



دراسة بيئية تصنيفية لمنطقة حدية شبه جافة في شمال الأردن



## An Ecosystematic Study of a semi-arid ecotone in the Northern part of Jordan

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### المُلخَص

نفذ هذا البحث في منطقة حدية شبه جافة تقع في شمال الأردن، كانت محمية منذ أكثر من 25 سنة. بدأت الفلورا في هذه المنطقة تتعرض لاعتداءات بيئية مختلفة كالحريق، والرعي الجائر والاستعمال السيئ للأراضي بعد إنشاء جامعة العلوم والتكنولوجيا ومزرعة لتربيته المواشي تابعه لكلية الزراعة. أجريت دراسة للنباتات الزهرية التي تنمو طبيعياً في هذه المنطقة. تم تسجيل قرابة 330 نوعاً من النباتات الزهرية مصنفة في 46 عائلة نباتية. أظهرت الدراسة أن العائلات النباتية السائدة في المنطقة كانت على النحو الآتي: العائلة المركبة (57 نوعاً)، العائلة البقولية (38 نوعاً)، والعائلة النجيلية (27 نوعاً). تم تسجيل خمسة أنواع نباتية جديدة في المنطقة، هي:

*Ferula biverticillata* Lag., *Argemone mexicana* L., *Reseda luteola* L. var. *Luteola*, *Smyrniopsis cachroides* Boiss and *Aegilops crassa* Boiss. subsp. *Vavilovi* Zhuk.

تضمن البحث دراسة المؤشرات البيئية الآتية: طرق الانتشار، وعمر النبات، وأشكال الحياة، وأنماط التوزيع المختلفة للنباتات التي تنمو في هذه المنطقة. إضافة إلى دراسة التنوع الحيوي باستعمال دليل شانون - واينر، التكرار. ودرست أيضاً بعض المؤشرات البيئية الاجتماعية، مثل التكرار، والكثافة، والوفرة، والأهمية البيئية لأنواع النباتات في هذه المنطقة.

الكلمات المفتاحية: الأردن، الموقع البيئي، التنوع النباتي، المنطقة الجغرافية الحيوية، علم البيئة، النوع الحيوي.

### Abstract

This study was conducted on a semi-arid ecotone in the Northern part of Jordan near Irbid City and it has been protected for more than 25 years.

After the establishment of Jordan University of Science and Technology in the area and an animal farm for the college of Agriculture, the flora in this site became under severe stress due to man interference, fire, overgrazing, drought and land misuse. Survey of all vascular plants that grow naturally was done. 330 species of flowering plants belonging to 46 families. The most dominant families were the Compositae (57 species) Leguminosae (38 species) and Poaceae (27 species). Five species of flowering plants were newly recorded for

the first time from the studied area and these are: *Ferula biverticillata* Lag., *Argemone mexicana* L., *Reseda luteola* L. var. *Luteola*, *Smyrniopsis cachroides* Boiss and *Aegilops crassa* Boiss. subsp. *Vavilovi* Zhuk. Complete floristic analysis was conducted. The following parameters were studied: type of diaspore, duration, life form, distribution affinities as well as species diversity using Shanon-Wiener Index. Some socioecological parameters like frequency, density and abundance of species were considered.

**Key words:** Jordan, Ecotone, Flora, Biogeographical region, Ecology, Plant biodiversity.

## Introduction

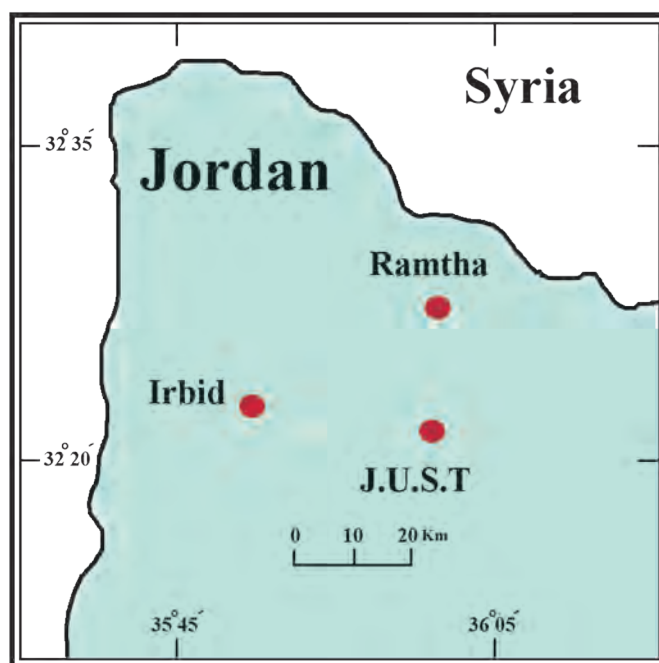
The zone where two or more different communities meet and integrate is an ecotone. This zone of intergradation may be narrow or wide, local or regional.

