

Medicinal Plants of Bulgaria

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Abstract

Bulgaria is a small country in Southeast Europe, but its geographic location, varied relief and climate contribute to great floristic diversity. The medicinal plants are part of it. They represent 23.2% of the country's flora. The aim of the present paper is to present information about the full composition of the medicinal plants of Bulgarian flora as well as characteristics of the systematic structure and classification according to biological type, life form, floristic geoelements, period of flowering, and ecological groups. The complete list of medicinal plants in Bulgaria was compiled on the basis of the Medicinal Plants Act, extensive literature analysis and own researches. The life forms were identified according to Raunkiaer and for floral elements the classification of Walter was used. The ecological forms were identified according to Flora of Republic Bulgaria. As a result of the conducted surveys it was found that there are 950 medicinal species of vascular plants in the country belonging to 468 genera and 126 families. The richest family containing medicinal plants was Rosaceae (98 specie). The most medicinal plants existed among perennial herbaceous plants (539 species). Geoelements with a European component were predominated (408 species). The most plants bloom from June to August (121 species). The ecological structure of medicinal plants shows that mesophytes (435 species); heliophytes (545 species) and thermophilous plants (607 species) were dominated. The results of the study include also a detailed information about the national and international conservation importance of the analyzed species. 65 species were included in the Red Book of Bulgaria. There were 81 species protected by the Biodiversity Law. Among the medicinal plants are 16 Balkan and 4 Bulgarian endemic species. The international significance of these plants was defined by the fact that 33 of species were under protection by different international conventions. The ratio between the biological types, the predominant geoelements and the life forms shows is typical for the temperate continental climate zone and the flora of our country. The total percentage of protected species (7%) is not high, which is positive because most species are subject to use by the local population, the pharmaceutical and perfumery industry.

Key words: Medicinal plants, flora, systematic structure, geoelements, biological types, conservation significance, Bulgaria

1. Introduction

Bulgaria is a small country in Southeast Europe, but its geographic location, varied relief and climate contribute to great floristic diversity. The medicinal plants are part of it. They represent 23.2% of the country's flora. Regardless of the great achievements of organic synthetic chemistry in the field of pharmaceuticals, the interest in medicinal plants and medicines obtained from them does not decrease. On the contrary, he has shown a certain upswing in recent years.

In our country many authors have focused their research on medicinal plants (Stoyanov, 1972, Ivanov et al, 1973, Hardalova et al., 1994, Assenov et al., 1998, Gussev, 2005,

Landzhev, 2005, Evstatieva et al., 2007, Vitkova and Tahsev, 2007, Nikolov, 2007, Tashev and Tsavkov, 2008, Koev et al., 2014). The aim of the present paper is to present information about the full composition of the medicinal plants of Bulgarian flora as well as characteristics of the systematic structure and classification according to biological type, life form, floristic geolements, period of flowering, and ecological groups.

2. Material and Methods

Study sites: Bulgaria is a small country in Southeast Europe (Fig. 1) with a territory of 110,994 square kilometres. On this territory there is a mountainous, hilly and plain relief. Bulgaria has a changeable climate, which results from being positioned at the meeting point of the Mediterranean and continental air masses combined with the barrier effect of mountains and nearness of Black Sea. The interaction of climatic, hydrological, geological and topographical conditions has produced a relatively wide variety of plant species. Bulgaria's biodiversity is one of the richest in Europe. According to the latest official data, 4102 species of higher plants from 913 genera and 155 families have been established in the flora of Bulgaria (Assyov and Petrova, 2012).



Fig. 1. Object of investigation

The complete list of medicinal plants in Bulgaria was compiled on the basis of the Medicinal Plants Act, extensive literature analysis and own researches. The life forms were identified according to Raunkiaer, 1934 and for floral elements the classification of Walter [14] was used. The ecological forms were identified according to Flora of Republic Bulgaria (Stoyanov, 1966, Jordanov, 1963, Velchev, 1989, Kozhuharov, 1995, Peev, 2012). The following documents are used to determine the conservation significance of the species: Biological Diversity Law [20]; Convention on International Trade in Endangered Species (CITES); Convention on the Conservation of European Wildlife and Natural Habitats. Appendix I; Council Directive 92/43/EEC, 21.05.1992 on the protection of natural habitats and wild fauna and flora; IUCN Red List of Threatened Plants.

3. Results

In this paper, for the first time, an attempt has been made to characterize all the medicinal plants known in Bulgaria. Analysis of literature data, and own research, found that in official and traditional medicine and in homeopathy in Bulgaria, 950 species belonging to 468 genera and 126 families are used (Annex 1). This represents 23.2% of all species, 51.3% of the genera and 81.3% of all vascular plant families in the country. The systematic structure of these plants shows that 4 species from 4 genera and 2 families belong to Lycopodiophyta, 5 species from one genus and one family belong to Equisetophyta, 14 species from 10 genera and 7 families belong to Polypodiophyta. Pinophyta is represented by 12 species from 7 genera and 4 families, Magnoliophyta - 915 species from 446 genera and 112 families of which 98 species from 46 genera and 17 families belong to Liliopsida, and to Magnoliopsida - 817 species from 400 genera and 95 families. The richest families containing medicinal plants are Rosaceae - 98 species, Lamiaceae - 86 species, Asteraceae - 80 species, Apiaceae - 51 species, Fabaceae - 50 species, Brassicaceae - 49 species, Ranunculaceae and Scrophulariaceae - 29 species, Alliaceae - 25 species, Orchidaceae and Polygonaceae - 19 species, etc. Families represented by only one species are 37.

