



**Alliance for Research on North Africa (ARENA)  
University of Tsukuba, Japan**

# **Working Paper Series**

## **Plant Inventory with Traditional Medicinal Plant Resources Information in Tunisia**

Kiyokazu Kawada, Kohei Suzuki, Hideki Suganuma,  
Kazuo Obata, Abderrazak Smaoui and Hiroko Isoda

**Working Paper No.1**

**March 2017**

# Plant Inventory with Traditional Medicinal Plant Resources Information in Tunisia

Kiyokazu Kawada<sup>a</sup>, Kohei Suzuki<sup>b</sup>, Hideki Suganuma<sup>c</sup>,  
Kazuo Obata<sup>d</sup>, Abderrazak Smaoui<sup>e</sup> and Hiroko Isoda<sup>a, f</sup>

<sup>a</sup> Faculty of Life and Environmental Sciences, University of Tsukuba, Japan

<sup>b</sup> Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan

<sup>c</sup> Faculty of Science and Technology, Seikei University, Japan

<sup>d</sup> Ibaraki Nature Museum, Japan

<sup>e</sup> Center of Biotechnology of Borj Cedria, Tunisia

<sup>f</sup> Alliance for Research on North Africa, University of Tsukuba, Japan

## 1. Introduction

The prospecting of new bioresources has distinctly contributed to innovation within our lives. For example, new medicines and cosmetics are composed of many novel materials, which have been identified from new bioresources (Coulibaly et al., 2014). New functions within bioresources such as plants, animals and fungi have been noted within fields of research by the development of analytical techniques (Unkles et al., 2014; Upadhyay et al., 2016). Most bioprospecting depends on an ethnobotanical approach to identify new functionality within materials (Cox and Balick, 1994; Hart and Cox, 2000). Therefore, an inventory of bioresources is considered important information to facilitate the use of these bioresources. Detailed information on these bioresources will facilitate the acceleration of bioprospecting work and contribute to an increasing benefit to all human beings.

An inventory of species is fundamentally important information to facilitate understanding of potential natural resources. For example, a list of flora is an important component within an inventory of plant resources (Shaheen et al., 2014). A record of flora reflects the actual plant distribution in a specific time and location (Sousa-Baena et al., 2014). Accurate information on flora can be of use to facilitate the determination of an approach to utilise a bioresource. In addition, updating flora information is important. Outdated information may obstruct bioprospecting work because some plants may have been eradicated through human activities. Updating records with the latest information on flora can improve the efficiency of bioprospecting work.

A general inventory of plant species was basically constructed through records collected during field surveys. These data record the existence of plants as binary data (present or absent) into a flora list. This is a rational approach for the collection of a large quantity of flora data. This approach is also useful for the collection of information on infrequently observed species such as rare or endangered species. On the other hand, this approach is insufficient to explain the presence of a plant species as there is no concrete evidence of information. To resolve this issue, an inventory based on evidence of the presence of a resource such as a specimen voucher is necessary.

The aim of the present study was to analyse the contents of traditional medicinal plants within the floristic data based on voucher specimens collected in Tunisia. This inventory possesses a high reliability because the existence of plant resources has been confirmed by voucher specimens. We integrated the inventory information and information on medicinal functionalities in plant resources in Tunisia.

## 2. Materials and methods

A field survey was conducted in Tunisia. The study area incorporates three climate zones, namely Mediterranean, steppe and desert. Annual precipitation is  $\leq 600$  mm in the Mediterranean climate zone. Plant specimens were collected on several occasions from 2007 to 2010 (Table 1). The collected plants were nipped by newspapers and dried. Species identification was conducted in a

laboratory. We followed the nomenclature of *Flora de la Tunisie* (Cuenod et al., 1954; Pottier-Alapetite, 1979, 1981). A field survey was conducted as an international collaboration based on a joint research agreement. The collection of voucher specimens was managed at the Borj Cedria Technology Park and the University of Tsukuba. Information on medicinal plants in North Africa was collected from eight references (Batanouny, 1999; Boulos, 1983; Chemli, 1997; Delille, 2007; Kotb, 1985; Nasri, 2013; Neffati, 2008; Rejeb, et al., 2006). Information on a total of 726 species of medicinal plant resources was compiled into the Alliance for Research on North Africa (ARENA) database. The information from the database was used for comparison with the voucher specimens. SPSS version 22 [International Business Machines (IBM) Corporation, NY, USA] was used for correlation analysis.

**Table 1: Overview of sampling period and location in Tunisia**

Period	Location	Collector
26/May/07 28/May/07	– Beja, Jendouba, Kasserine, Le Kef	Obata, K.
24/Jun./08 07/Jul./08	– Bizerte, Jendouba, Kasserine, Le Kef, Kairouan, Kasserine, Tozeur	Kawada, K., Omri, A.E.
12/Nov./08 23/Nov./08	– Gafsa, Kasserine, Medenine, Tozeur	Kawada, K., Smaoui, A., Suganuma, H., Suzuki, K.
16/Nov./09 22/Nov./09	– Jendouba, Gafsa, Kasserine	Kawada, K., Smaoui, A., Suganuma, H., Suzuki, K.
06/Mar./10 13/Mar./10	– Jendouba, Le Kef, Zaghouan	Kawada, K., Smaoui, A.
13/Apr./10 20/Apr./10	– Beja, Ben Arous, Jendouba, Medenine, Nabeul, Sousse, Zaghouan	Kawada, K., Smaoui, A.
03/Nov./10 13/Nov./10	– Bizerte, Jendouba, Siliana, Zaghouan	Kawada, K., Smaoui, A., Sugiyama S.

