

**TAXONOMIC STUDIES ON THE GENUS *SALVIA* L. (LABIATAE) IN  
CENTRAL ANATOLIA, TURKEY**

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CENTRAL ANATOLIA, TURKEY**

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## **ABSTRACT**

### **TAXONOMIC STUDIES ON THE GENUS *SALVIA* L. (LABIATAE) IN CENTRAL ANATOLIA, TURKEY**

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This research study is a revision of the genus *Salvia* (Labiatae) in Central Anatolia. The author has carried out extensive research studies conducted in a 3 year period starting from June 2005 by collecting specimens from all the localities in Central Anatolia, Turkey. Specimens collected from Turkey by the other researchers and kept either in Turkey or abroad were also examined.

The samples were studied using their root, stem and leaf morphology including essential characteristics of flowers. Using this information dendograms were obtained and taxa cut off lines were drawn. The cross sectional preparations of stem and leaf were observed for taxonomical evaluation. *Salvia* taxa leaf surface, flower organs and seed surface were studied for understanding the diagnostic value of their micro morphological characteristics. Anatomical sections of the specimens were analyzed under light microscope and the data was used for further taxa separations.

The *Salvia* species were further investigated for their pollen characteristics such as surface view and dimensions. Numeric taxonomic methods were used for constructing a natural infrageneric grouping in the genus as far as the species allows. Using software and computer grouping each sample was ranked and placed into specific taxa.



First the samples were identified by using the species key given in Turkish Flora. According to the Turkish Flora there were two ways to identify samples. One way based on the stamen features and the other based on the leaves and flowers. For nomenclatural reasons the specimens were cross checked with the existing type specimens known from Turkey and kept in some international herbaria.

This thesis is formed by two sections. The first section is comprised of introduction, materials and methods and basic findings. Basic findings are the result of morphological, anatomical, palynological and ecological investigations. In the second section of the thesis, a revision of *Salvia* in Central Anatolia, Turkey is given. This includes results of numeric studies and infrageneric grouping.

Soil types and habitat characteristics were also studied. Soil samples were taken from the various locations and analyzed for their content. The populations were revisited to determine the sustainability and vulnerability of each taxon. IUCN threat categories were determined based on habitat information and species limitations. The phenological data and relevant field observations were all recorded.

In Central Anatolia 43 *Salvia* species were found. Among the specimens collected from the area one taxon was re-discovered after 116 years.

Key Words: Labiatae, *Salvia*, Revision, Turkey.

## ÖZ

### İÇ ANADOLU BÖLGESİ'NDE BULUNAN *SALVIA* L. TÜRLERİNİN TAKSONOMİK ÇALIŞMALARI

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Bu araştırmada, İç Anadolu'da yayılış gösteren *Salvia* (Labiatae) cinsinin revizyonu yapılmıştır. Yazar, Haziran 2005 tarihinden başlayarak 3 yıl süreyle İç Anadolu'daki tüm lokalitelerden numuneler toplayarak kapsamlı araştırmalar gerçekleştirmiştir. Ayrıca, başka araştırmacılar tarafından Türkiye'den toplanan ve Türkiye yada yurtdışında tutulan örnekler de incelenmiştir.

Örnekler kök, gövde ve yaprak morfolojisi ile çiçek temel özellikleri kullanılarak çalışılmıştır. Bu bulgular kullanılarak dendogramlar elde edilmiş ve taksonların kesim hatları çizilmiştir. Taksonomik değerlendirme için gövde ve yaprak anatomik kesitlerine bakılmıştır. Mikromorfolojik karakterlerin ayırıcı özelliklerini anlamak için, *Salvia* taksonlarının yaprak yüzeyleri, çiçek organları ve tohum yüzeyleri çalışılmıştır. Örneklere ilişkin anatomik kesitler, ışık mikroskobu altında incelenmiş ve elde edilen veriler taksonların birbirinden ayırımında kullanılmıştır.

Çalışılan türlerin polen özellikleri ve yüzey mikromorfolojileri ayrıntılı olarak çalışılmıştır. Belirlenmiş türler kullanılarak cinsiçi doğal sınıflandırmanın yapılabilmesi için numerik taksonomik metodlar kullanılmıştır. Her bir örnek bilgisayar ve yazılım kullanılarak özel bir takson olarak atanmıştır.

Öncelikle, örnekler, Türkiye Florasında verilen tür anahtarları kullanılarak teşhis edilmiştir. Türkiye Florasına göre örneklerin tespit edilmesi için iki yol vardır. Bu yollardan biri stamen özelliklerine, diğeri ise yaprak ve çiçek özelliklerine dayalıdır. Nomenklatürel nedenler ile örnekler, Türkiye 'den bilinen ve bazı uluslararası herbaryumlardaki mevcut tip örnekleri ile kıyaslanmıştır.