The distribution of taxa by biological types shows that the largest number of medicinal plants is of herbaceous perennials - 539 species or 56.8% of all plants, followed by annuals - 130 species (13.7%), shrubs - 91 species (9.6%) and trees - 48 species (5.0%). The remaining species belong to the transitional biological types. The biological spectrum of medicinal plants [13] is dominated by hemicryptophytes (H) - 363 species or 38.2% of the total, followed by cryptophytes (Cr) - 176 species (18.5%), phanerophytes (Ph) - 155 species (16.4%), terophytes (Th) - 130 species (13.6%) and hamefitites (Ch) - 35 species (3.6%). The remaining species belong to transitional life forms - among them most are 50 species (5.2%), these are plants that can be hemicryptophytes or terophytes (H-Th), depending on the habitat. An analysis of the distribution of medicinal plants by the geo-elements of the flora according to the Walter classification adapted for the flora of Bulgaria [11] shows that the geo-elements with the European component are predominant - 408 species, or 42.9%. Among them, the most Eurasian (Eur-As) are 136 species (14.3%), Euro-Mediterranean (Eur-Med) - 92 species (9.7%), European (Eur) 76 species (8.1%), Euro-Siberian (Eur-Sib) - 73 species (7.7%), etc. On second place is a group of species with a mediterranean component - 333 species, or 35.0%. Most of them are submediterranean (subMed) - 120 species (12.7%), Euromediterranean (Eur-Med) - 92 species (9.7%), Mediterranean (Med) itself - 55 species (5.8%), Ponti-Tertiary Terran (Pont-Med) - 30 species (3.2%), Euro-Submediterans (Eur-subMed) - 18 species (1.9%), etc. Boreal species (Boreal) are 112 (11.8%), adventitious (Adv) - 76 (8.1%), and cosmopolitan (Kos) - 30 (3.2%), etc. For two species (*Allium longispatum* Redoute and *A. webbii* GC Clementi) there is no information on the florogenetic affiliation. The distribution of medicinal plants by flowering period shows that the most plants bloom from June to August - 121 species (12.7%). 96 species bloom in June-July, 85 species - from May to July, 84 - from June to September, 81 - from June to August, 71 - from May to June, etc.

An ecological characteristic of medicinal plants has been made in relation to three main environmental factors: moisture, solar lightening and temperature. In relation to the moisture factor, mesophytes predominate, represented by 435 species (45.8%),

followed by xeromezophytes — 139 species, xerophytes — 135 species, hygromezophytes — 94 species, hygrophytes — 92 species and in the last hydrophytes — 21 species. Heliophytes dominate in relation to the light factor - there are more than half of all species - 545 (57.4%), the hemiscyphyte group includes 269 plants (28.3%), and sciophytes - 136 species (14.3%). In relation to the thermal factor, the species are divided into three groups. More than half are thermophilic plants - 607 species (63.9%), followed by mesotherms - 247 species (26.0%), and the remaining 96 species (10.1%) belong to the group of microtherms. An analysis of the conservation value of medicinal plants, made on the basis of national and international reference documents, shows the following: the Red Book of the Republic of Bulgaria (Peev, 2015), includes a total of 65 species of which 2 (*Hottonia palustris* L., *Pimpinella major* (L.) Huds.) with category "regionally extinct species" (Re), 24 species with category "under critical threat of extinction" (Cr), 36 species with category "under threat of extinction" (En) and 3 species with category "vulnerable" (Vu). Under the protection of the Biodiversity Law there are 81 species. Among the medicinal plants are 16 Balkan and 4 Bulgarian endemics. The international significance of these plants is determined by the fact that 22 species are protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 4 species (*Campanula lanata* Friv., *Orchis provincialis* Balb., *Rheum rhaponticum* L., *Vaccinium arctostaphylos* L.) are under strict protection of the "Convention on the Conservation of European Wildlife and Natural Habitats" (Bern Convention).

Annex II of Directive 92/43/EEC on the protection of natural habitats and wild fauna and flora includes 2 species (*Echium russicum* JF Gmel., *Himantoglossum caprinum* (M. Bieb.) Spreng.), five species (*Alchemilla achtarowii* Pawl., *A. asteroantha* Rothm., *A. jumrukczalica* Pawl., *Campanula lanata*, *Rheum rhaponticum*) are included in the "IUCN Red List of Threatened Plants" (Walter and Gillett (eds), 1998).

4. Discussion and Conclusion

The ratio between the biological types, the predominant geoelements and the life forms shows that it is typical for the temperate continental climate zone and the flora of our country. The total percentage of protected species (7%) is not high, which is positive because most species are subject to use by the local population, the pharmaceutical and perfumery industry.

Annex I. Sistematic list of medicinal plants of Bulgarian flora

Lycopodiophyta

Lycopodiaceae: *Diphasiastrum alpinum* (L.) Holub., *Huperzia inundata* (L.) Bernh ex Schrank et Mart., *Lycopodium clavatum* L.; **Ophioglossaceae:** *Ophioglossum vulgatum* L.

Equisetophyta

Equisetaceae: *Equisetum arvense* L., *E. fluviatile* L., *E. palustris* L., *E. sylvaticum* L., *E. telmateia* Ehrh.

Polypodiophyta

Adiantaceae: *Adiantum capillus-veneris* L.; **Aspidiaceae:** *Dryopteris filix-mas* (L.) Schott., *Polystichum lonchitis* (L.) Roth.; **Aspleniaceae:** *Asplenium adiantum-nigrum* L., *A. ruta-*

muraria L., *A. septentrionale* (L.) Hoffm., *A. trichomanes* L., *Ceterach officinarum* DC., *Phyllitis scolopendrium* (L.) Newm.; **Athyriaceae**: *Athyrium filix-femina* (L.) Roth.; **Hypolepidaceae**: *Pteridium aquilinum* (L.) Kuhn.; **Osmundaceae**: *Osmunda regalis* L.; **Polypodiaceae**: *Polypodium cambriacum* L., *P. vulgare* L.