### 3. Results and discussion

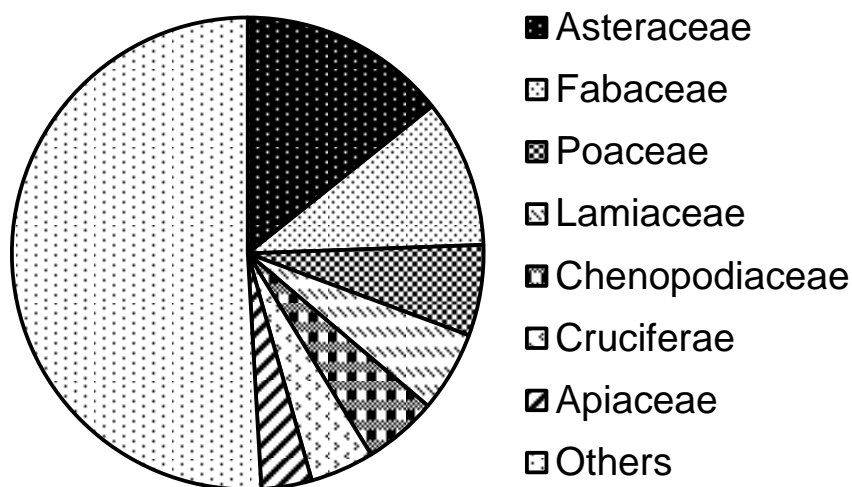
The list of all plant specimens is given in Appendix 1. In total, 434 species belonging to 273 genera and 76 families were identified during the present study (Table 2). The total number of vascular plant species in Tunisia has been reported as 2,103 species (Chemli, 1997). The number of species represented by our plant specimens was approximately 20.6% of all flora in Tunisia. These specimens were mainly collected from within the Mediterranean and steppe climate zones (Table 1) because there is a greater amount of plant resources in a humid condition than in a dry condition. However, approximately 1,630 plant species were reported to grow in the arid zone of Tunisia (Cheib and Boukhris, 1998). This species number dominates approximately 77.5% of the flora in Tunisia. This suggests that the bioprospecting of species rationally occurs in the arid zone. On the other hand, sampling of plant resources in an extremely arid zone such as the Sahara Desert remains challenging because it is difficult to locate each species and to collect a sufficient number of each species. In addition, the diversity of taxa is low within the arid zone because several specific species groups are only adapted to an arid environment. For example, 105 species from a semi-arid region were included in 18 families (Atia et al., 2014). We considered that the arid and semi-arid zones may be suitable environments to conduct bioprospecting on a species level in Tunisia.

**Table 2: Summary of voucher specimens**

Phylum division	Class	Specimens
Pteridophyta		2
	Gymnospermae	6
Spermatophyta	Dicotyledoneae	373
	Monocotyledoneae	53

The Asteraceae family contains the highest number of species at 62, and it is the largest and most widely distributed family globally. We considered that the proportion of total species within Asteraceae reflects the diversity of this family. The seven families containing the most species (14.3%, 10.1%, 6.2%, 5.5%, 5.1%, 4.4%, 3.5% and 2.5% of species within Asteraceae, Fabaceae, Poaceae, Lamiaceae, Chenopodiaceae, Cruciferae, Apiaceae and Boraginaceae, respectively) account for approximately half of the total species number (Fig. 1). We considered that the proportion of species within these families will vary according to the environmental state. For example, the proportions of species within Chenopodiaceae and Poaceae tend to increase in arid and semi-arid environments (Atia et al., 2014). This suggests that records of sampling locations are important for considering the proportions of species within families.

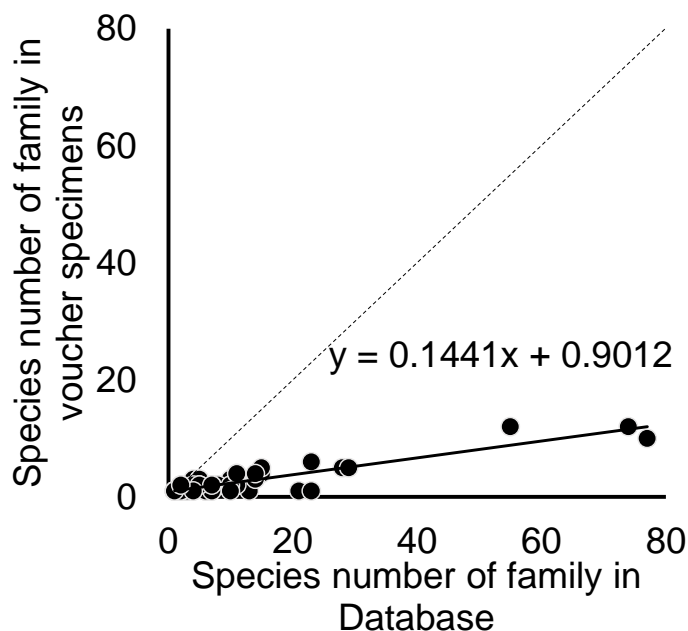
**Figure 1: A ratio of families in voucher specimens**



Plant specimens representing a total of 135 species have been listed in the ARENA database. These specimens comprise approximately 18.6% of the voucher specimens. Medicinal plants were included in a total of 53 families. Asteraceae and Lamiaceae contained the highest number of medicinal plants (12 species). These families were common and often included medicinal species (Joseph, 2014), and the number of their appearances in references to medicinal plants indicate that these families are associated with medicinal plants. The most frequently observed species was *Artemisia herba-alba*, which is a common species within semi-arid areas in North Africa. There has been much research on the pharmacological activities of this species; however, the precise underlying mechanisms of action of these pharmacological activities remain unknown (Moufid and Eddouks, 2012).

