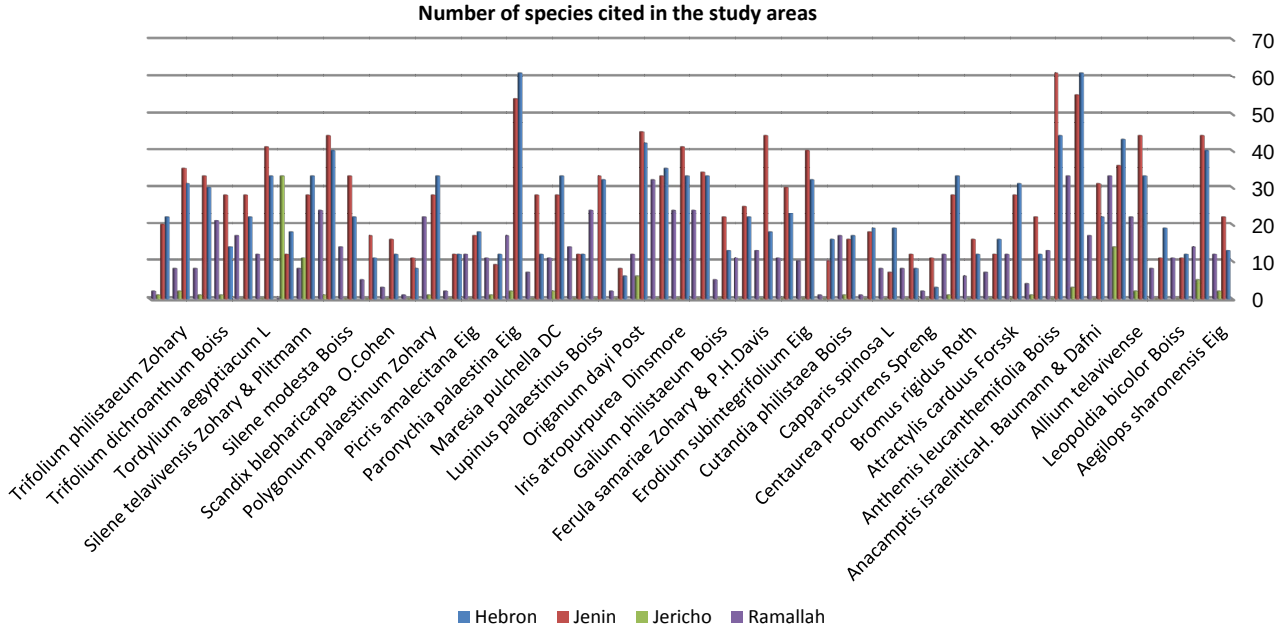

Figure 3. The name and extent of plant presence in the area studied in Palestine.

Table 4. Synthetic representation of plant and its repetitions of the number of plants in study area sampled.

Synthetic representation of plant	Hebron	Jenin	Jericho	Ramallah		
Altitude in m 1 = 10	690	370	−220	670		
Surface in m^2	200	300	100	70		
Cover rate %	60	65	75	70		
Average height of veg. in m	1.5	2	2	2.5		
slope %	5	15	10	25		
Orientation	W	N	E	S	Average Family	
Species						
Aegilops sharonensis Eig.	13	22	2	12	12.25	Poaceae
Convolvulus secundus desr.	40	44	5	14	25.75	Convolvulaceae
Leopoldia bicolor Boiss.	12	11	0	11	8.5	Liliaceae
Rumex occultans Sam.	19	11	0	8	9.5	Polygonaceae
Allium telavivense	33	44	2	22	25.25	Liliaceae
Allium papillare	43	36	14	33	31.5	Liliaceae
Anacamptis israelitica H. Baumann & Dafni	22	31	0	17	17.5	orciddaceae
Anthemis brachycarpa Eig	61	55	3	33	38	Compositae
Anthemis leucanthemifolia Boiss.	44	61	0	13	29.5	Compositae
Aristida sieberiana Trin.	12	22	1	4	9.75	Poaceae
Atractylis carduus Forssk.	31	28	0	12	17.75	Compositae
Ballota philistaea Bornm.	16	12	0	7	8.75	Labiatae
Bromus rigidus Roth.	12	16	0	6	8.5	Poaceae
Campanula sulphurea Boiss.	33	28	1	12	18.5	Campanulaceae
Centaurea procurrens Spreng.	3	11	0	2	4	Compositae
Trisetaria koelerioides Melderis.	8	12	0	8	7	Poaceae
Capparis spinosa L.	19	7	0	8	8.5	Capparaceae
Crocus aleppicus Baker.	19	18	0	1	9.5	Iridaceae
Cutandia philistaea Boiss.	17	16	1	17	12.75	Poaceae
Echinops philistaeus Feinbrun & Zohary	16	10	0	1	6.75	Compositae
Erodium subintegrifolium Eig.	32	40	0	10	20.5	Geraniaceae
Erodium telavivense Eig.	23	30	0	11	16	Geraniaceae
Ferula samariae Zohary & P.H.Davis	18	44	0	13	18.75	Apiaceae
Gagea dayana Chodat & Beauverd	22	25	0	11	14.5	Liliaceae
Galium philistaeum Boiss	13	22	0	5	10	Rubiaceae
Iris atrofusca Baker	33	34	0	24	22.75	Iridaceae
Iris atropurpurea Dinsmore	33	41	0	24	24.5	Iridaceae
Iris vartanii Foster	35	33	0	32	25	Iridaceae