Bu tez iki bölümden oluşmaktadır. Birinci bölüm giriş, materyal ve yöntemler ile temel bulguları içerir. Temel bulgular morfolojik, anatomik, palinolojik ve ekolojik araştırmaların sonucudur. Tezin ikinci bölümünde İç Anadolu'daki *Salvia* cinsinin revizyonu verilmektedir. Bu da numerik taksonomi ve cinsiçi gruplamanın sonuçlarını içermektedir.

Toprak tipleri ve habitat özellikleride incelenmiştir. Toprak örnekleri çeşitli lokalitelerden alınmış ve bunların içeriği analiz edilmiştir. Popülasyonlar her bir taksonun sürdürülebilirlik ve duyarlılığını belirlemek için tekrar ziyaret edilmiştir. Habitat bilgilerine ve tür limitlerine dayalı olarak IUCN tehlike kategorileri belirlenmiştir. Fenolojik veriler ve bilimsel arazi gözlemlerinin tümü kaydedilmiştir.

İç Anadolu'da 43 *Salvia* türü belirlenmiştir. Bu bölgeden toplanan örneklerin arasında bir takson 116 yıl sonra yeniden toplanmıştır.

Anahtar Kelimeler: Labiatae, *Salvia*, Revizyon, Türkiye.

To my wife Dawn and my three sons: Daniel, Michael and Andrew.

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## ABBREVIATIONS

- ANK : Ankara Üniversitesi Fen Fakültesi Herbariumu  
c. : Approximately  
CR : Critically endangered  
Da. : Dağı-mountain  
E : Edinburgh Herbariumu (Edinburgh, Scotland)  
EGE : Ege Üniversitesi Fen Fakültesi Herbariumu  
EN : Endangered  
Fig. : Figure  
G : Genève Herbariumu  
GAZI : Gazi Üniversitesi Fen Fakültesi Herbariumu  
Holo. : Holotype  
HUB : Hacettepe Üniversitesi Fen Fakültesi Herbariumu  
Ic. : İkona (Figure)  
ISTE : İstanbul Üniversitesi Eczacılık Fakültesi Herbariumu  
ISTF : İstanbul Üniversitesi Fen Fakültesi Herbariumu  
IUCN : International Union for Conservation of Nature  
K : Kew Herbariumu (London, England)  
KNYA : Selçuk Üniversitesi Fen Fakültesi Herbariumu  
LC : Least Concern  
NT : Near Threatened  
Subsp. : Subspecies  
Syn. : Synonym  
UPGMA: Un-weighted Pair Group Method with Arithmetic mean  
VAN : Yüzüncüyl Üniversitesi Fen Fakültesi Herbariumu  
var. : Variety  
VU : Vulnerable

# CHAPTER 1

## INTRODUCTION

### 1.1 Historical background

CIVILIZATION rose to two great heights in Southwest Asia, namely in the Bronze Age and in the later Classical period. In the latter medicine advanced considerably and culminated in the work of Hippocrates. Knowledge of medicine in the Greek Bronze age depended on the study of Homer until this century, when work in the fields of archaeology and philology provided more facts. This work has shown that this early Greek medicine had much in common with that of its contemporary Near Eastern civilizations. During this period medicine was taken to a much higher level than that practiced in Egypt. Discovery of tablets from this period indicate a long list of plants. The plants were named in palace records and were described by dry volume and weight. The following plant names have been identified on the tablets: celery, coriander, cumin, cyperus grass, fennel, figs, garden grass, ginger grass, iris root, linseed, mint, pennyroyal, rose, safflower, sage and sesame. The mention of sage in this list emphasizes the importance of it as far as 1500 B.C. (Warren, 1970).

The genus *Salvia* (sage) has been an important medicinal plant since earliest times. This is an herb that has the reputation as one which wards off evil. It was thought to be efficacious against the biting of serpents and the dispelling of evil spirits [Ceres, 1984]. It was employed in ancient Egypt to increase the fertility of women [Schauenberg and



Paris, 1990]. Theophrastus records two taxa of *Salvia*, one a spineless wild under shrub whose name he gives as Joakos (sphakos), the other resembling it, but cultivated, called (elelispakos) [Theophrastus]. Pliny says that elelispakos called *Salvia* by the Romans, is a mint-like, hoary and aromatic plant. It was cultivated more than sphakos of Theophrastus, and was used as a diuretic, for promoting menstruation, as a local anesthetic (numbing the surface of the skin where it is applied), and when taken in drink with wormwood, a treatment for dysentery [Pliny]. Monastery gardens in the time of the Carolingian empire of the early Middle Ages were cultivating the plant. Walahfrid Strabao, in his Hortulus, describes it as having a sweet scent and being of proved value in many human ailments. He goes back to the Greek root for the name he gives it, Lelifagus [Strabao]. There can be little doubt that, from the time of Theophrastus and Pliny on, the *salvia* cultivated under these different names is *Salvia officinalis* (Dweck, 2000).