This inventory can contribute to determining whether a candidate species is a compassable bioresource. A combinational use of the inventory and ARENA database is expected to enhance the efficiency of bioprospecting because the ARENA database contains the results of bioassays such as antioxidation. The efficiency of medicinal plant collection is important in bioprospecting (Fig. 2). A significant correlation was observed between species number of a family represented by voucher species and that in the ARENA database ( $r = 0.658$ ,  $p < 0.01$ ). The coefficient of correlation formula was 0.144. This indicates that the expected efficiency of medicinal plant collection was approximately 14.4%. We considered that the efficiency of our bioprospecting was satisfactory because approximately 18.6% of our voucher samples consisted of medicinal plants.

**Figure 2: Species number in each family between database and voucher specimens.**



#### 4. Conclusions

An inventory of plant resources in Tunisia was constructed through the present study. We are able to assess the plant resource before sampling using the inventory. However, the inventory remains insufficient as plant specimens represented merely approximately 20.6% of the flora in Tunisia. We should update this inventory to clarify the latest flora. In addition, the discovery of new functionality involves a risk of bioresource depletion. This problem may occur if a beneficiary group does not consider the sustainable use of these resources. Therefore, the Convention on Biological Diversity (CBD) was created to limit the risk of these problems. CBD, which is a basic concept to conserve the diversity of all living things on Earth, was first put into action during 1993. It is composed of three concepts: 1) conservation of biodiversity; 2) sustainable use of biodiversity; and 3) access and benefit-sharing (ABS). On the other hand, we have to comprehend information derived from genetic resources within each country. Most of these data can be used to help regulate the harvest of wild species (Beattie et al., 2011). The inventory of plant resources is necessary to devise a base strategy of biodiversity conservation.

#### Acknowledgement

This work was conducted under the support of the Mitsui & Co., Ltd. Environment Fund, Grant-in-Aid for Scientific Research (19880006) of the Japan Society for the Promotion of Science and Science and Technology Research Partnership for Sustainable Development (SATREPS) project from Japan Science and Technology Agency (JST) and Japan International Cooperation Agency (JICA).

#### References

- Atia, A., Rabhi, M., Debez, A., Abdelly, C., Gouia, H., Haouari, C.C., Smaoui, A. (2014), "Ecophysiological aspects and photosynthetic pathways in 105 plants species in saline and arid environments of Tunisia" *Journal of Arid Land*, Vol. 6: pp. 762–770.
- Batanouny, K.H. (1999), "Wild medicinal plants in Egypt" Academy of Scientific Research and Technology, Egypt, International Union for Conservation.
- Beattie, A.J., Hay, M., Magnusson, B., de Nys, R., Smeathers, J., Vincent, J.F.V. (2011), "Ecology

- and bioprospecting” *Austral Ecology*, Vol. 36, pp. 341-356.
- Boulos, L. (1983), “*Medicinal plant in North Africa*” Reference Publications, Inc. Michigan.
- Chemli, R. (1997), “Medicinal, aromatic and culinary plants of Tunisian flora” in *Proceedings of the International Expert Meeting on Medicinal, Culinary and Aromatic Plants in the Near East. Cairo, Egypt 19-21 May 1997*, FAO Regional Office for the Near East.
- Cheib, M., Boukhris, M. (1998), "Flora succint and illustrated flora of the arid zone and Sahara of Tunisia" Tunisia official printing house, Tunis.
- Coulibaly, A.Y., Hashim, R., Sulaiman, S.F., Sulaiman, O., Ang, L.Z.P., et al. (2014), “Bioprospecting medicinal plants for antioxidant components” *Asian Pacific Journal of Tropical Medicine*, Vol. 36, pp. S553-S559.
- Cox, P.A. and Balick M.J. (1994), “The ethnobotanical approach to drug discovery” *Scientific American*, Vol. 270, pp. 82-87.
- Cuenod, A., Pottier-Alapetite, G., Labbe, A. (1954), “*Flora de Tunisie Gyptogames vasculaires, Gymnospermes et Monocotyledones*” Imprimerie S. E. F. A. N., Tunis.
- Delille, L. (2007), “*Les plantes médicinales d'Algérie*” Berti editions, Alger.
- Hart, K.H., Cox, P.A. (2000), “A cladistic approach to comparative ethnobotany: Dye plants of the the southwestern United States” *Journal of Ethnobiology*, Vol. 20, pp. 303–325.
- Joseph, G., Faran, M., Raskin, I., Ann Lila, M., Fridlender, B. (2014), “Medicinal Plants of Israel: A Model Approach to Enable an Efficient, Extensive, and Comprehensive Field Survey” *J Biodivers Biopros Dev* Vol.1, pp.134. doi: 10.4172/2376-0214.1000134
- Kotb, F. (1985), “*Medicinal Plants in Libya*” Arab Encyclopedia House.
- Moufid, A., Eddouks, M. (2012), “*Artemisia herba alba*: A Popular Plant with Potential Medicinal Properties” *Pakistan Journal of Biological Sciences* Vol. 15, pp. 1152-1159.
- Nasri, B. (2013), “*Recueil des experiences concernant la medication a base des plantes*” Orientissime, Nanterre.
- Neffati, M. (2008), “*Domestication des plantes spontanées autochtones à usages multiples en zones arides et désertiques*” Centre d'Information et de Documentation des Régions Arides. Médenine.
- Pottier-Alapetite G. (1979), “*Flora de Tunisie Angiospermes - dictyledones Apetales – dialypetales*” Ministère de l'Enseignement Supérieur et de la Recherche Scientifique et le Ministère de l'Agriculture, Tunis.
- Pottier-Alapetite G. (1981), “*Flora de Tunisie Angiospermes - dictyledones Gamopetales*” Ministère de l'Enseignement Supérieur et de la Recherche Scientifique et le Ministère de l'Agriculture, Tunis.
- Rejeb, M.N., Khouja, M.L., Ghrabi, Z., Chemli, R., Albouchi, A., Khaldi, A. Dahman, M. (2006), “*Guide des plantes médicinales et aromatiques*” Imprimerie Maghreb Editions, Tunis.
- Shaheen, H., Qureshi, R., Akram, A., Gulfraz, M. (2014), “Inventory of Medicinal Flora from Thal Desert, Punjab, Pakistan” *African Journal of Traditional, Complementary, and Alternative Medicines*, Vol. 11, pp. 282–290.
- Sousa-Baena M.S., Garcia, L.C., Peterson, A.T. (2014), “Completeness of digital accessible knowledge of the plants of Brazil and priorities for survey and inventory” *Diversity and Distributions* Vol. 20: pp. 369-381.
- Unkles, S.E., Valiante, V, Mattern, D.J., Brakhage, A.A. (2014), “Synthetic Biology Tools for Bioprospecting of Natural Products in Eukaryotes” *Chemistry & Biology*, Vol. 21, pp. 502-508.
- Upadhyay, P., Shrivastava, R., & Agrawal, P. K. (2016). “Bioprospecting and biotechnological applications of fungal laccase” *Biotech*, Vol. 6, 15. <http://doi.org/10.1007/s13205-015-0316-3>.