Pinophyta

Cupressaceae: *Juniperus communis* L., *J. excelsa* Bieb., *J. oxycedrus* L., *J. sabina* L., *J. sibirica* Burget.; **Ephedraceae**: *Ephedra distachya* L.; **Ginkgoaceae**: *Ginkgo biloba* L. **Pinaceae**: *Abies alba* Mill., *Picea abies* (L.) Karst., *Pinus nigra* Arnold, *P. peuce* Griseb., *P. sylvestris* L.; **Taxaceae**: *Taxus baccata* L.

Magnoliphyta

Liliopsida

Alismataceae: *Alisma plantago-aquatica* L.; **Alliaceae**: *Allium albidum* Fischer ex Bieb., *A. amethystinum* Tausch, *A. ampeloprasum* L., *A. angulosum* L., *A. atrovioleaceum* Boiss., *A. carinatum* L., *A. cepa* L., *A. cirrhosum* Vand., *A. flavum* L., *A. fuscum* Waldst. & Kit. *A. guttatum* Steven, *A. longispatum* Redoute, *A. melanatherum* Pančič, *A. paczoskianum* Tuzson, *A. porrum* L., *A. proliferum* (Moench) Schrader, *A. rotundum* L., *A. sativum* L., *A. schaerocephalon* L., *A. schoenoprasum* L., *A. scordoprasum* L., *A. ursinum* L., *A. victorialis* L., *A. webbii* G. C. Clementi, *Nectaroscordum siculum* (Ucria) Lindley; **Amaryllidaceae**: *Galanthus elwesii* Hook., *G. nivalis* L., *Leucojum aestivum* L.; **Araceae**: *Acorus calamus* L., *Arum italicum* Mill., *A. maculatum* L., *Dracunculus vulgaris* Schott; **Asparagaceae**: *Asparagus officinalis* L., *A. tenuifolius* Lam., *Ruscus aculeatus* L.; **Butomaceae**: *Butomus umbellatus* L.; **Cyperaceae**: *Eriophorum angustifolium* Honck., *E. latifolium* Hoppe., *E. vaginatum* L.; **Dioscoreaceae**: *Tamus communis* L.; **Hydrocharitaceae**: *Hydrocharis morsus-ranae* L.; **Iridaceae**: *Crocus chrysanthus* Herb., *C. pallasii* Bieb., *Gladiolus communis* L., *G. imbricatus* L., *Iris graminea* L., *I. pseudacorus* L., *I. pumila* L.; **Juncaceae**: *Juncus inflexus* L.; **Lemnaceae**: *Lemna minor* L., *Spirodela polyrhiza* (L.) Schleid.; **Liliaceae**: *Asphodeline lutea* (L.) Reichenb., *Asphodelus albus* Mill., *Colchicum autumnale* L., *C. diampolis* Delip. & Česchm., *Convallaria majalis* L., *Lilium martagon* L., *Paris quadrifolia* L., *Polygonatum latifolium* (Jacq.) Desf., *P. multiflorum* (L.) All., *P. odoratum* (Mill.) Druce, *Scilla bifolia* L., *Veratrum lobelianum* Bernth., *V. nigrum* L.; **Najadaceae**: *Najas marina* L.; **Orchidaceae**: *Anacamptis pyramidalis* (L.) L.C. Rich., *Gymnadenia conopsea* (L.) R. Br., *Himantoglossum hircinum* (L.) Spreng., *Orchis coriophora* L., *O. laxiflora* Lam., *O. mascula* L., *O. militaris* L., *O. morio* L., *O. pallens* L., *O. papilionacea* L., *O. provincialis* Balb., *O. punctulatum* Stev., *O. purpurea* Huds., *O. simia* L., *O. spitzelii* Saut. ex Koch., *O. tridentata* Scop., *O. ustulata* L., *Platanthera bifolia* (L.) L.C. Rich., *P. chlorantha* (Cust.) Rehb.; **Poaceae**: *Anthoxanthum odoratum* L., *Briza media* L., *Cynodon dactylon* (L.) Pers., *Elymus repens* (L.) Gould., *Hierochloa australis* (Schrader) Roemer & Schultes, *Hordeum vulgare* L., *Lolium temulentum* L. *Sclerochloa dura* (L.) Beauv., *Zea mays* L.; **Sarganiaceae**: *Sparganium erectum* L.; **Smilacaceae**: *Smilax excelsa* L.; **Typhaceae**: *Typha angustifolia* L., *T. latifolia* L.

Magnolipsida

Acanthaceae: *Acanthus balcanicus* Heyw. et Richards, *A. spinosus* L.; **Aceraceae**: *Acer campestre* L., *A. negundo* L., *A. platanoides* L., *A. pseudoplatanus* L., *A. tataricum* L.; **Adoxaceae**: *Adoxa moschatellina* L.; **Amaranthaceae**: *Amaranthus spinosus* L.; **Anacardiaceae**: *Cotinus coggygria* Scop., *Pistacia vera* L., *Rhus coriaria* L.; **Apiaceae**: *Aethusa cynapium* L., *Anethum graveolens* L., *Angelica archangelica* L., *A. panicii* Vand., *A.*