More recent scientists site *Salvia* species as being used in medicines all around the world, possessing antibacterial, antioxidant, antidiabetic and antitumor properties (Senol et al., 2010; Ulubelen, 2003). In addition, many *Salvia* species are used as herbal tea and food flavoring, as well as in cosmetics, perfumery and the pharmaceutical industry (Demirci *et al.*, 2003). They are also grown in parks and gardens as ornamental plants (Nakipoğlu, 1993).

Anatolia is a major center for the genus in Asia. Some species are native to the Mediterranean region while also cultivated all over the world. Dried leaves and flowers are used as a culinary spice for flavoring and seasoning and tea. In Western countries, essential oils from some species are used for the treatment of various diseases. The name *Salvia* came from the Latin word meaning “to save” or “to heal.” A few centuries ago, it was nearly always at the top of the list of household remedies for the relief of itching, the lowering of fevers, and the relief of nervous headaches. Extracts and essential oil have been used to treat digestive disorders and to control excessive sweating (Duke, 1985). Additionally some extract are reported to be strong antioxidant (Chang et al.,

1977). The chemical components of *Salvia* species are very complex. Flavonoids from *Salvia* are useful for taxonomy (Nakipoğlu, 2002).

Turkey is an exporter of *Salvia* (*Salvia fruticosa*) leaves. *Salvia* is collected from the wild in western Turkey, dried and exported. There is also a sizeable internal market for *Salvia* leaves, since they are used as herbal tea in western and southern provinces of Turkey. *Salvia* leaf exports of Turkey (kg/US\$/unit value in dollars) are as follows:

**Table 1.1.** *Salvia* leaf export (Baser, 2000). kg/US\$/unit value in dollars.

1991	1992	1993	1994	1995	1996
508.646	563.863	576.257	400.220	547.821	681.044
1,096.145	1,118.746	1.367.658	837.511	1,121.261	1,476.674
2.160	1.980	2.370	2.090	2.050	2.170

In Turkey, *Salvia* oil is produced from *S. fruticosa* (wild) in Manisa and Alanya by steam distillation using commercial stills. The oil also known as elma yagi (apple oil) is obtained using cottage-type stills in South-Aegean parts of Turkey. In some districts, the plant is locally known as “elma” (apple) due to the resemblance of galls growing on its leaves and stems to small apples. *Salvia* oil is locally used medicinally as herbal oil. Annual production is an estimated 500 kg (Baser, 1994).

## 1.2 Literature review

Lamiaceae or Labiatae, also known as the mint family, is a family of plants comprising about 210 genera and some 3,500 species. The plants are frequently aromatic in all parts and include many widely used culinary herbs, such as basil, mint, rosemary, *Salvia*, savory, marjoram, oregano, thyme, lavender, and perilla. Some are shrubs, but rarely trees or vines. The original family name is Labiatae, so given because the flowers typically have petals fused into an upper lip and a lower lip. Although this is still considered an acceptable alternate name, most botanists now use the name "Lamiaceae" in referring to this family.

Briquet's (1895-1897) classification of Labiatae, currently the most widely used system for the family, was heavily influenced by and has largely displaced Bentham's (1876) classification, with which it differs mainly in ranking and interrelationship of suprageneric groups rather than the content of those groups (Table 1.2). Briquet's most significant alteration of Bentham's system was the merging of four tribes Lamieae, Nepeteae, Salviae and Mentheae in one subfamily Lamioideae which should not have been made. Briquet's transfer of *Rosmarinus* from Bentham's Salviae to his own Ajugoideae was a mistake; *Rosmarinus* has hexacolpate pollen and was thus better placed in Salviae. Bentham's classification is highly congruent with Erdtman's subfamilial system. By and large, Bentham's tribe Ajugeae, Prostantheroideae, Prasieae, and Lamieae correspond to Erdtman's Subfam. Lamioideae, while Bentham's other four tribes correspond to subfam. Nepetoideae. The most recent and the best classification (Erdtman, 1945) includes subfamily Nepetoideae which comprises the taxa of *Salvia* (Cantino, 1986).