**Appendix 1: Species list of voucher specimens**

Species	Family
<i>Mesembryanthemum edule</i>	Aizoaceae
<i>Mesembryanthemum nodiflorum</i>	Aizoaceae
<i>Alisma plantago-aquatica</i>	Alismataceae
<i>Biscutella didyma</i>	Amaranthaceae
<i>Pistacia lentiscus</i>	Anacardiaceae
<i>Rhus tripartitum</i>	Anacardiaceae
<i>Bupleurum balansae</i>	Apiaceae
<i>Bupleurum lancifolium</i>	Apiaceae
<i>Bupleurum spinosum</i>	Apiaceae
<i>Coriandrum sativum</i>	Apiaceae
<i>Daucus carota</i>	Apiaceae
<i>Eryngium triquetrum</i>	Apiaceae
<i>Pituranthos chloranthus</i>	Apiaceae
<i>Pituranthos scoparius</i>	Apiaceae
<i>Pituranthos tortuosus</i>	Apiaceae
<i>Scandix pecten-veneris</i>	Apiaceae
<i>Smyrniium olusatrum</i>	Apiaceae
<i>Thapsia garganica</i>	Apiaceae
<i>Thapsia polygama</i>	Apiaceae
<i>Tordylium apulum</i>	Apiaceae
<i>Torylis nodosa</i>	Apiaceae
<i>Nerium oleander</i>	Apocynaceae
<i>Periploca laevigata</i>	Apocynaceae
<i>Arisarum vulgare</i>	Araceae
<i>Chamaerops humilis</i>	Arecaceae
<i>Doemia cordata</i>	Asclepiadaceae
<i>Scilla lingulata</i>	Asparagalceae
<i>Asphodelus microcarpus</i>	Asphodelaceae
<i>Anacyclus clavatus</i>	Asteraceae
<i>Anthemis maritima</i>	Asteraceae
<i>Artemisia arborescence</i>	Asteraceae
<i>Artemisia campestris</i>	Asteraceae
<i>Artemisia herba-alba</i>	Asteraceae
<i>Asplenium adiantum-nigrum</i>	Asteraceae
<i>Asteriscus pygmaeus</i>	Asteraceae
<i>Atractylis cancellata</i>	Asteraceae
<i>Atractylis humilis</i>	Asteraceae
<i>Atractylis serratuloides</i>	Asteraceae
<i>Bellis sylvestris</i>	Asteraceae
<i>Beta macrocarpa</i>	Asteraceae
<i>Brocchia cinerea</i>	Asteraceae
<i>Broteroa amethystina</i>	Asteraceae
<i>Calendula aegyptiaca</i>	Asteraceae
<i>Calendula algarbiensis</i>	Asteraceae