Three types of ecotones are recognizable (Daubenmire, 1968). One is an abrupt transition, the result of sudden change in environmental conditions, such as soil type or soil drainage. The second is a sharp transition brought about by plant interaction, particularly competition. The third type is blending of two or more adjacent vegetational types. As a result the ecotone exhibits a shift in dominance of the conspicuous species of both sides; it also may include a number of highly adaptable species that tend to colonize such transitional areas. Because of this, the variety and density of life is often greatest in such areas. This phenomena has been called the edge effect (Smith, 2002).

This study was conducted on the flora that grows naturally on the fenced campus of Jordan University of Science and Technology (J.U.S.T) which is located in northern Jordan (32° 34' N Latitude 36° 01' E longitude and 520 m altitude) during the growing seasons of 2001/2002 and 2002/2003. The size of the site is about 11 square kilometers (Fig. 1)

The study area represents an ecotone as a result of blending of plant communities from Irano-Turanian, Mediterranean and Saharo-Arabian phytogeographical regions. The location is characterized by semi-arid climate of mild rainy winters and dry hot summers. In the last ten years the mean annual rainfall in the

University campus was 211 mm, the mean maximum air temperature during July and August was 36° C, while the mean minimum air temperature was 0.9° C during January, and the prevailing wind direction is west wind. Soil in the study area is fine-loamy, mixed, thermic, calcite paleargid (Khresat *et al.*, 1998).



**Fig. 1.** Location of the study area (J.U.S.T)

Many publications related to the floristics and ecosystematics of particular regions in Jordan where published in the last three decades e.g (Boulos *et al.*, 1977; Al-Eisawi, 1982, 1986, and 1988; El-Oqlah *et al.*, 1985; Lahham, 1975 and 1977; Oran, 1994; Oran *et al.*, 1994). No studies were undertaken on this region. This area is also under severe stress pressure due to drought, human interference, fire, overgrazing etc. There is a serious need for the monitoring of these

hazards on the flora and changes in habitats.

The objectives of this research work were to survey all vascular plants that grow naturally in this area, to determine the rare and threatened or endangered species. In addition to that, ecological parameters such as types of diaspores, distribution affinities, duration, life forms, species frequency, density and diversity were also recorded.

## Materials and Methods

Twenty six blocks (each is about 0.5 sq Km) were taken and three to eight quadrates in each block were used to tabulate the existing plant species and their numbers. The minimal size of quadrate for studying vegetation was determined by laying a quadrate of small area and count the number of plant species occurring within it. Then we increased the size till no additional species are likely to occur in the enlarged quadrate.

Herbarium specimens were collected several times through the continuous visits to the study area. These specimens were professionally prepared and deposited at the herbarium of Yarmouk University, Department of Biological Sciences. Shannon-Wiener species index was used to measure species diversity. Frequency and density were calculated.

## Results

### I. Plant Diversity:

In this study we reported the occurrence of 330 flowering plant species belonging to 212 genera, 48 families, 29 orders, 9 subclasses and 2 classes. The terminology used for the ranks above the family level is that of Cronquist (1981). Five species were newly recorded in the study area and these are : *Aegilops crassa* Boiss. subsp. *vavilovi* Zhuk, *Argemone mexicana* L., *Ferula biverticillata* Lag., *Reseda luteola* L. var. *luteola* and *Smyrniopsis cachroides*

Boiss. This area includes about 14% of the plant species recorded from Jordan, 28% of the genera and 44% of plant families. The most dominant plant families in the study area were the *Asteraceae* (42 genera, 57species), *Fabaceae* (*Leguminosae*) (15 genera, 38 species) and *Poaceae* (*Gramineae*) (18 genera, 27 species).

Twenty six rare plant species reported by Al-Eisawi *et al.*, (2000) from Jordan were found in the study area. A list of names of plant species, genera and higher taxa in which they are classified as well as rare plant species and plants which have possible economic importance as medicinal, ornamental, range, culinary and for the improvement of other economic plants are listed in Appendix 1.

### II. Diaspores:

The dispersal mechanisms of plants growing in this ecotone are given in Table 1.(The nomenclature and terminology used is that of Van Derv Pijl (1969) and Ridley (1930).

**Table 1:** The Diaspore type of existing species.

Diaspore type	No. of species	(%)
Sporchore	11	3.4
Pterochore	13	3.9
Pogonochore	51	15.5
Cyclochore	13	3.9
Epizoochore	36	11.0
Ballochore	1	0.3
Anthropochore	6	1.8
Atelechore	181	54.7
Polychore	18	5.5
Total	330	100

Plants were grouped into the above mentioned categories according to nature of their diaspores, their structure and appendages, of their mechanisms

of discharge from the parent plant. Table 1 show that plants without specialized dispersal mechanisms which are classified under the category atelochore are considerably higher than those furnished with appendages or other accessories that enables dispersal for long distance.

In a similar study on the forest vegetation of Ajlun mountains dominated by pine, deciduous tabor oak and evergreen oak trees and maquis by Lahham and Oqlah (1986), the atelochore type of diaspore was much less (34.7%) than what is found in this ecotone (54.7%). Next to atelochores came the pogonochores (diaspores with plumed seeds and fruits) and their percentage was about 15.5%.