sylvestris L., *Anthriscus cerefolium* (L.) Hoffm., *Apium graveolens* L., *Astrantia major* L., *Bifora tadians* Bieb., *Bupleurum longifolium* L., *B. rotundifolium* L., *Carum carvi* L., *C. graecum* Boiss.et Heldr., *Chaerophyllum bulbosum* L., *C. tenulentum* L., *Cicuta virosa* L., *Conium maculatum* L., *Coriandrum sativum* L., *Cuminum cyminum* L., *Daucus sativus* Hoffm., *Eryngium campestre* L., *E. maritimum* L., *Ferulago sylvatica* (Bess.) Rchb., *Foeniculum vulgare* Mill., *Heracleum sibiricum* L., *H. verticillatum* Panc., *Laser trilobum* (L.) Borkh., *Laserpitium latifolium* L., *L. prutenicum* L., *L. siler* L. *Levisticum officinale* Koch, *Meum athamanticum* Jacq., *Oenanthe aquatica* L., *Opopanax chironium* (L.) Koch., *O. hispidus* (Friv.) Grsb. *Petroselinum crispum* (Mill.) A. W. Hill, *Peucedanum arenarium* Waldst. & Kit., *P. cervaria* (L.) Lapeyer., *P. officinalis* L., *P. ruthenicum* Bieb., *Pimpinella anisum* L., *P. major* (L.) Huds., *P. saxifraga* L., *Prangos ferulacea* (L.) Lindl., *Sanicula europaea* L., *Scandix pecten-veneris* L., *Seseli rigidum* W. et K., *S. tortuosum* L., *Tordylium maximum* L., *Torilis arvensis* (Huds.) Link; **Apocynaceae**: *Trachomitum venetum* (L.) Woodson, *Vinca herbacea* W. et K., *V. major* L., *V. minor* L.; **Aquifoliaceae**: *Ilex aquifolium* L., *I. colchica* Pojark.; **Araliaceae**: *Hedera helix* L.; **Aristolochiaceae**: *Aristolochia clematitis* L., *A. rotunda* L., *Asarum europaeum* L.; **Asclepiadaceae**: *Cionura erecta* (L.) Griseb., *Periploca graeca* L., *Vincetoxicum fuscatum* (Hornem.) Reichenb. f., *V. hirundinaria* Medic., *V. speciosum* Boiss. & Spruner; **Asteraceae**: *Achillea clypeolata* Sm., *A. grandifolia* Friv., *A. millefolium* L., *A. nobilis* L., *Antennaria dioica* (L.) Gaertn., *Anthemis cotula* L., *A. tinctoria* L., *Arctium lappa* L., *A. minus* Bernh., *A. nemorosum* L., *A. tomentosum* Mill., *Artemisia absinthium* L., *A. alba* Turra, *A. annua* L., *A. campestre* L., *A. dracunculus* L., *A. lerchiana* Weber, *A. santonicum* L., *A. vulgaris* L., *Bellis perennis* L., *Bidens tripartita* L., *Calendula officinalis* L., *Carduus acanthoides* L., *C. armatus* Boiss. & Heldr., *Carlina acanthifolia* All., *C. vulgaris* L., *Carthamus lanatus* L., *Centaurea calcitrapa* L., *C. cyanus* L., *C. pannonica* (Heuff.) Simk., *C. rocheliana* (Heuff.) Dost., *C. solstitialis* L., *Chamomilla recutita* (L.) Rausch., *C. suaveolens* (Pursh.) Rydb., *Cichorium endivia* L., *C. intybus* L., *Cnicus benedictus* L., *Doronicum columnae* Ten., *Echinops sphaerocephalus* L., *Filago lutescens* Jord., *F. vulgaris* Lam., *Galinsoga parviflora* Cav., *Gnaphalium uliginosum* L., *Helichrisum arenarium* (L.) Moench., *Hieracium pilosella* L., *Hypochaeris maculata* L., *H. radicata* L., *Inula aschersoniana* Janka, *I. ensifolia* L., *I. germanica* L., *I. helenium* L., *Lactuca serriola* L., *Leucanthemum vulgare* Lam., *Ligularia glauca* (L.) O. Hoffm., *Matricaria trichophylla* (Boiss.) Boiss., *Onopordium acanthium* L., *O. tauricum* Willd., *Petasites albus* (L.) Gaertn., *P. hybridus* (L.) Gaertn., *Pulicaria dysenterica* (L.) Bernh., *P. vulgaris* Gaerth., *Scorzonera hispanica* L., *Senecio jacobaea* L., *S. nemorensis* L., *S. othonnae* Bieb., *S. paludosus* L., *S. viscosus* L., *S. vulgaris* L., *Silybum marianum* (L.) Gaerth., *Solidago virgaurea* L., *Tagetes erecta* L., *T. minima* L., *Tanacetum vulgare* L., *Taraxacum officinale* Web., *Telekia speciosa* (Schreb.) Baumg., *Tragopogon pratensis* L., *Tussilago farfara* L., *Xanthium spinosum* L., *X. strumarium* L., *Xeranthemum annuum* L.; **Balsaminaceae**: *Impatiens balsamina* L., *I. parviflora* DC., *Berberis thunbergii* DC., *B. vulgaris* L.; **Betulaceae**: *Alnus glutinosa* (L.) Gaertn., *A. incana* (L.) Moench, *Betula pendula* Roth.; **Boraginaceae**: *Alkanna tinctoria* (L.) Taush, *Anchusa azurea* Mill., *A. officinalis* L., *Buglossoides arvensis* (L.) Lohnst., *B. purpureocaerulea* (L.) Lohnst., *Cerithe glabra* Mill., *C. minor* L., *Cynoglossum officinale* L., *Echium italicum* L., *E. russicum* J. Gmel., *E. vulgare* L., *Heliotropium europaeum* L., *Lithospermum officinale* L., *Pulmonaria mollis* Wulf. et Horn., *P. officinalis* L., *Symphytum officinale* L.; **Brassicaceae**: *Alliaria petiolata* (Bieb.) Cavara et Grande., *Alyssum alyssoides* L., *Armoracia macrocarpa* (Waldst. & Kit.) Kit. ex Baumg., *A. rusticana* (Lam.) P. Gaerthner, B. Meyer & Scherb., *Barbarea vulgaris* R.Br., *Brassica juncea* (L.) Czern., *B. nigra* (L.) Koch., *Bunias orientalis* L., *Capsella bursa-pastoris* (L.) Medic., *Cardamine amara* L., *C. bulbifera* (L.) Crantz., *C. pratensis* L., *Coronopus*