<i>Calendula algeriensis</i>	Asteraceae
<i>Calendula arvensis</i>	Asteraceae
<i>Calendula suffruticosa</i>	Asteraceae
<i>Carduus macrocephalus</i>	Asteraceae
<i>Carduus pycnocephalus</i>	Asteraceae
<i>Carlina lanata</i>	Asteraceae
<i>Carlina racemose</i>	Asteraceae
<i>Centaurea furfuracea</i>	Asteraceae
<i>Centaurea napifolia</i>	Asteraceae
<i>Centaurea nicaeensis</i>	Asteraceae
<i>Centaurea pullata</i>	Asteraceae
<i>Centaurea sphaerocephala</i>	Asteraceae
<i>Chrysanthemum coronarium</i>	Asteraceae
<i>Chrysanthemum fuscatum</i>	Asteraceae
<i>Chrysanthemum segetum</i>	Asteraceae
<i>Cichorium intybus</i>	Asteraceae
<i>Cotula cinerea</i>	Asteraceae
<i>Echinops strigosus</i>	Asteraceae
<i>Erigeron canadense</i>	Asteraceae
<i>Evax pygmaea</i>	Asteraceae
<i>Galactites tomentosa</i>	Asteraceae
<i>Hedypnois cretica</i>	Asteraceae
<i>Hertia cheirifolia</i>	Asteraceae
<i>Hyoseris radicata</i>	Asteraceae
<i>Inula crithmoides</i>	Asteraceae
<i>Inula graveolens</i>	Asteraceae
<i>Inula viscosa</i>	Asteraceae
<i>Launaea quercifolia</i>	Asteraceae
<i>Launaea resedifolia</i>	Asteraceae
<i>Onopordon nervosum</i>	Asteraceae
<i>Pallenis spinose</i>	Asteraceae
<i>Phagnalon rupestre</i>	Asteraceae
<i>Picris coronopifolia</i>	Asteraceae
<i>Pulicaria odora</i>	Asteraceae
<i>Rhagadiolus stellatus</i>	Asteraceae
<i>Rhaponticum acaule</i>	Asteraceae
<i>Scolymus cardunculus</i>	Asteraceae
<i>Scolymus hispanicus</i>	Asteraceae
<i>Scorzonera undulata</i>	Asteraceae
<i>Senecio leucanthemifolius</i>	Asteraceae
<i>Seriola aetnensis</i>	Asteraceae
<i>Silybum marianum</i>	Asteraceae
<i>Sonchus asper</i>	Asteraceae
<i>Sonchus oleraceus</i>	Asteraceae
<i>Taraxacum megalorrhizon</i>	Asteraceae
<i>Urospermum dalechampii</i>	Asteraceae



<i>Alkanna tinctoria</i>	Boraginaceae
<i>Borago officinalis</i>	Boraginaceae
<i>Cynoglossum cheirifolium</i>	Boraginaceae
<i>Echium italicum</i>	Boraginaceae
<i>Echium parviflorum</i>	Boraginaceae
<i>Echium plantagineum</i>	Boraginaceae
<i>Echium trygorrhizum</i>	Boraginaceae
<i>Heliotropium curassavicum</i>	Boraginaceae
<i>Heliotropium europaeum</i>	Boraginaceae
<i>Nonea vesicaria</i>	Boraginaceae
<i>Solenanthes tubiflorus</i>	Boraginaceae
<i>Specularia falcata</i>	Campanuloideae
<i>Capparis inermis</i>	Capparaceae
<i>Cleome Arabica</i>	Capparaceae
<i>Lonicera etrusca</i>	Caprifoliaceae
<i>Lonicera implexa</i>	Caprifoliaceae
<i>Viburnum tinus</i>	Caprifoliaceae
<i>Dianthus caryophyllus</i>	Caryophyllaceae
<i>Gymnocarpos decander</i>	Caryophyllaceae
<i>Paronychia arabica</i>	Caryophyllaceae
<i>Paronychia argentea</i>	Caryophyllaceae
<i>Pteranthus dichotomus</i>	Caryophyllaceae
<i>Silene colorata</i>	Caryophyllaceae
<i>Silene tunetana</i>	Caryophyllaceae
<i>Spergularia salina</i>	Caryophyllaceae
<i>Anabasis articulata</i>	Chenopodiaceae
<i>Anabasis oropedium</i>	Chenopodiaceae
<i>Arthrocnemum indicum</i>	Chenopodiaceae
<i>Arthrophytum schimttianum</i>	Chenopodiaceae
<i>Arthrophytum scoparium</i>	Chenopodiaceae
<i>Atriplex glauca</i>	Chenopodiaceae
<i>Atriplex halimus</i>	Chenopodiaceae
<i>Atriplex inflata</i>	Chenopodiaceae
<i>Atriplex mollis</i>	Chenopodiaceae
<i>Atriplex portulacoides</i>	Chenopodiaceae
<i>Bassia muricata</i>	Chenopodiaceae
<i>Chenopodium murale</i>	Chenopodiaceae
<i>Halocnemum strobilaceum</i>	Chenopodiaceae
<i>Salicornia arabica</i>	Chenopodiaceae
<i>Salsola soda</i>	Chenopodiaceae
<i>Salsola tetrandra</i>	Chenopodiaceae
<i>Salsola vermiculata</i>	Chenopodiaceae
<i>Salsola villosa</i>	Chenopodiaceae
<i>Suaeda fruticosa</i>	Chenopodiaceae
<i>Suaeda mollis</i>	Chenopodiaceae
<i>Suaeda pruinosa</i>	Chenopodiaceae