**Table 1.2.** Comparison of classification of Bentham (1876), Briquet (1895-1897), and Erdtman (1945).

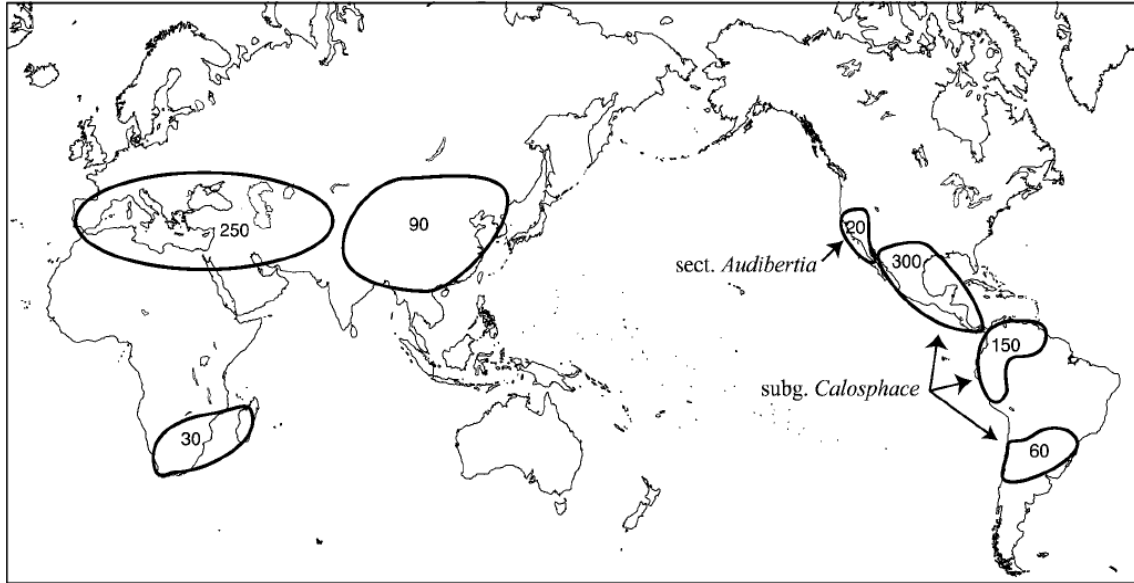
Bentham	Briquet	Erdtman
Tribe Ajugeae	Subfam. Ajugoideae(including Rosmarinus)	Subfam. Lamioideae
Tribe prostantheroideae	Subfam. prostantheroideae	
Tribe prasieae	Subfam. Prasioideae	
Tribe Lamieae	Subfam. Lamioideae	Subfam. Nepetoideae
Tribe Nepeteae		
Tribe Salviae(including Rosmarinus)		
Tribe Mentheae		
Tribe Ocimeae	Subfam. Ocimoideae (including Subfam. Lavanduloideae and Subfam. Catopherioideae)	

*Salvia* L. belongs to the subfamily Nepetoideae within the Labiatae, a monophyletic group well supported by both molecular and morphological data (Claben-Bockhoff *et al.* 2004). *Salvia* is a fascinating plant genus. One of the widest-spread members of the Labiatae family. The genus *Salvia* represents an enormous and cosmopolitan assemblage

of nearly 1000 species displaying a remarkable range of variation. *Salvia* has undergone marked species radiations in three regions of the world: Central and South America (500 spp.), Central Asia/Mediterranean (250 spp.), and eastern Asia (90 spp.) Bentham's (1848) study of *Salvia* separated the genus into 12 sections and remains the most widely accepted treatment of *Salvia* (Walker, 2004).

According to the most recent edition of the Turkish Flora there are 86 *Salvia* species in Turkey (Hedge 1982a) and later the number of species was raised to 89 (Davis et al., 1988; Guner, 2000; Vural & Adiguzel, 1996; Dönmez, 2001). About 50% of the species residents of Central Anatolia and of these 26 are endemic to this area. The distribution in neighboring countries or "Flora areas" is as follows: 75 species in the former USSR (Pobedimova, 1954), 70 in the *Flora Iranica* (Hedge, 1982b), 36 in Europe (Hedge, 1972).

It is assumed that *Salvia* originated in the Old World, from an ancient Mediterranean ancestral species. Member species might have migrated during the Miocene and Pliocene via tropical mountains to South America and South Africa. Fossils from Mexico and Alaska date from the Lower and Upper Miocene and thus indicate an age of at least 25 million years (Claben-Bockhoff et. al., 2004). There are seven important distribution areas for the genus in the world (Map 1.1). Anatolia is a major centre for *Salvia* in Asia.



**Map 1.1.** *Salvia* distribution worldwide.

Taxonomy of *Salvia* at the present time has many inconsistencies. It is becoming increasingly difficult to recognize above species groups from each other (according to the most recent edition of the flora of Turkey, Hedge, 1982a). Because of the interest in the medicinal activity of this genus to date the majority of the research is directed toward this area (Ulubelen A., 2003). Therefore, what gives importance to *Salvia* has distracted many from directing research into the most important aspect of any plant and that is its proper taxonomy. Additionally there are inconsistencies in literature about the total number of species and their rate of endemism. At the present time there are no sectional divisions prepared for *Salvia* in Turkey.