### III. Life forms:

In Table 2 an analysis of the life forms as defined by Raunkier is given. These are given as number of species and percentages.

**Table 2:** The life form of existing plant species.

Life form	No. of species	(%)
Therophytes	214	64.7
Hemicytrophytes	37	11.2
Cryptophytes	37	11.2
Chamaephytes	36	10.9
Phanerophytes	2	0.3
Succulents	2	0.3
Parasites	2	0.3
<b>Total</b>	<b>330</b>	<b>100</b>

The percentage of therophytes (annuals which finish their life cycle from seed germination to seeds in one year or less) in the study area is around 64.7% of the total number of species. Therophytes are typical of deserts and grassland. Number of therophytes is about 6 times the number of chamaephytes (shrubs with

buds less than 0.5 m above ground and considered as typical of cool, dry climates). Phanerophytes, succulents and parasites are the least represented life forms in the area.

### IV. Distribution affinities:

A phytogeographical analysis of this ecotone revealed the existence of uni-,bi- and pluriregional groups. The numerical proportions of these groups are shown in Table 3.

**Table 3.1 :**Uni-regional plant species.

Regional group	No. of species	(%)
Mediterranean	71	21.6
Irano-Turanian	53	16.1
Saharo-Arabian	11	3.4
Euro-Siberian	2	0.6

**Table 3.2:** Bi-regional plant species.

Regional group	No. of species	(%)
Mediterranean_ Irano-Trunian	127	38.3
Mediterranean_ Saharo-Arabian	4	1.2
Irano-Turanian_ Saharo-Arabian	18	5.5

**Table 3.3:** Pluriregional plant species.

Regional group	No. of species	(%)
Med_Irano_ Saharo	13	3.9
Med_Irano_Euro	15	4.5
Irano_Saharo_ Sudanian	1	0.3
others	15	4.5

The number of species of the Irano-Turanian element in the flora of studied area is 53, about 16.1% of the flora of the ecotone. Adding to their number 174 species of bi- and pluriregional species such as Mediterranean- Irano-Turanian, Irano-Turanian-Saharo-Arabian, and Med-Irano-Saharo groups; the Irano-Turanian affinity of local flora becomes strongly apparent. The Mediterranean elements (uni-, bi-, and pluriregional) were almost equal to the Irano-Turanian elements. The Saharo-Arabian elements (uni-, bi-, and pluriregional) were very much less represented and the total of their percentages was 14.2%.

## V. Frequency, density and species diversity:

Frequency percentage is an efficient method for evaluating the spatial distribution of species. Frequency percentage of the most frequent species were determined and presented in Table 4.

*Hordeum marinum*, *Trigonella caelesyriaca* and *Avena sterilis* were the most frequent species in the study area. Density is an efficient expression for evaluating numerical strength of a species. Arrangement of the highest dense species in the area is found in Table 5.

**Table 4.** The most frequent species in the study area.

Species	Total No. of individuals of each Species	No. of Quadrate of Occurrence	%F	%Rf	D	Rd
<i>Hordeum marinum</i>	1969	85	72.0	4.5	4.2	6.3
<i>Trigonella caelesyriaca</i>	1169	83	70.3	4.4	2.5	3.8
<i>Avena sterilis</i>	1908	78	66.1	4.2	4.0	6.2
<i>Anthemis palestina</i>	1906	77	65.3	4.1	4.0	6.1
<i>Erodium cicutarium</i>	1133	65	55.1	3.5	2.4	3.7
<i>Senecio vernalis</i>	1136	65	55.1	3.5	2.4	3.7
<i>Trigonella arabica</i>	1784	61	51.7	3.3	3.8	5.8
<i>Onobrychis crist-galli</i>	1015	58	49.2	3.1	2.2	3.3
<i>Calendula arvensis</i>	1395	54	45.8	2.9	3.0	4.5
<i>Centaurea hyalolepis</i>	579	54	45.8	2.9	1.2	1.9
<i>Erucaria hispanica</i>	412	53	44.9	2.8	0.9	1.3
<i>Hordeum spontaneum</i>	878	48	40.7	2.6	1.9	2.8
<i>Vicia peregrina</i>	751	47	39.8	2.5	1.6	2.4
<i>Filago contracta</i>	4100	43	36.4	2.3	8.7	13.2
<i>Fumaria densiflora</i>	1017	38	32.2	2.0	2.2	3.3
<i>Astragalus gattutus</i>	332	37	31.4	2.0	0.7	1.1
<i>Carduus australis</i>	348	35	29.7	1.9	0.7	1.1
<i>Trisetaria macrochateta</i>	260	31	26.3	1.7	0.6	0.8
<i>Diplotaxis eruroides</i>	412	27	22.9	1.4	0.9	1.3
<i>Adonis aleppica</i>	114	26	22.0	1.4	0.2	0.4

F: frequency, Rf: relative frequency, D: density, and Rd: relative density.