<i>Traganum nudatum</i>	Chenopodiaceae
<i>Cistus libanotis</i>	Cistaceae
<i>Cistus monspeliensis</i>	Cistaceae
<i>Cistus salvifolius</i>	Cistaceae
<i>Cistus villosus</i>	Cistaceae
<i>Fumana laevipes</i>	Cistaceae
<i>Fumana thymifolia</i>	Cistaceae
<i>Halimium halimifolium</i>	Cistaceae
<i>Helianthemum cinereum</i>	Cistaceae
<i>Helianthemum hirtum</i>	Cistaceae
<i>Helianthemum nummularium</i>	Cistaceae
<i>Helianthemum sessiliflorum</i>	Cistaceae
<i>Convolvulus althaeoides</i>	Convolvulaceae
<i>Convolvulus arvensis</i>	Convolvulaceae
<i>Convolvulus sicutus</i>	Convolvulaceae
<i>Convolvulus supinus</i>	Convolvulaceae
<i>Convolvulus tricolor</i>	Convolvulaceae
<i>Cuscuta epithymum</i>	Convolvulaceae
<i>Sedum pubescens</i>	Crassulaceae
<i>Sedum sediforme</i>	Crassulaceae
<i>Ammosperma cinereum</i>	Cruciferae
<i>Capsella bursa-pastoris</i>	Cruciferae
<i>Diplotaxis erucoides</i>	Cruciferae
<i>Diplotaxis harra</i>	Cruciferae
<i>Diplotaxis muralis</i>	Cruciferae
<i>Eruca sativa</i>	Cruciferae
<i>Eruca vesicaria</i>	Cruciferae
<i>Farsetia aegyptiaca</i>	Cruciferae
<i>Hirschfeldia incana</i>	Cruciferae
<i>Lobularia maritima</i>	Cruciferae
<i>Maresia nana</i>	Cruciferae
<i>Matthiola longipetara</i>	Cruciferae
<i>Moricandia arvensis</i>	Cruciferae
<i>Muricaria prostata</i>	Cruciferae
<i>Oudnaya africana</i>	Cruciferae
<i>Raphanus raphanistrum</i>	Cruciferae
<i>Rapistrum rugosum</i>	Cruciferae
<i>Sinapis alba</i>	Cruciferae
<i>Vella annua</i>	Cruciferae
<i>Citrullus colocynthis</i>	Cucurbitaceae
<i>Ecballium elaterium</i>	Cucurbitaceae
<i>Callitris articulata</i>	Cupressaceae
<i>Juniperus oxycedrus</i>	Cupressaceae
<i>Juniperus phoenicea</i>	Cupressaceae
<i>Carex flacca</i>	Cyperaceae
<i>Scabiosa arenaria</i>	Dipsacaceae

<i>Arbutus unedo</i>	Ericaceae
<i>Erica arborea</i>	Ericaceae
<i>Erica multiflora</i>	Ericaceae
<i>Erica scoparia</i>	Ericaceae
<i>Lycium arabicum</i>	Ericaceae
<i>Lycium europium</i>	Ericaceae
<i>Euphorbia akenocarpa</i>	Euphorbiaceae
<i>Euphorbia calyptrata</i>	Euphorbiaceae
<i>Euphorbia guyoniana</i>	Euphorbiaceae
<i>Euphorbia helioscopia</i>	Euphorbiaceae
<i>Euphorbia terracina</i>	Euphorbiaceae
<i>Mercurialis annua</i>	Euphorbiaceae
<i>Ricinus communis</i>	Euphorbiaceae
<i>Acacia cyanophylla</i>	Fabaceae
<i>Anthyllis tetraphylla</i>	Fabaceae
<i>Anthyllis vulneraria</i>	Fabaceae
<i>Argyrobium uniflorum</i>	Fabaceae
<i>Astragalus armatus</i>	Fabaceae
<i>Astragalus armatus</i> subsp. <i>tragacanthoides</i>	Fabaceae
<i>Astragalus incanus</i>	Fabaceae
<i>Calycotome villosa</i>	Fabaceae
<i>Ceratonia siliqua</i>	Fabaceae
<i>Coronilla juncea</i>	Fabaceae
<i>Coronilla repanda</i>	Fabaceae
<i>Cytisus triflorus</i>	Fabaceae
<i>Ebenus pinnata</i>	Fabaceae
<i>Genista cinerea</i>	Fabaceae
<i>Genista tricuspidata</i>	Fabaceae
<i>Hedysarum capitatum</i>	Fabaceae
<i>Hedysarum coronarium</i>	Fabaceae
<i>Hedysarum spinosissimum</i>	Fabaceae
<i>Lathyrus ochrus</i>	Fabaceae
<i>Lathyrus sativus</i>	Fabaceae
<i>Lotophyllus argenteus</i>	Fabaceae
<i>Lotus creticus</i>	Fabaceae
<i>Lotus edulis</i>	Fabaceae
<i>Lotus peregrina</i>	Fabaceae
<i>Lupinus angustifolius</i>	Fabaceae
<i>Medicago hispida</i>	Fabaceae
<i>Medicago intertexta</i>	Fabaceae
<i>Medicago minima</i>	Fabaceae
<i>Medicago sativa</i>	Fabaceae
<i>Medicago truncatula</i>	Fabaceae
<i>Melilotus sulcata</i>	Fabaceae
<i>Ononis alopecuroides</i>	Fabaceae
<i>Ononis natrix</i>	Fabaceae