Therefore, we prepare a more detailed taxonomic study based both on morphology and micro-morphology. The aim of this project is to produce a complete revision of the genus *Salvia* in Central Anatolia, Turkey.

Boissier (1875), in his *Flora Orientalis*, recognized 107 species of *Salvia*; some of which were either described or recorded from Turkey. He placed these species under seven sections, which had been all recognized previously by Bentham (1833). These sections are as follows: *Eusphace*, *Hymenosphace*, *Drymosphace*, *Aethiopsis*, *Plethiosphace*, *Horminum* and *Hemisphace*. Section *Eusphace* was later designated as

the type section of the genus *Salvia* (Hedge, 1972; Reales *et al.*, 2004). Section *Drymosphace* Benth is absent in the Central Anatolia.

The first revision of *Salvia* L. in Turkey was made by Hedge (1982a) in *Flora of Turkey and the East Aegean Islands* vol. 7. Additional to the same were supplements 10 (Davis *et al.*, 1988) and 11 (Guner *et al.*, 2000) in which 88 species in total were recognized. Since the publication of the flora and the supplements, 5 more new taxa, *S. hedgeana* (Dönmez, 2001) and *S. anatolica* (Hamzaoglu & Duran, 2005), *S. marashica* (İlçim *et al.*, 2009), *S. ekimiana* (Celep & Doğan, 2009) and *S. sericeotomentosa* (Celep *et al.*, 2009), and 3 new records, namely *S. macrosiphon* Boiss. (Kahraman *et al.*, 2009) and *S. aristata* Aucher ex Benth. (Behçet & Avlamaz, 2009) and *Salvia viscosa* Jacq. (Celep *et al.*, 2009) have been recorded. The total at present is 95 species.

### **1.3 The study area**

There are three major phytogeographical regions in Turkey: Euro-Siberian, Mediterranean and Irano-Turanian. Central Anatolia, part of the Irano-Turanian phytogeographical region is the most isolated section of Turkey. It contains over 50% of the endemic taxa of *Salvia* in Turkey. This region stretches inland from the Aegean; it occupies the area between the two zones of folded mountains: the Sultan and the Sundukan mountains on the west-northwest and the Taurus Mountains on the south. It extends east to the point where the two mountain ranges converge. The Central Anatolian region occupies 19% of the total area of Turkey with its 151.000 square kilometers of land; it's the second largest region of Turkey after Eastern Anatolia.

The plateau-like, arid highlands of Anatolia are considered the heartland of the country. The region varies in altitude from 300 to 3,900 meters west to east, predominately about 900 meters in elevation. The two largest vegetational areas are the peripheral areas of deciduous scrubs which represents the originally forested areas and the treeless basin occupied by Tuz Gölü (Salt Lake). This unique region of the Central Anatolian basin is

composed of salt steppe, saline lakes and halophytic vegetation as well as marshes, rivers and freshwater bodies (Davis, 1965).

This study was conducted in Central Anatolia, Turkey where the most abundant gypsum areas are present. Gypsum areas occupy 0.5% of Turkey. The largest fraction of gypsum is present within the Sivas province. The rate of endemism in the Sivas area is high due to the presence of gypsum habitats. The chief advantage of gypsum for *Salvia* is perhaps reduced moisture stress during the early summer drought. This is due either to reduced competition for water because of low densities or to intrinsic properties of the gypsum soil (Akpulat, 2005). Habitat and soil development are also dependent on temperature and precipitation, both of which require long-term study (Doğan, 2003). Such studies have been done by many authors (Akman and Ketenoğlu, 1976; Cetik, 1985; Ketenoğlu et al., 1983, 1996, 2000). The northern part of the Central Anatolia area is well studied by Doğan(2003) and he finds the northern part as receiving lower amount of precipitation than the southern area, but since the area has colder climate it has lower annual actual evaporation. The most critical period suggested by Doğan (2003) for the studied area was during the month of May and September. During this period evaporation exceeds precipitation resulting in critical water deficiencies.

For ecological studies, soil samples were taken from suitable habitats of *Salvia*. All soil samples were analyzed at the Soil, Fertilizer and Water Resources Central Research Institute, Ankara. Soil texture, organic matter, total salt, pH, CaCO<sub>3</sub>, P and K analysis were made using standard techniques (Bayraklı, 1987) and the results have been evaluated according to Kaçar (1972).