procumbens Gilib., *Descurainia sophia* (L.) Webb. ex Prantl., *Diploaxis tenuifolia* (L.) DC., *Euclidium syriacum* (L.) R.Br., *Hesperis matronalis* L., *Lepidium campestre* (L.) R. Br., *L. graminifolium* L., *L. latifolium* L., *L. perfoliatum* L., *L. ruderales* L., *L. sativum* L., *Lunaria rediviva* L., *Nasturtium officinale* R. Br., *Raphanus raphanistrum* L., *Rorippa austriaca* (Crantz.) Bess., *R. sylvestris* (L.) Bess., *Sinapis alba* L., *Sisymbrium loeselii* L., *S. officinale* (L.) Scop., *Thlaspi alliaceum* L., *T. arvense* L.; **Buddlejaceae**: *Buddleja davidii* Franchet; **Buxaceae**: *Buxus sempervirens* L.; **Campanulaceae**: *Campanula lanata* Friv., *C. persicifolia* L., *Jasione heldreichii* Boiss. & Orph., *J. montana* L.; **Cannabaceae**: *Cannabis sativa* L., *Humulus lupulus* L.; **Caprifoliaceae**: *Lonicera caprifolium* L., *L. xilostemum* L., *Sambucus deborensis* (Košamin) Košamin, *S. ebulus* L., *S. nigra* L., *S. racemosa* L., *Viburnum opulus* L.; **Caryophyllaceae**: *Agrostemma githago* L., *Dianthus giganteiformis* Borbas, *D. pontederiae* A.Kern., *Gypsophila paniculata* L., *Herniaria glabra* L., *H. hirsuta* L., *H. incana* Lam., *Lychnis coronaria* (L.) Desr., *L. flos-cuculi* L., *Minuartia setacea* (Thuill) Hay., *Saponaria officinalis* L., *Scleranthus annuus* L., *S. perennis* L., *Silene otites* (L.) Wibel., *Spergularia rubra* (L.) J. et C. Prest., *Stellaria graminea* L., *S. media* (L.) Vill., *Viscaria vulgaris* Röhlng; **Celastraceae**: *Euonymus europaeus* L., *E. verrucosus* Scop.; **Chenopodiaceae**: *Atriplex rosea* L., *Camphorosma monspeliaca* L., *Chenopodium album* L., *C. ambrosioides* L., *C. bonus-henricus* L., *C. botrys* L., *C. foliosum* (Moench) Ascherson, *C. hybridum* L., *C. polyspermum* L., *C. rubrum* L., *C. vulvaria* L., *Salicornia europaea* L., *Salsola soda* L.; **Cistaceae**: *Cistus incanus* L., *Helianthemum nummularium* (L.) Mill.; **Convolvulaceae**: *Calystegia sepium* (L.) Rr., *Convolvulus arvensis* L.; **Cornaceae**: *Cornus mas* L., *C. sanguinea* L.; **Corylaceae**: *Carpinus betulus* L., *C. orientalis* Mill., *Corylus avellana* L., *C. colurna* L.; **Crassulaceae**: *Jovibarba heuffelii* (Schott) A. & D. Löve, *J. velenovskyi* (Českm.) J. Holub, *Rhodiola rosea* L., *Sedum acre* L., *S. album* L., *S. maximum* (L.) Suter., *S. spectabile* Boreau, *Sempervivum erythraeum* Velen., *S. leucanthum* Pančič, *S. marmoreum* Grab., *S. tectorum* L., *S. zebeborii* Schott, *Umbilicus erectus* DC.; **Cucurbitaceae**: *Bryonia alba* L., *B. cretica* ssp. *dioica* (Jacq.) Tutin, *Citrullus colocynthis* (L.) Schrader, *C. lanatus* (Thumb.) Matsum. & Nakai, *Cucurbita maxima* Duchesne, *Ecbalium elaterium* (L.) A. Rich.; **Cuscutaceae**: *Cuscuta epilinum* Weihe, *C. europaea* L.; **Dipsacaceae**: *Dipsacus fullonum* L., *Knautia arvensis* (L.) Coult., *Scabiosa ochroleuca* L., *Succisa pratensis* Moench.; **Droseraceae**: *Drosera rotundifolia* L.; **Elaeagnaceae**: *Elaeagnus angustifolia* L., *Hippophae rhamnoides* L.; **Ericaceae**: *Arctostaphylos uva-ursi* (L.) Spreng., *Calluna vulgaris* (L.) Hull., *Rhododendron ponticum* L., *Vaccinium arctostaphylos* L., *V. myrtillus* L., *V. uliginosum* L., *V. vitis-idaea* L.; **Euphorbiaceae**: *Euphorbia amygdaloides* L., *E. cyparissias* Host., *E. myrsinites* L., *E. peplis* L., *E. peplus* L., *Mercurialis annua* L., *M. perennis* L., *Ricinus communis* L.; **Fabaceae**: *Amorpha fruticosa* L., *Anthyllis vulneraria* L., *Astragalus dasyanthus* Pallas, *A. glycyphylloides* DC., *A. glycyphyllos* L., *Bituminaria bituminosa* (L.) Stirt., *Cercis siliquastrum* L.; **Fabaceae**: *Chamaecytisus albus* (Jacq.) Rothm., *C. hirsutus* (L.) Link., *C. lejocarpus* (A. Kern.) Rothm., *C. ratisbonensis* (Schaeff.) Rothm., *Chamaespartium sagittale* (L.) P. Gibbs., *Colutea arborescens* L., *Coronilla scorpioides* (L.) Koch., *C. varia* L., *Galega officinalis* L., *Genista ovata* W.et K., *G. tinctoria* L., *Gleditsia triacanthos* L., *Glycyrrhiza glabra* L., *Hippocrepis comosa* L., *Lathyrus niger* (L.) Bernh., *L. pratensis* L., *L. sativus* L., *L. sylvestris* L., *L. tuberosus* L., *L. vernus* (L.) Bernh., *Lotus corniculatus* L., *Medicago disciformis* DC., *Melilotus alba* Medic., *M. indica* (L.) All., *M. officinalis* (L.) Pal., *Ononis pusilla* ssp. *orientalis* (Širj.) Kožuharov, *O. spinosa* L., *Robinia pseudoacacia* L., *Securigera securidaca* (L.) Roth., *Spartium junceum* L., *Tetragonolobus maritimus* (L.) Roth., *Trifolium alpestre* L., *T. arvense* L., *T. pannonicum* Jacq., *T. pratense* L., *T. repens* L., *Trigonella coerulea* (L.) Ser., *T. foenum-graecum* L., *T. procumbens* (Bess.) Rchb., *Vicia cracca* L., *V. grandiflora* Scop., *V.*