Continued

Origanum dayi Post	42	45	6	12	26.25	Labiatae
Linaria joppensis Bornm.	6	8	0	2	4	Scrophulariaceae
Lupinus palaestinus Boiss	32	33	0	24	22.25	Papilionaceae
Lycium schweinfurthii Bot.	12	12	0	14	9.5	Solanaceae
Maresia pulchella DC.	33	28	2	11	18.5	Cruciferae
Onopordum telavivense Eig.	12	28	0	7	11.75	Asteraceae
Paronychia palaestina Eig	61	54	2	17	33.5	Caryophyllaceae
Phlomis brachyodon Boiss.	12	9	1	11	8.25	Labiatae
Picris amalecitana Eig.	18	17	0	12	11.75	Compositae
Plantago sarcop L.	12	12	0	2	6.5	Plantaginaceae
Polygonum palaestinum Zohary	33	28	1	22	21	Polygonaceae
Pyrus syriaca Boiss.	8	11	0	1	5	Rosaceae
Scandix blepharicarpa O.Cohen	12	16	0	3	7.75	Apiaceae
Senecio joppensis Dinsm.	11	17	0	5	8.25	Compositae
Silene modesta Boiss.	22	33	0	14	17.25	Caryophyllaceae
Silene papillosa Boiss.	40	44	1	24	27.25	Caryophyllaceae
Silene telavivensis Zohary & Plitmann	33	28	11	8	20	Caryophyllaceae
Tamarix aphylla L.	18	12	33	0	15.75	Tamaricaceae
Tordylium aegyptiacum L.	33	41	0	12	21.5	Apiaceae
Trifolium billardieri L.	22	28	0	17	16.75	Fabaceae
Trifolium dichroanthum Boiss.	8	3	0	5	4	Papilionaceae
Trifolium dichroanthum Boiss.	8	8	1	4	5	Papilionaceae
Trifolium philistaeum Zohary	8	8	3	3	11	Papilionaceae
Trifolium palaestinum Zohary & Eig.	10	8	2	4	4	Chenopodiaceae
Onopordum carduiforme Eig.	10	5	1	4	5	Compositae

Average: Representing average of each of plant in the total sampled, total of plant repetitions in study area is 6091, the standard deviation of the vegetation analysis is equal 14.43.

coexistence between flora of Palestine due to the biodiversity, the topography, the nature of the climate and bioclimatic factors.

4. Conclusions

Within the historic lands of Palestine, the number of plant species is 2750 in an area of 27,000 km^2, of which them 2485 species in the area of occupied Palestinian territories year 1967 with a 5600 km^2, whereas the flora of study area (Hebron, Jenin, Ramallah and Jericho) of Palestine has 1881 species (with the area of 1145 km^2), 53 plant species of which are endemically rare such as *Paronychia palaestina Eig*, *Trifolium palaestinum Boiss.*, *Trifolium philistaeum Zohary*, *Suaeda philistaeum Zohary* and others, representing forests, copses, herbaceous and

high shrublands influenced by climate as climatophilous and edaphohygrophilic, and bioclimate factors as ombrotype and thermotype.

Palestine flora and biodiversity belong to arid, semi-arid, dry, sub-humid and humid ombrotype and lower inframediterranean to mesomediterranean environments thermotype in Mediterranean region. Consequently, Palestine's geographical position has been, both its blessing and its curse, located at the meeting point between Eurasia and Africa and plants of three continents have interacted and spread throughout history. Moreover, the flora endemic species representing a more present in the area of Hebron and Jenin, because Hebron is affected by climate and biodiversity of Mediterranean basin, topography, Dead Sea, Red Sea, Sinai desert and Negev and the mountains highland, meanwhile Jenin is affected by Mediterranean basin, and Jordan valley and Al-Aghwar, and other factors.

In the end, we need achieve some of projects and researches to knowledge all of Palestine plant and established plants bank.

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