## 1.4 Objectives and Scope of the study

The objectives of this study were to:

- a) To collect all of *Salvia* taxa growing in Central Anatolia so as to prepare a taxonomic revision of it.
- b) To classify the *Salvia* species by means of using numeric taxonomic methods.
- c) To study ecological preferences of the taxa.
- d) To determine the conservation status of *Salvia* taxa on the basis of IUCN threat categories.
- e) To understand morphological, palynological, phytogeographical and anatomical diagnostic characteristic of the taxa.
- f) To determine significance of the micro-morphological properties of pollens.
- g) To prepare a revision of *Salvia* found in Central Anatolia.



## CHAPTER 2

### MATERIALS AND METHODS

#### 2.1 Sampling Methodology

The Central Anatolia area was divided into grids according to Davis's grid system. The Flora location information was entered into excel file and each grid was identified for its existing species richness. In general, limestone and igneous slopes and or quercus and calcareous rocky areas are preferred by taxa of *Salvia*. Therefore, it was decided to concentrate sampling to these areas and repeat sampling at different times of year. Flowering times of the flora was also incorporated into the sampling plan. Sampling time was began in March and ended in August. During the field trips samples were carefully labeled and numbered. The location information and field identifications were recorded in the field notebook. This included GPS information for each sampling site. Digital photographs were taken to be used later in identifying the specimens. The samples were pressed, dried, brought to the lab, and kept in a safe area (Davis & Heywood, 1973). They were identified using the species key given in the Flora (Hedge, 1982a). According to the Flora there were two ways to identify samples. One was based on stamen features and the other was based mostly on leaves and flowers. They were cross-checked with the *Salvia* accounts of various relevant floras, such as *Flora Orientalis* (Boissier, 1879), *Flora Iranica* (Hedge, 1982b), *Flora of the USSR* (Pobedimova, 1954) and *Flora Europaea* (Hedge, 1972). The samples were also compared with the samples in existing herbaria; Ankara (ANK), Gazi (GAZI) and

Istanbul (ISTE). International collections deposited at the University of California at Riverside, CA, United States and Edinburgh (E) were also consulted.

## **2.2 Morphological and Anatomical Methods**

The samples were studied using their stem and leaf morphology including essential characteristics of their flowers and reproductive organs. The cross sectional preparations of stem and leaf were observed for taxonomical evaluation (Metcalf & Chalk, 1950). The *Salvia* taxa leaf surfaces, flower organs and seed surfaces were studied for their micro morphological characteristics. Using statistical analysis, histograms were prepared and the position of each taxa was determined (Doğan, 1982). Cross sectional specimens were also studied under electron microscope. The *Salvia* species were further investigated for their pollen characteristics such as surface and diameter. Finally numeric taxonomic methods were used for constructing a natural infrageneric grouping in the genus. This includes character selection followed by measurements. Using software and computer grouping each sample was ranked and placed into specific groups (Sneath & Sokal, 1973).

Anatomical studies were carried out on the specimens kept in 70% alcohol. The paraffin method was used for the cross sections of the leaves and stems. The specimens were embedded in paraffin and then sectioned (10-15 um thickness) with a Leica RM2125RT rotary microtome. All sections were stained with safranin-fast green and mounted with entellan. Measurements and photos were taken using a Leica DM1000 binocular light microscope with a Leica DFC280 camera.

Nutlets were first examined using a Leica S8AP0 stereomicroscope to ensure that they were of normal size and maturity. In order to determine the average seed sizes, mature nutlets were measured. For SEM, the mature nutlets were placed on stubs directly and covered with gold. After that, they were observed and photographed with a JEOL JSM-6400 scanning electron microscope (Dogan 1988).

### 2.3 Palynological Methods

Pollen materials were obtained from plant specimens collected in the field during the flowering time in the years 2005, 2006, 2007, 2008. Pollen grains for examination by LM were prepared according to the Wodehouse (1935) method. Pollen grains were dissected from herbarium specimens and placed on a clean microscope slide. Two to three drops of 96% ethanol were added to melt the resin and oil. Glycerin-jelly with basic fuchsin was placed on pollen grains and allowed to melt. The pollen grains and jelly were mixed by a clean pin to get scattered pollen grains. The pollen grains were photographed from a permanent slide with an Olympus BX51 camera. All measurements were determined on thirty pollen grains. The terminology of the exine sculpturing and structure follows mainly that of Henderson et al. (1968), Faegri–Iversen (1984) and Punt et al. (2007).