pisiformis L., *V. sativa* L.; **Fagaceae**: *Castanea sativa* Mill., *Fagus orientalis* Lipsky, *F. sylvatica* L., *Quercus coccifera* L., *Q. frainetto* Ten., *Q. robur* L.; **Fumariaceae**: *Corydalis bulbosa* (L.) DC., *C. solida* (L.) Swartz., *Fumaria officinalis* L., *F. vaillantii* Loisel.; **Gentianaceae**: *Centaurium erythraea* Rafn., *C. pulchellum* (Swartz) Druce, *Gentiana asclepiadea* L., *G. cruciata* L., *G. lutea* L., *G. pneumonanthe* L., *G. punctata* L., *G. verna* L., *Gentianella bulgarica* (Vel.) Holub.; **Geraniaceae**: *Erodium cicutarium* (L.) L'Her., *Geranium macrorrhizum* L., *G. pyrenaicum* Burm. f., *G. robertianum* L., *G. sanguineum* L., *G. sylvaticum* L.; **Gesneriaceae**: *Haberlea rhodopensis* Friv.; **Globulariaceae**: *Globularia ahyllanthes* Crantz, *G. cordifolia* L.; **Grossulariaceae**: *Ribes nigrum* L., *R. uva-crispa* L.; **Haloragaceae**: *Myriophyllum spicatum* L.; **Hippocastanaceae**: *Aesculus hippocastanum* L.; **Hypericaceae**: *Hypericum androsaemum* L., *H. cerastoides* (Spach) N. Robson, *H. elegans* Stephan ex Willd., *H. hirsutum* L., *H. maculatum* Crantz., *H. olympicum* L., *H. perforatum* L.; **Juglandaceae**: *Juglans regia* L.; **Lamiaceae**: *Acinos alpinus* (L.) Moench, *A. arvensis* (Lam.) Dandy, *A. suaveolens* (S. et S.) G. Don., *Ajuga chamaepitis* (L.) Schreb., *A. laxmannii* (L.) Benth., *A. reptans* L., *Ballota nigra* L., *Betonica officinalis* L., *Calamintha grandiflora* (L.) Moench, *C. nepeta* (L.) Savi., *Clinopodium vulgare* L., *Galeopsis ladanum* L., *G. speciosa* Mill., *G. tetrachit* L., *Glechoma hederaceae* L., *G. hirsuta* Waldst. & Kit., *Hyssopus officinalis* L., *Lamium album* L., *L. maculatum* L., *L. purpureum* L., *Lavandula angustifolia* Mill., *Leonurus cardiaca* L., *Lycopus europaeus* L., *Marrubium parviflorum* Friv. et Mey., *M. peregrinum* L., *M. vulgare* L., *Melissa officinalis* L., *Melittis melissophyllum* L., *Mentha aquatica* L., *M. arvensis* L., *M. longifolia* (L.) Huds., *M. piperita* L., *M. pulegium* L., *M. spicata* L., *M. suaveolens* Ehrh., *M. verticillata* L., *Nepeta cataria* L., *Ocinum basilicum* L., *Origanum vulgare* L., *Phlomis tuberosa* L., *Prunella grandiflora* (L.) Scholler, *P. vulgaris* L., *Rosmarinus officinalis* L., *Salvia aethiopsis* L., *S. glutinosa* L., *S. nemorosa* L., *S. officinalis* L., *S. pratensis* L., *S. sclarea* L., *S. tomentosa* Mill., *S. verticillata* L., *Satureja cuneiflora* Ten., *S. montana* L., *Scutellaria altissima* L., *S. galericulata* L., *S. hastifolia* L., *Sideritis montana* L., *S. scardica* Griseb., *S. syriaca* L., *Stachys annua* L., *S. germanica* L., *S. recta* L., *S. sylvatica* L., *Teucrium chamaedrys* L., *T. montanum* L., *T. polium* L., *T. scordium* L., *Thymus albanus* H. Braun, *T. atticus* Čelak., *T. bracteosus* Vis. ex Benth., *T. callieri* Borb., *T. comptus* Friv., *T. glabrescens* Willd., *T. jankae* Čelak., *T. leucotrichus* Halacsy, *T. longicaulis* C. Presl., *T. longidentatus* (Deg. et Urum.) Ronn., *T. moesiacus* Velen., *T. pannonicus* All., *T. perinicus* (Velen.) Jalas, *T. pulegioides* L., *T. sibthorpii* Benth., *T. stojanovii* Degen, *T. striatus* Vahl., *T. thracicus* Velen., *T. vandasii* Velen., *T. zygioides* Griseb.; **Linaceae**: *Linum catharticum* L., *L. usitatissimum* L.; **Loranthaceae**: *Loranthus europaeus* Jacq., *Viscum album* L.; **Lythraceae**: *Lythrum salicaria* L., *L. virgatum* L.; **Malvaceae**: *Abutilon theophrastii* Medic., *Alcea pallida* (Waldst.) Waldst. & Kit., *A. rosea* L., *Althaea cannabina* L., *A. officinalis* L., *Gossypium hirsutum* L., *Hibiscus syriacus* L., *H. trionum* L., *Lavatera thuringiaca* L., *Malva alcea* L., *M. moschata* L., *M. neglecta* Wallr., *M. pusilla* Sin., *M. sylvestris* L.; **Menyanthaceae**: *Menyanthes trifoliata* L.; **Monotropaceae**: *Monotropa hypopitys* L.; **Moraceae**: *Ficus carica* L., *Morus alba* L., *M. nigra* L.; **Nymphaeaceae**: *Nuphar lutea* (L.) S. et S., *Nymphaea alba* L.; **Oleaceae**: *Fraxinus excelsior* L., *F. ornus* L., *F. oxycarpa* Willd., *F. pallisiae* Wilm., *Jasminum officinale* L., *Ligustrum vulgare* L., *Phillyrea latifolia* L., *Syringa vulgaris* L.; **Onagraceae**: *Epilobium lanceolatum* Sebastiani & Mauri, *E. parviflorum* Scheber, *Oenothera biennis* L.; **Orobanchaceae**: *Orobanche minor* Sm., *O. rapum-genistae* Thuill.; **Oxalidaceae**: *Oxalis acetosella* L.; **Paoniaceae**: *Paeonia peregrina* Mill.; **Papaveraceae**: *Chelidonium majus* L., *Glaucium corniculatum* (L.) J. H. Rudolph, *G. flavum* Crantz., *G. leiocarpum* Boiss., *Papaver rhoeas* L., *P. somniferum* L.; **Parnassiaceae**: *Parnassia palustris* L.; **Phytolaccaceae**: *Phytolacca americana* L.; **Plantaginaceae**: *Plantago afra* L., *P. coronopus* L., *P. lanceolata* L., *P. major* L., *P. media* L.,