**Note:** The total sampled quadrates is 118, and the area of each quadrate is 4 m<sup>2</sup>

**Table 5.** Arrangement of the highest dense species in the area.

Species	Total No. of individuals of each Species	No. of Quadrate of Occurrence	%F	% Rf	D	Rd
<i>Filago Contracta</i>	4100	43	36.4	2.3	8.7	13.2
<i>Hordeum marinum</i>	1969	85	72.0	4.5	4.2	6.3
<i>Avena sterilis</i>	1908	78	66.1	4.2	4.0	6.2
<i>Anthemis palestina</i>	1906	77	65.3	4.1	4.0	6.1
<i>Trigonella arabica</i>	1784	61	51.7	3.3	3.8	5.8
<i>Calendula arvensis</i>	1395	54	45.8	2.9	3.0	4.5
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<i>Senecio vernalis</i>	1136	65	55.1	3.5	2.4	3.7
<i>Erodium cicutarium</i>	1133	65	55.1	3.5	2.4	3.7
<i>Fumaria densiflora</i>	1017	38	32.2	2.0	2.2	3.3
<i>Onobrychis crista-galli</i>	1015	58	49.2	3.1	2.2	3.3
<i>Hordeum spontaneum</i>	878	48	40.7	2.6	1.9	2.8
<i>Plantago coronopus</i>	821	4	3.4	0.2	1.7	2.6
<i>Minuratia picta</i>	816	16	13.6	0.9	1.7	2.6
<i>Vicia peregrina</i>	751	47	39.8	2.5	1.6	2.4
<i>Centaurea hyalolepis</i>	579	54	45.8	2.9	1.2	1.9
<i>Phalaris minor</i>	551	24	20.3	1.3	1.2	1.8
<i>Crepis aspera</i>	479	25	21.2	1.3	1.0	1.5
<i>Sedum pallidum</i>	444	14	11.9	0.7	0.9	1.4
<i>Diplotaxis eruroides</i>	412	27	22.9	1.4	0.9	1.3

F: frequency, Rf: relative frequency, D: density, and Rd: relative density.

**Note:** The total sampled quadrates is 118, and the area of each quadrate is 4 m<sup>2</sup>

It is obvious that *Filago contracta*, *Hordeum marinum* and *Avena sterilis* are the most dense species in the area. Species diversity (sometimes called species heterogeneity), a characteristic unique to the community level of biological organization, is an expression of community structure. High species diversity indicates a highly complex community, for a greater variety of species allows for more variety of species interactions.

In this study we used Shannon-Wiener species index to study the species diversity. We found that the species diversity in the study area equals 1.567. In a similar study on a natural reserve near Al-Sult

city/ Jordan (Odimat, M.Sc thesis) in which three phytogeographical regions meet( Mediterranean, Irano-Turanian and Sudanian) she found that the species diversity was 1.423.

## Discussion

This study showed that the flora of this ecotone with a size of about 11 sq km, comprise about 14% of the total flora of Jordan. From this point we understand the importance of studying and conserving ecotones because of their high biological diversity. Analysis of the distribution affinities of the recorded

species indicates that vegetation in this area resulted from the blending of vegetation of Irano-Turanian, Mediterranean and Saharo-Arabian elements. The life form analysis of this ecotone indicates the dominance of therophytes in this area. Therophytes dominance is characteristic of arid, hot or xerophytic habitats.

The study of dispersal mechanisms showed that ateleochores represent 54.7% of the total type of diaspore. The dominance of the *Compositae* family in the area with their characteristic plumed fruits explains the high percentage of pogochoire type of diaspores in the area.

## Appendix 1:

### Abbreviations:

Rare plant species (Rs)

Threatened plant species ( Ts)

Medicinal plant species (Ms)

Ornamental plant species (Os)

Forage plant species (Fs)

Culinary(food) plant species (Cs)

### Classification of plant species according to Cronquist system

#### Magnoliophyata

Magnoliopsida (dicots)

Magnoliidae

#### Aristolochiales

#### Aristolochiaceae (1 species)

- \* *Aristolochia maurorum* L.

#### Ranunculales

#### Ranunculaceae (10 species)

- \* *Adonis aestivalis* L.
- \* *Adonis aleppica* Boiss.
- \* *Anemone coronaria* L. (Os)
- \* *Ceratocephala falcata* (L.) Pers.
- \* *Consolida scleroclada* (Boiss.) Schordger.(RS)
- \* *Delphinium peregrinum* L. (Os ;RS)

- \* *Nigella arvensis* L.
- \* *Ranunculus asiaticus* L. (Os)
- \* *Ranunculus arvensis* L.
- \* *Ranunculus damascenus* Boiss. et Gaill.