Pollen slides for morphologic examination by light microscopy were prepared (Wodehouse, 1935) and the measurements were made with a Leica DM1000 microscope. The measurements corresponding to the polar length (P) and equatorial length (E) of pollen grains were taken, and P/E ratios were calculated. Colpus length, exine thickness and intine thickness were measured. For studying pollen ornamentation, dry pollen grains were first mounted on double-sided carbon tape affixed to aluminum stubs. Grains were coated with gold using a Bio-Rad Polaron Division coating system and observations were made using a Jeol JSM-6490LV Scanning Electron Microscope (SEM) at the Turkish Petroleum Corporation (TPAO). SEM images were used to describe surface texture of the pollen, the calyx, inflorescence indumentum and nutlet. The descriptive terminology of Faegri and Iversen (1975) was followed.

For SEM studies, pollen grains were transferred directly to a stub with double-sided tape and micrographs were obtained using Jeol-6060 SEM (at Gazi University) and Jeol JSM-6400 SEM (at Middle East Technical University), at an accelerating voltage of 20 KV. The measurements on the base of SEM photomicrographs were recorded.

## **2.4 Methods used for Numeric Taxonomy**

There were at least five steps in phenetic classification that results in numeric taxonomy (Stuessy, 1990). The first step was the selection of operational taxonomic units (OTU), followed by the selection of characters. Measurements and /or description of character states were made on the herbarium specimens. The data obtained from the herbarium materials were averaged and tabulated. The data matrix resulting from the morphometric study, composed by 41 rows (species) and 53 columns (characters) (Table 4.2), was constructed prior to multivariate analyses. Multiple correspondence analyses were used to obtain a single phenogram, applying UPGMA (the unweighted pair-group method using arithmetic averages) algorithm and the Gower General Similarity Coefficient.

A similarity matrix was created first, using the Gower General Similarity Coefficient which can handle binary, multistate, and quantitative data equally well (Sneath and Sokal, 1973). These similarity values were then clustered by UPGMA and the results are shown in the phenogram. UPGMA is the most frequently used clustering method (Rosemburg, 1984) and also appears to produce the best results (Radford, 1986). For these analyses, the MVSP (a multivariate statistics package for PC and compatibles) program package for clustering analysis was applied.

## CHAPTER 3

### BASIC FINDINGS

#### 3.1 Morphological information

Leaf, calyx and corolla observation and measurement results were recorded (Table 4.2) and used in numeric taxonomy evaluation. Leaves are opposite in all taxa of *Salvia* and vary in shape and size from one part of a plant to another. Because of this variation the most mature and most common forms are used as a general description tool. Due to wide variation in leaf shape, there has been a great deal of taxonomic confusion over the years. The variation in leaf depends on geographical area. Plants growing on the south and western part of Turkey usually have smaller leaves while plants growing on the north and eastern side of Turkey have much bigger leaves. Leaf variations are many, from narrowly oblong leaves of *S. Russellii* and *S. hypargeia* to almost rounded leaves of *S. Candidissima* and *S. cyanescens*. Many taxa of *Salvia* have pinnate leaves. Pinnate leaf taxa are generally endemic to Turkey. Some examples are *S. hedgeana*, *S. wiedemannii*, *S. freyniana*, *S. tchihatcheffii*, *S. heldreichiana* and *S. caespitosa*. Leaf margins are also an important taxonomic characteristic, varying from smooth leaves of *cryptantha* to sharply toothed leaves of *S. virgata*. *S. halophila* has the fleshiest leaf of all *Salvia* taxa. *S. ceratophylla* and *S. longipedicellata* poses the largest leaves.

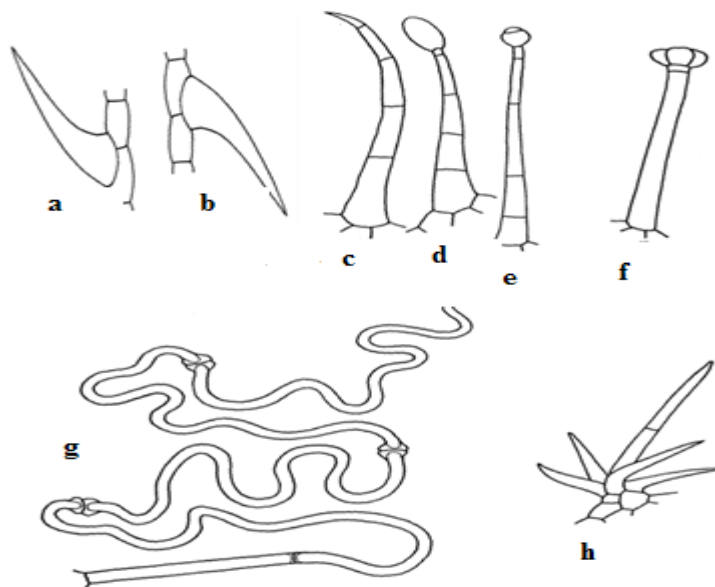
The calyx shape varies considerably from species to species within *Salvia*: tubular, campanulate and infundibular or a combination of these shapes. In Central Anatolia most calyxes are campanulate like: *S. hedgeana*, *S. freyniana*, *S. euphratica*, *S. suffruticosa* and *S. cadmica*. Calyxes are either membranous or none. There are only six taxa of *Salvia* with membranous calyx in Central Anatolia. They include: *S. cadmica*, *S. blepharochlaena*, *S. euphratica*, *S. anatolica*, *S. multicaulis* and *S. cryptantha*.