<i>Psoralea bituminosa</i>	Fabaceae
<i>Retama raetam</i>	Fabaceae
<i>Scorpiurus muricatus</i>	Fabaceae
<i>Scorpiurus villosus</i>	Fabaceae
<i>Tetragonolobus purpureus</i>	Fabaceae
<i>Trifolium campestre</i>	Fabaceae
<i>Trifolium cherleri</i>	Fabaceae
<i>Trifolium scabrum</i>	Fabaceae
<i>Trifolium stellatum</i>	Fabaceae
<i>Trifolium tomentosum</i>	Fabaceae
<i>Vicia sativa</i>	Fabaceae
<i>Quercus coccifera</i>	Fagaceae
<i>Quercus faginea</i>	Fagaceae
<i>Quercus ilex</i>	Fagaceae
<i>Quercus ilex var. ballota</i>	Fagaceae
<i>Quercus ilex var. guenuina</i>	Fagaceae
<i>Quercus suber</i>	Fagaceae
<i>Frankenia thymifolia</i>	Frankeniaceae
<i>Blackstonia perfoliata</i>	Gentianaceae
<i>Centaurium pulchellum</i>	Gentianaceae
<i>Erodium cicutarium</i>	Geraniaceae
<i>Erodium glaucophyllum</i>	Geraniaceae
<i>Erodium malachoides</i>	Geraniaceae
<i>Erodium moschatum</i>	Geraniaceae
<i>Erodium triangulare</i>	Geraniaceae
<i>Geranium atlanticum</i>	Geraniaceae
<i>Geranium molle</i>	Geraniaceae
<i>Geranium moschatum</i>	Geraniaceae
<i>Pelargonium zonale</i>	Geraniaceae
<i>Globularia alypum</i>	Globulariaceae
<i>Globularia fricans</i>	Globulariaceae
<i>Hypericum humifusum</i>	Guttiferae
<i>Hypericum triquetrifolium</i>	Guttiferae
<i>Dipcadi serotinum</i>	Hyacinthaceae
<i>Gladiolus segetum</i>	Iridaceae
<i>Iris sisyrynchium</i>	Iridaceae
<i>Juncus maritimus</i>	Juncaceae
<i>Ajuga iva</i>	Lamiaceae
<i>Ballota hirsuta</i>	Lamiaceae
<i>Lavandula officinalis</i>	Lamiaceae
<i>Lavandula stoechas</i>	Lamiaceae
<i>Marrubium vulgare</i>	Lamiaceae
<i>Mentha pulegium</i>	Lamiaceae
<i>Mentha rotundifolia</i>	Lamiaceae
<i>Mentha viridis</i>	Lamiaceae
<i>Origanum majorana</i>	Lamiaceae

<i>Origanum vulgare</i>	Lamiaceae
<i>Prasium majus</i>	Lamiaceae
<i>Rosmarinus officinalis</i>	Lamiaceae
<i>Salvia barrelieri</i>	Lamiaceae
<i>Salvia verbenaca</i>	Lamiaceae
<i>Satureia nervosa</i>	Lamiaceae
<i>Sideritis montana</i>	Lamiaceae
<i>Stachys hirta</i>	Lamiaceae
<i>Teucrium compactum</i>	Lamiaceae
<i>Teucrium fruticans</i>	Lamiaceae
<i>Teucrium polium</i>	Lamiaceae
<i>Teucrium pseudo-chamaepitys</i>	Lamiaceae
<i>Thymus algeriensis</i>	Lamiaceae
<i>Thymus capitatus</i>	Lamiaceae
<i>Thymus numidicus</i>	Lamiaceae
<i>Lauris nobilis</i>	Lauraceae
<i>Allium roseum</i>	Liliaceae
<i>Asparagus acutifolius</i>	Liliaceae
<i>Asparagus albus</i>	Liliaceae
<i>Asparagus stipularis</i>	Liliaceae
<i>Colchicum autumnale</i>	Liliaceae
<i>Ornithogalum umbellatum</i>	Liliaceae
<i>Smilax aspera</i>	Liliaceae
<i>Tulipa sylvestris</i>	Liliaceae
<i>Linum corymbiferum</i>	Linaceae
<i>Linum strictum</i>	Linaceae
<i>Linum usitatissimum</i>	Linaceae
<i>Lawsonia inermis</i>	Lythraceae
<i>Malva nicaeensis</i>	Malvaceae
<i>Malva parviflora</i>	Malvaceae
<i>Malva sylvestris</i>	Malvaceae
<i>Myrtus communis</i>	Myrtaceae
<i>Nitraria retusa</i>	Nitrariaceae
<i>Jasminium fruticans</i>	Oleaceae
<i>Olea europaea</i>	Oleaceae
<i>Olea europaea</i> subsp. <i>sylvestris</i>	Oleaceae
<i>Phillyrea angustifolia</i>	Oleaceae
<i>Ophrys lutea</i>	Orchidaceae
<i>Ophrys speculum</i>	Orchidaceae
<i>Orchis papilionacea</i>	Orchidaceae
<i>Bellardia trixago</i>	Orobanchaceae
<i>Bellis annua</i>	Orobanchaceae
<i>Oxalis pes-caprae</i>	Oxalidaceae
<i>Fumaria agraria</i>	Papaveraceae
<i>Fumaria capreolata</i>	Papaveraceae
<i>Glaucium corniculatum</i>	Papaveraceae