#### Berberidaceae (2 species)

- \* *Bongardia chrysogonum* (L.) Spach(Ms)
- \* *Leontice leontopetalum* L.(Ms)

#### Papaverales

#### Papaveraceae (7 species)

- \* *Argemone mexicana* L. (Os)
- \* *Glaucium aleppicum* Boiss. et Huasskn.
- \* *Glaucium arabicum* Fresen.
- \* *Papaver hybridum* L.
- \* *Papaver polytrichum* Boiss.et Ky.(Ms)
- \* *Roemeria hybrida* (L.) DC.
- \* *Roemeria procumbens* Aarons. et Opphr.(Ts)

#### Fumariaceae (4 species)

- \* *Fumaria densiflora* DC.
- \* *Hypecoum aegypticum* (Forssk.) Aschers. et Schweinf.
- \* *Hypecoum imberbe* Sm.
- \* *Hypecoum pendulum* L.

#### Hamamelidae

#### Urticales

#### Urticaceae (1 species)

- \* *Urtica urens* L.

#### Caryophyllidae

#### Caryophyllales

#### Chenopodiaceae (11 species)

- \* *Aellenia austrani* (Post) Zoh.
- \* *Anabasis syriaca* L.
- \* *Atriplex leuoclada* Boiss.(Fs)
- \* *Atriplex rosae* L.
- \* *Beta vulgaris* L.
- \* *Chenopodium album* L.(Cs)
- \* *Chenopodium vulvaria* L.
- \* *Hammada scoparia* (Pomel) Iljin
- \* *Salsola inermis* Forssk.
- \* *Sasola kali* L.
- \* *Salsola vermiculata* L.(Fs)

### **Amaranthaceae (5 species)**

- \* *Amaranthus albus* L.
- \* *Amaranthus blitoides* S. Wats.
- \* *Amaranthus gracilis* Desf.(Rs)
- \* *Amaranthus hybridus* L.
- \* *Amaranthus retroflexus* L.

### **Portulacaceae (1 species)**

- \* *Portulaca oleracea* L.(CS)

### **Molluginaceae (1 species)**

- \* *Glinus lotoides* L.

### **Caryophyllaceae (17 species)**

- \* *Cerastium dichotomum* L.
- \* *Dianthus strictus* Banks et. Sol. (Os)
- \* *Gypsophila arabica* Barkoudah (Os)
- \* *Gypsophila pilosa* Huds.
- \* *Herinaria hirsuta* L.
- \* *Holosteum glutinosum* (M.B.) Fesch. Etmey.
- \* *Holosteum umbellatum* L.
- \* *Minuratia picta* (Sibth. et. Sm) Bornm.
- \* *Paronychia argentea* Lam.
- \* *Silene arabica* Boiss.
- \* *Silene colorata* Poir
- \* *Silene conoidea* L.
- \* *Silene longipetala* Vent.
- \* *Silene rubella* L.
- \* *Spergularia diandra* (Gass.)Heldr .et. Sart.
- \* *Stellaria media* (L.) Vill.
- \* *Vaccaria pyramidata* Medik. (Os)

### **Polygonales**

#### **Polygonaceae (4 species)**

- \* *Polygonum equistiforme* Sibth. et. Sm.
- \* *Polygonum lapathifolium* L.
- \* *Polygonum patulum* M. B.
- \* *Polygonum monospeliensis* (L.) Desf.

#### **Dilleniidae**

#### **Theales**

#### **Clusiaceae(Guttiferae) (1 species)**

- \* *Hypericum triquetrifolium* Turra(Ms)

#### **Malvales**

#### **Malvaceae (5 species)**

- \* *Alcea acaulis* (Cav.) Alef.

- \* *Lavatera cretica* L.
- \* *Malva nicaeensis* All.
- \* *Malva sylvestris* L.
- \* *Malvella sherardiana* (L.) Jaub. et. Sp.

### **Violales**

#### **Cistaceae (1 species)**

- \* *Helianthemum ledifolium* (L.)Mill. Var. *microcarpum* Coss.

#### **Cucuribitaceae (1 species)**

- \* *Ecballium elaterium* (L.)A. Rich.(Ms)

### **Capparales**

#### **capparaceae(2 species)**

- \* *Capparis ovata* Desf.
- \* *Capparis spinosa* L.

#### **Brassicaceae (Cruciferae) (16 species)**

- \* *Biscutella didyma* L.var. *ciliata* (Dc.)Hal.
- \* *Cardaria draba* (L.)Desv.
- \* *Chorispora purpurascens* (Banks et. Sol.) Eig
- \* *Diploaxis eruroides* (L.)DC.
- \* *Erucaria boveana* Coss.
- \* *Erucaria hispanica* (L.) Durce
- \* *Eruca sativa* Mill.
- \* *Hirschfeldia incana* (L.)Lagveze-Fossat
- \* *Isatis lusitanica* L.
- \* *Malcolmia crenulata* (DC.) Boiss.
- \* *Ochthodium aegyptiacum* (L.) DC.
- \* *Raphanus raphanistrum* L.
- \* *Sinapis alba* L.
- \* *Sisymbrium irio* L.(Cs)
- \* *Texiera glastifolia* (DC.) Jaub. et Sp.
- \* *Torularia torulosa* (Desf.)O.E Schulz

#### **Resedaceae (2 species)**

- \* *Reseda lutea* L.
- \* *Reseda luteola* L.