P. scabra Moench., *P. subulata* L.; **Platanaceae**: *Platanus orientalis* L.; **Plumbaginaceae**: *Limonium vulgare* Mill., *Plumbago europaea* L.; **Polygalaceae**: *Polygala amarella* Crantz., *P. major* Jacq., *P. monspeliaca* L., *P. vulgaris* L.; **Polygonaceae**: *Bistorta major* S. Gray., *Fagopyrum esculentum* Moench, *Oxyria digyna* (L.) Hill., *Persicaria hydropiper* (L.) Spach., *P. lapathifolia* (L.) S. Gray, *P. maculata* (Raf.) S. Gray, *Polygonum arenastrum* Boreau, *P. aviculare* L., *Rheum rhaponticum* L., *Rumex acetosa* L., *R. acetosella* L., *R. alpinus* L., *R. aquaticus* L., *R. crispus* L., *R. hydrolapathum* Huds., *R. obtusifolius* L., *R. patientia* L., *R. pulcher* L., *R. scutatus* L.; **Portulacaceae**: *Portulaca oleracea* L.; **Primulaceae**: *Anagallis arvensis* L., *Cyclamen coum* Mill., *C. hederifolium* Ait., *Hottonia palustris* L., *Lysimachia nummularia* L., *Primula acaulis* (L.) L., *P. elatior* (L.) Hill., *P. veris* L., *Samolus valerandi* L.; **Punicaceae**: *Punica granatum* L.; **Pyrolaceae**: *Moneses uniflora* (L.) Gray., *Orthilia secunda* (L.) House, *Pyrola chlorantha* Swartz., *P. rotundifolia* L.; **Ranunculaceae**: *Aconitum licoctonum* ssp. *neapolitanum* (Ten.) Nym., *A. firmum* Reichenb., *A. variegatum* L., *Actaea spicata* L., *Adonis aestivalis* L., *A. vernalis* L., *Anemone nemorosa* L., *A. ranunculoides* L., *Aquilegia nigricans* Baumg., *Caltha palustris* L., *Clematis recta* L., *C. vitalba* L., *Consolida hispanica* (Costa) Greut. et Burdet., *C. regalis* S.F.Gray., *Ficaria verna* Huds., *Helleborus odorus* W. et K., *Hepatica nobilis* Mill., *Isopyrum thalictroides* L., *Nigella arvensis* L., *N. damascena* L., *N. sativa* L., *Ranunculus flammula* L., *R. lingua* L., *R. polyanthemus* L., *R. repens* L., *R. scleratus* L., *Thalictrum aquilegifolium* L., *T. flavum* L., *T. minus* L.; **Resedaceae**: *Reseda inodora* Rchb., *R. lutea* L.; **Rhamnaceae**: *Frangula alnus* Mill., *Paliurus spina-christi* Mill., *Rhamnus alpinus* L., *R. catharticus* L., *R. saxatilis* L., *Zizyphus jujuba* Mill.; **Rosaceae**: *Agrimonia eupatoria* L., *A. odorata* All., *Alchemilla achtarowii* Pawl., *A. acutiloba* Opiz., *A. anisiaca* Wettst., *A. asteroantha* Rothm., *A. bulgarica* Rothm., *A. catachnoa* Rothm., *A. cinerea* Buser., *A. connivens* Buser., *A. crinita* Buser., *A. erythropoda* Juz., *A. fissa* Gunt. et Schum., *A. flabellata* Buser., *A. glabra* Neygenf., *A. glaucescens* Wallr., *A. gorcensis* Pawl., *A. gracilis* Opiz., *A. gracillima* Rothm., *A. grossidens* Buser., *A. incisa* Buser., *A. indivisa* (Buser.) Rothm., *A. jumrukczalica* Pawl., *A. mollis* (Buser.) Rothm., *A. monticola* Opiz., *A. obtusa* Buser., *A. pawlowskii* Assen., *A. plicata* Gand., *A. pyrenaica* Dufour., *A. reniformis* Buser., *A. subcrenata* Buser., *A. viridiflora* Rothm., *A. xathochlora* Rothm., *Amygdalus communis* L., *A. nana* L., *Aronia prunifolia* Rehder, *Crataegus monogyna* Jacq., *C. orientalis* Pallas & Bieb., *C. pentagyna* W. et K. ex Willd., *Dasiphora fruticosa* (L.) Rydb., *Dryas octopetala* L., *Filipendula ulmaria* Maxim., *F. vulgaris* Moench., *Fragaria vesca* L., *Geum coccineum* S. et S., *G. montanum* L., *G. reptans* L., *G. rivale* L., *G. urbanum* L., *Laurocerasus officinalis* Roem., *Malus sylvestris* Mill., *Potentilla alba* L., *P. apennina* ssp. *stojanovii* Urum. & Jav., *P. argentea* L., *P. erecta* (L.) Rausch., *P. inclinata* Vill., *P. micrantha* Ramond ex DC., *P. neglecta* Baumg., *P. palustris* (L.) Scop., *P. pindicola* (Nyman) Hausskn., *P. reptans* L., *P. rupestris* L., *P. supina* L., *Prunus cerasifera* Ehrh., *P. cerasus* L., *P. domestica* L., *P. fruticosa* Pall., *P. mahaleb* L., *P. padus* L., *P. spinosa* L., *Rosa caesia* Sm., *R. canina* L., *R. caryophyllacea* Bess., *R. corymbifera* Borkh., *R. dumalis* Bechst., *R. gallica* L., *R. micrantha* Borrer ex Sm., *R. nitidula* Bess., *R. oxyodon* Boiss., *R. pendulina* L., *R. tomentosa* Sm., *Rubus caesius* L., *R. canescens* DC., *R. discolor* Weihe & Nees, *R. hirtus* Waldst. & Kit., *R. idaeus* L., *R. lloydianus* Genev., *R. macrophyllus* Wehie & Nees, *R. sanguineus* Friv., *R. saxatilis* L., *R. thyrsanthus* Focke, *Sanguisorba minor* Scop., *S. officinalis* L., *Sorbus aucuparia* L., *S. domestica* L., *S. torminalis* (L.) Crantz., *Spiraea chamaedrifolia* L., *S. salicifolia* L.; **Rubiaceae**: *Cruciata laevipes* Opiz., *Galium aparine* L., *G. lucidum* All., *G. odoratum* (L.) Scop., *G. verum* L., *Rubia tinctorum* L.; **Rutaceae**: *Dictamnus albus* L., *Ruta graveolens* L.; **Salicaceae**: *Populus alba* L., *P. nigra* L., *P. tremula* L., *Salix alba* L., *S. caprea* L., *S. fragilis* L., *S. pentandra* L., *S. purpurea* L., *S. reticulata* L., *S. triandra* L.; **Saxifragaceae**: *Chrisosplenium alternifolium* L., *Saxifraga*