<i>Papaver dubium</i>	Papaveraceae
<i>Papaver hybridum</i>	Papaveraceae
<i>Papaver rhoeas</i>	Papaveraceae
<i>Pinus halepensis</i>	Pinaceae
<i>Pinus pinaster</i>	Pinaceae
<i>Pinus pinea</i>	Pinaceae
<i>Plantago albicans</i>	Plantaginaceae
<i>Plantago bellardi</i>	Plantaginaceae
<i>Plantago ciliata</i>	Plantaginaceae
<i>Plantago coronopus</i>	Plantaginaceae
<i>Plantago lagopus</i>	Plantaginaceae
<i>Plantago psyllium</i>	Plantaginaceae
<i>Plantago tunetana</i>	Plantaginaceae
<i>Limoniastrum guyonianum</i>	Plumbaginaceae
<i>Limonium delicatulum</i>	Plumbaginaceae
<i>Limonium pruinatum</i>	Plumbaginaceae
<i>Limonium tunetanum</i>	Plumbaginaceae
<i>Aegilops ovata</i>	Poaceae
<i>Aeluropus littoralis</i>	Poaceae
<i>Aira tenorei</i>	Poaceae
<i>Ammophila arenaria</i>	Poaceae
<i>Ampelodesma mauritanica</i>	Poaceae
<i>Andropogon hirtum</i>	Poaceae
<i>Andryala integrifolia</i>	Poaceae
<i>Aristida plumosa</i>	Poaceae
<i>Aristida pungens</i>	Poaceae
<i>Brachypodium distachyum</i>	Poaceae
<i>Brachypodium silvaticum</i>	Poaceae
<i>Briza maxima</i>	Poaceae
<i>Cenchrus ciliaris</i>	Poaceae
<i>Cynodon dactylon</i>	Poaceae
<i>Dactylis glomerata</i>	Poaceae
<i>Danthonia forskahlii</i>	Poaceae
<i>Hordeum murinum</i>	Poaceae
<i>Hordeum vulgare</i>	Poaceae
<i>Lygeum spartum</i>	Poaceae
<i>Phalaris minor</i>	Poaceae
<i>Phragmites communis</i>	Poaceae
<i>Puccinellia distans</i>	Poaceae
<i>Setaria verticillata</i>	Poaceae
<i>Stipa parviflora</i>	Poaceae
<i>Stipa retorta</i>	Poaceae
<i>Stipa tenacissima</i>	Poaceae
<i>Trisetaria flavescens</i>	Poaceae
<i>Polygala nicaeensis</i>	Polygalaceae
<i>Emex spinosis</i>	Polygonaceae

<i>Polygonum equisetiforme</i>	Polygonaceae
<i>Rumex bucephalophorus</i>	Polygonaceae
<i>Rumex tuberosus</i>	Polygonaceae
<i>Polypodium vulgare</i>	Polypodiaceae
<i>Posidonia oceanica</i>	Posidoniaceae
<i>Anagallis arvensis</i>	Primulaceae
<i>Anagallis monelli</i>	Primulaceae
<i>Anarrhinum brevifolium</i>	Primulaceae
<i>Coris monspeliensis</i>	Primulaceae
<i>Cyclamen africanum</i>	Primulaceae
<i>Cytinus hypocistis</i>	Rafflesiaceae
<i>Adonis dentata</i>	Ranunculaceae
<i>Clematis cirrhosa</i>	Ranunculaceae
<i>Clematis flammula</i>	Ranunculaceae
<i>Nigella damascena</i>	Ranunculaceae
<i>Ranunculus ficaria</i>	Ranunculaceae
<i>Ranunculus macrophyllus</i>	Ranunculaceae
<i>Ranunculus sardous</i>	Ranunculaceae
<i>Ranunculus spicatus</i>	Ranunculaceae
<i>Reseda alba</i>	Resedaceae
<i>Reseda arabica</i>	Resedaceae
<i>Rhamnus lycoides</i>	Rhamnaceae
<i>Ziziphus lotus</i>	Rhamnaceae
<i>Crataegus oxyacanthus</i>	Rosaceae
<i>Rubus ulmifolius</i>	Rosaceae
<i>Sanguisorba minor</i>	Rosaceae
<i>Galium rotundifolium</i>	Rubiaceae
<i>Galium saccharatum</i>	Rubiaceae
<i>Galium setaceum</i>	Rubiaceae
<i>Galium vaillantia</i>	Rubiaceae
<i>Rubia peregrina</i>	Rubiaceae
<i>Rubia tinctorum</i>	Rubiaceae
<i>Sherardia arvensis</i>	Rubiaceae
<i>Haplophyllum linifolium</i>	Rutaceae
<i>Ruta chalepensis</i>	Rutaceae
<i>Ruta montana</i>	Rutaceae
<i>Muscari parviflorum</i>	Scilloideae
<i>Anchusa azurea</i>	Scrophulariaceae
<i>Linaria aegyptiaca</i>	Scrophulariaceae
<i>Linaria rubrifolia</i>	Scrophulariaceae
<i>Linaria triphylla</i>	Scrophulariaceae
<i>Orobanche ramosa</i>	Scrophulariaceae
<i>Orobanche sanguinea</i>	Scrophulariaceae
<i>Parentucellia viscosa</i>	Scrophulariaceae
<i>Verbascum rotundifolium</i>	Scrophulariaceae
<i>Verbascum sinuatum</i>	Scrophulariaceae

<i>Veronica cymbalaria</i>	Scrophulariaceae
<i>Selaginella denticulata</i>	Selaginellaceae
<i>Nicotiana glauca</i>	Solanaceae
<i>Solanum nigrum</i>	Solanaceae
<i>Solanum sodomium</i>	Solanaceae
<i>Reaumuria vermiculata</i>	Tamaricaceae
<i>Tamarix africana</i>	Tamaricaceae
<i>Tamarix boveana</i>	Tamaricaceae
<i>Tamarix gallica</i>	Tamaricaceae
<i>Daphne gnidium</i>	Thymelaeaceae
<i>Thymelaea hirsuta</i>	Thymelaeaceae
<i>Thymelaea microphylla</i>	Thymelaeaceae
<i>Valerianella eriocarpa</i>	Valerianaceae
<i>Fedia cornucopiae</i>	Verbenaceae
<i>Lippia citriodora</i>	Verbenaceae
<i>Valerianella carinata</i>	Verbenaceae
<i>Vitex agnus-castus</i>	Verbenaceae
<i>Fagonia cretica</i>	Zygophyllaceae
<i>Fagonia glutinosa</i>	Zygophyllaceae
<i>Fagonia microphylla</i>	Zygophyllaceae
<i>Peganum harmala</i>	Zygophyllaceae
<i>Zygophyllum album</i>	Zygophyllaceae

---