### **Primulales**

#### **Primulaceae (3 species)**

- \* *Anagallis arvensis* L.
- \* *Androsace maxima* L.
- \* *Asterolinum linum-stellatum* (L.) Duby



## Rosidae

### Rosales

#### Crassulaceae (1 species)

- \* *Sedum pallidum* M. B.

#### Rosaceae (1 species)

- \* *Potentilla reptans* L. (Os)

### Fabales

#### Fabaceae(Leguminosae) (38 species)

- \* *Astragalus beershabensis* Eig et Sam.
- \* *Astragalus callichrous* Boiss.
- \* *Astragalus cruciatus* Link.
- \* *Astragalus deinacanthus* Boiss.(Rs)
- \* *Astragalus feinbruniae* Eig et Rech. f.(Ms)
- \* *Astragalus guttatus* Banks et Sol.(Fs)
- \* *Astragalus palaestinus* Eig
- \* *Astragalus sanctus* Boiss.(RS)
- \* *Asragalus transjordanicus* Sam.(TS)
- \* *Astragalus trimestris* L.(RS)
- \* *Coronilla scorpioides* (L.) Koch
- \* *Hippocrepis unisiliquosa* L.(Fs)
- \* *Lathyrus aphaca* L.(Fs)
- \* *Lathyrus cicera* L.(Fs)
- \* *Medicago orbicularis* (L.) Bart(Fs)
- \* *Medicago polymorpha* L.(Fs)
- \* *Medicago rotata* Boiss. (Fs)
- \* *Melilotus indicus* (L.)All.(Rs)
- \* *Onobrychis crista-galli* (L.) Lam.
- \* *Onobrychis squarrosa* Viv.
- \* *Ononis antiquorum* L.
- \* *Ononis natrix* L.
- \* *Ononis reclinata* L.
- \* *Ononis viscosa* L.
- \* *Pisum syriacum* (Berg.) Lehm.(Fs)
- \* *Retama raetam* (Fossk.) Weeb(Fs)
- \* *Scorpiurus muricatus* L.
- \* *Tetragonolobus palaestinus* Boiss. et Bl.
- \* *Trifolium arvense* L.
- \* *Trifolium clusii* Godr. et Gren.
- \* *Trifolium repens* L.
- \* *Trigonella arabica* Del.(Fs)
- \* *Trigonella caelesyriaca* Boiss.(Fs)
- \* *Vicia narbonensis* L.(Fs)
- \* *Vicia palaestina* Boiss.(Fs)
- \* *Vicia peregrina* L.(Fs)
- \* *Vicia sativa* L.(Fs)
- \* *Vicia villosa* Roth(Fs)

## Euphorbiales

### Euphorbiaceae (10 species)

- \* *Chrozophora tinctoria* (L.) Raf.
- \* *Chrozophora obliqua* (Vahl) Ad. Juss.
- \* *Euphorbia chamaepeplus* Boiss. et Gaill.
- \* *Euphorbia chamaesyce* L.
- \* *Euphorbia densa* Schrenk (RS)
- \* *Euphorbia geniculata* Ortega
- \* *Euphorbia helioscopia* L.
- \* *Euphorbia nutans* Lag.
- \* *Euphorbia peplis* L.
- \* *Euphorbia petiolata* Banks et Sol.

### Linales

#### Linaceae (1 species)

- \* *Linum peyronii* Post. (Os)

### Sapindales

#### Rutaceae (1 species)

- \* *Haplophyllum buxbaumii* (Poir.)G.Don. (Ms)

#### Zygophyllaceae (2 species)

- \* *Peganum harmala* L.(Ms)
- \* *Tribulus terrestris* L.

### Geraniales

#### Oxalidaceae (1 species)

- \* *Oxalis corniculata* L.

#### Geraniaceae (7 species)

- \* *Erodium ciconium* (L.) L'Her (Rs)
- \* *Erodium cicutarium* (L.) L'Her.
- \* *Erodium laciniatum* (Cav.) Wild
- \* *Erodium malcooides* (L.) L'Her.(Rs)
- \* *Erodium telavivense* Eig
- \* *Geranium molle* L.
- \* *Geranium tubrosum* L.

### Apiales

#### Apiaceae(Umbelliferae) (13 species)

- \* *Ammi majus* L.
- \* *Bupleurum lancifolium* Hornem.
- \* *Daucus carota* L.
- \* *Eryngium creticum* Lam.(Cs)
- \* *Eryngium glomeratum* Lam.

- \* *Ferula biverticillata* Lag.
- \* *Foeniculum vulgare* Mill.(Cs)
- \* *Lagoecia cuminoides* L.
- \* *Malabalia secacul* (Banks et sol.) Boiss
- \* *Pimpinella cretica* Poir.
- \* *Smyrniopsis cachroides* Boiss.
- \* *Tordylium aegyptiacum* (L.) Lam.
- \* *Torilis leptophylla* (L.) Reichb.fil.