bulbifera L., *S. rotundifolia* L.; **Scrophulariaceae**: *Digitalis ferruginea* L., *D. grandiflora* Mill., *D. lanata* Ehrh., *D. purpurea* L., *Euphrasia rostkoviana* Hayne, *Gratiola officinalis* L., *Kickxia elatine* (L.) Dum., *Kickxia spuria* (L.) Dum., *Lathraea squamaria* L., *Linaria vulgaris* Mill., *Pedicularis occulta* Janka, *P. palustris* L., *Pseudolysimachion orchideum* (Crantz) Wraber, *Rhinanthus minor* L., *Scrophularia canina* L., *S. nodosa* L., *Verbascum densiflorum* Bertol., *V. nigrum* L., *V. nobile* Vel., *V. phlomoides* L., *V. phoeniceum* L., *V. pseudonobile* Stoj. et Stef., *Veronica anagallis-aquatica* L., *V. arvensis* L., *V. austriaca* L., *V. beccabunga* L., *V. chamaedrys* L., *V. officinalis* L., *V. prostrata* L.; **Simaroubaceae**: *Ailanthus altissima* (Mill.) Swingle.; **Solanaceae**: *Atropa belladonna* L., *Capsicum esculentum* Mill., *Datura stramonium* L., *Hyoscyamus albus* L., *H. niger* L., *Nicandra physaloides* (L.) Gaertn., *Physalis alkekengi* L., *Solanum dulcamara* L., *S. luteum* Mill., *S. melongena* L., *S. nigrum* L.; **Staphyleaceae**: *Staphylea pinnata* L.; **Tamaricaceae**: *Myricaria germanica* (L.) Desv., *Tamarix ramosissima* Ledeb., *T. tetrandra* Pall. et Bieb.; **Thymeleaceae**: *Daphne mezereum* L., *D. pontica* L.; **Tiliaceae**: *Tilia cordata* Mill., *T. platyphyllos* Scop., *T. rubra* DC., *T. tomentosa* Moench.; **Ulmaceae**: *Celtis australis* L., *Ulmus glabra* Huds., *U. minor* Mill.; **Urticaceae**: *Parietaria erecta* Mert. & Koch, *P. lusitanica* L., *Urtica dioica* L., *U. urens* L.; **Valerianaceae**: *Centranthus ruber* (L.) DC., *Valeriana officinalis* L., *Valerianella coronata* (L.) DC.; **Verbenaceae**: *Verbena officinalis* L., *Vitex negundo* L.; **Violaceae**: *Viola hirta* L., *V. odorata* L., *V. tricolor* L.; **Vitaceae**: *Vitis sylvestris* C. C. Gmelin, *V. vinifera* L.; **Zygophyllaceae**: *Peganum harmala* L., *Tribulus terrestris* L., *Zygophyllum fabago* L.

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