## Asteridae

### Solanales

#### Solanaceae (2species)

- \* *Hyoscyamus reticulatus* L.(Ms)
- \* *Solanum luteum* Mill.

#### Convolvulaceae (5 species)

- \* *Convolvulus althaeoides* L.
- \* *Convolvulus arvensis* L.
- \* *Convolvulus betonicifolius* Mill.
- \* *Convolvulus dorycnium* L.
- \* *Convolvulus stachydifolius* Choisy

#### Cuscutaceae(1 species)

- \* *Cuscuta epilinum* Weihe

### Lamiales

#### Boraginaceae (11 species)

- \* *Alkanna orientalis* (L.) Boiss.
- \* *Alkanna strigosa* Bois. et Hohen. (Os)
- \* *Anchusa italica* Retz.
- \* *Anchusa strigosa* Banks et Sol.
- \* *Asperugo procumbens* L.
- \* *Buglossoides arvensis* (L.) I.M Johnston
- \* *Echium glomeratum* Poir.
- \* *Heliotropium europaeum* L.
- \* *Heliotropium rotundifolium* Lehm.
- \* *Nonea philistaea* Boiss.
- \* *Onosma aleppica* Boiss.

#### Lamiaceae(Labiatae) (12 species)

- \* *Ballota undulata* (Fresen.) Benth.
- \* *Eremostachys laciniata* (L.) Bunge (Os)
- \* *Lallemantia iberica* (Bieb.)Fisch. et Meg.(Rs)
- \* *Lamium amplexicaule* L.

- \* *Moluccella laevis* L.
- \* *Salvia ceratophylla* L.
- \* *Salvia dominica* L.(Cs)
- \* *Salvia palaestina* Benth.
- \* *Salvia spinosa* L.
- \* *Salvia syriaca* L.
- \* *Teucrium polium* L.
- \* *Ziziphora tenuior* L.

## Plantaginales

#### Plantaginaceae (5 species)

- \* *Plantago coronopus* L.
- \* *Plantago indica* L.
- \* *Plantago lanceolatus* L.
- \* *Plantago major* L.
- \* *Plantago notata* L.

## Scrophulariales

#### Scrophulariaceae (9 species)

- \* *Kickxia aegyptiaca* (L.)Nabelek.
- \* *Kickxia lanigera* (Desf.) Hand-Mazz
- \* *Linaria simplex* Desf.(Rs)
- \* *Parentucelia faviflora* (Boiss.) Nevski
- \* *Scrophularia peyronii* Post.
- \* *Verbascum fruticosum* Post.
- \* *Verbascum sinaticum* Bentham
- \* *Veronica persica* Poir.
- \* *Veronica polita* Fries.

#### Orobanchaceae (1 species)

- \* *Orobanche mutelii* F.W. Schltz

## Campanulales

#### Campanulaceae (1 species)

- \* *Campanula strigosa* Banks et Sol.

## Rubiales

#### Rubiaceae (1 species)

- \* *Galium tricornutum* Dandy

## Dipscales

#### Valerianaceae (1 species)

- \* *Valerinella sclerocarpa* Fissch.et Mey.(Rs)

## Dipsacaceae (5 species)

- \* *Cephalaria syriaca* (L.) Schrad
- \* *Pterocephalus brevis* Coult.
- \* *Pterocephalus palverulentus* Boiss et Bl.
- \* *Scabiosa prophyronera* Blakelock.
- \* *Scabiosa palaestina* L.

## Asterales

### Asteraceae(Compositae) ( 57 species)

- \* *Achillea biebersteinii* Afan.
- \* *Achillea falcata* L.
- \* *Achillea fragrantissima* (Forssk.) Sch. Bip(Fs;Ms)
- \* *Achillea santolina* L.(Ms)
- \* *Anthemis palaestina* Reut.
- \* *Artemisia herba-alba* Asso
- \* *Aster subulatus* Michx.
- \* *Calendula arvensis* L. (Os)
- \* *Calendula tripterocarpa* Rupr.
- \* *Carduus australis* L.fil.
- \* *Carlina hispanica* Lam.
- \* *Carthamus tenuis* (Boiss, et Bl.) Bornm.
- \* *Centaurea hyalolepis* Boiss.(Cs)
- \* *Centaurea iberica* Spereng.
- \* *Centaurea rigida* Banks et sol.
- \* *Chardinia orientalis* (L.)O.Kuntze.(Rs)
- \* *Chondrilla juncea* L.
- \* *Cichorium pumilum* Jacq.(Cs)
- \* *Cnicus benedictus* L(Rs;Ms)
- \* *Conyza canadensis* (L.) Cornquist
- \* *Conyza bonariensis* (L.) Cornquist
- \* *Crepis aspera* L.
- \* *Crepis sancta* (L.)Bornm.subsp *sancta*
- \* *Cynara syriaca* Boiss.
- \* *Filago contracta* (Boiss.)Chrtek et Holub
- \* *Filago inexpectata* Wagenitz. (Rs)
- \* *Filago palaestina* (Boiss.)Chrtek et Holub
- \* *Filago pyramidata* L.
- \* *Geropogon hybridus* (L.)Sch.Bip.
- \* *Gundelia tournefortii* L.(Cs)(Cs)
- \* *Hedypnois rhagadioloides* (L.)F.W.Schmidt
- \* *Inula graveolens* (L.) Desf.
- \* *Koelpinia linearis* Pall.
- \* *Lactuca orientalis* (Bois.)Boiss.
- \* *Lactuca saligna* L.
- \* *Lactuca serriole* L.
- \* *Leontodon laciniatus* (Bert.)Widder.

- \* *Notobasis syriaca* (L.) Cass.
- \* *Onopordum macrocephalum* Eig.(Rs)
- \* *Pallenis spinosa* (L.) Cass.
- \* *Phagnalon rupestre* (L.) DC.
- \* *Pinynomon acarna* (L.) Cass.
- \* *Rhagadiolus stellatus* (L.) Gaertn.
- \* *Rhaponticum pusillum* (Labill.) Boiss.
- \* *Scolymus maculatus* L.
- \* *Scorzonera papposa* DC. (Os ;Cs)
- \* *Scorzonera subintegra* (Boiss.) Thiebalut(Rs)
- \* *Senecio vernalis* Wald. et Kit.
- \* *Silybum marianum* (L.) Gaertn
- \* *Sonchus oleraceus* L.
- \* *Taraxacum cyprum* H. Lindb.
- \* *Tolpis vrigata* (Desf.)
- \* *Tragopogon coelesyriacus* Boiss.
- \* *Urospermum picroides* (L.) F.W. Schmidt
- \* *Varthemia iphionoides* Boiss. et Bl.
- \* *Xanthium spinosum* L.
- \* *Xanthium strumarium* L.

## Liliopsida(monocots)

### Arecidae

### Arales

### Araceae (1 species)

- \* *Biarum pyrami* (Scott) Engler(Cs)

### Commelinidae

### Cyperales

### Cyperaceae (1 species)

- \* *Carex pachstylis* J.Gay

### Poaceae(Gramineae) (27 species)

- \* *Aegilops biuncialis* Vis.
- \* *Aegilops crassa* Boiss.(Rs)
- \* *Avena barbata* Pott ex Link
- \* *Avena sterilis* L.(Fs)
- \* *Bromus lanceolatus* Roth (Rs)
- \* *Bromus japonicus* Thunb.(Rs)
- \* *Bromus tectorum* L.
- \* *Catopodium rigidum* (L.) C.E.Hubbard
- \* *Cyndon dactylon* (L.)Pers.
- \* *Cynosurus callitrichus* W. Barbey
- \* *Dacytalis glomerata* L.

## References

- \* *Echinochloa colonum* (L.) Link
- \* *Hordeum bulbosum* L.
- \* *Hordeum glaucum* Steud.
- \* *Hordeum marinum* Huds(Fs)
- \* *Hordeum spontaneum* C.Koch
- \* *Lolium rigidum* Gandin
- \* *Lolium subulatum* (Banks et sol.) Eig
- \* *Lophochloa pumila* (Desf.) Bor.
- \* *Phalaris minor* Retz. (Rs)
- \* *Phalaris paradoxa* L.(Fs)
- \* *Schismus arabicus* Nees
- \* *Setaria viridis* (L.) Beauv.
- \* *Stipa capensis* Thumb
- \* *Stipa lagascae* Roem. et Schult.
- \* *Trisetaria macrochaete* (Boiss.) Maire
- \* *Vulpia unilateralis* (L.) Stace(Rs)

### Liliidae

### Liliales

#### Liliaceae (17 species)

- \* *Allium ampeloprasum* L.(Cs)
- \* *Allium hierochuntinum* Boiss.
- \* *Allium pallens* L.
- \* *Allium orientale* Boiss.
- \* *Allium schubertii* Zucc.
- \* *Allium stamineum* Boiss.(Rs)
- \* *Asphodelus aestivus* Brot.
- \* *Asphedulus fistulosus* L.
- \* *Bellevalia eigii* Feinbr.
- \* *Gagea commutata* C.Koch
- \* *Ixiolirion tataricum* (Pall.) Herbert. (Os)
- \* *Muscari pulchellum* Heldr. & Sart.
- \* *Narcissus tazetta* L. (Os ;Ts)
- \* *Ornithogalum lanceolatum* Labill (Os)
- \* *Ornithogalum narbonense* L.
- \* *Tulipa agenensis* DC. (Os;Ts)
- \* *Urginea maritima* (L.) Baker

#### Iridaceae (3 species)

- \* *Gladiolus atrovioleaceus* Boiss.
- \* *Gynandris sisyrinchium* (L.) Parl.
- Iris atrofusca* Baker (Os;Ts)

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