The calyx is made of two lips (bi-lobate) in *Salvia*. Usually the upper lip is three toothed (tri-dentate) and the lower lip two toothed (bi-dentate). Seldom the upper lips of the calyx are truncate, *S. viridis* and *S. hypargeia*. The upper lip is usually higher than the lower lip. Calyx upper lips of *S. cryptantha* and *S. cadmica* are flat. Calyx variations in *Salvia* are not just due to lips. Other varying points are indumentum and the length of the aristae. Aristae are mostly acuminate (*S. bracteata*, *S. verbenaca* and *S. viridis*), sometimes acute (*S. tomentosa*, *S. aytachii* and *S. divaricata*) and rarely spinosa (*S. yosgadensis*). There are four taxa of *Salvia* with no aristae (*S. cryptantha*, *S. multicaulis*, *S. cadmica* and *S. blepharochlaena*). Additionally there are color variations from green, blue, and purple. Comparison of the calyx to the size of the bract is also significant in taxonomic differentiation.

Like the calyx, the corolla also is bi-lobates and comes in many shapes and colors. The corolla in *Salvia* is composed of five fused petals, two upper lip and three lower lip. The corolla shape and features are very difficult to see in the dried herbarium specimens. Therefore we noted the size and shape of corolla in fresh materials in the field. In some cases the fresh corollas were photographed to record the exact color of the flowers. The corolla shape is mostly described by the upper lip whether it is straight (most taxa of *Salvia*), or falcate like: *S. eriophora*, *S. aethiopsis* and *S. modesta*. The tube of corolla is characterised by being squamulate or non-squamulate and the presence or absence of short hairs within the tube as being annulate or non-annulate. Corolla of *Salvia* taxa in Central Anatolia are mostly lilac violet to blue, however pink to white, yellow to yellowish white and cream colored are also noticed. Finally the size of the corolla is a major distinguishing factor in classification. Section *Hymenosphace* all have large corollas.

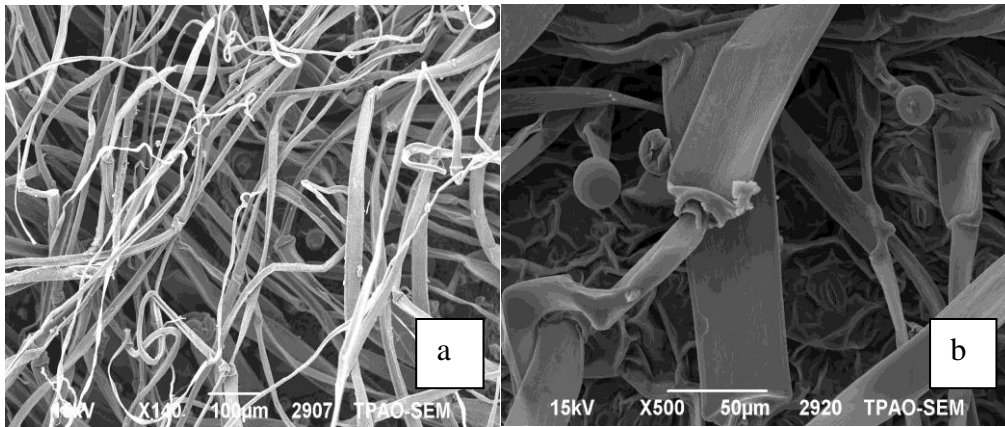
### 3.1.1 Indumentum types

*Salvia* has a variety of indumentum from a density and texture viewpoint (El-Gazzar, 1970). The hair on the surface contributes to the gray color of the *Salvia*. Generally *Salvia* indumentum is divided into two types, glandular (Figure 3.1d,e,f) and eglandular (Figure 3.1a,b,c). Glandular trichomes which can be seen with the naked eye are sticky and yellowish orange in color. The indumentum head is normally multicellular (2-10 celled), however a survey of 127 genera of the Labiatae Cantino (1990) found *Salvia* to have mostly four cells. Other authors have reported up to 12 celled indumentum heads (Kahraman et al., 2010). Species may be glabrous, sparingly hirsute to densely pilose, or tomentos. In some cases there are varieties of hair types within a species. The eglandular hairs on the stem are often in antrorse (Figure 3.1a) or retrorse (Figure 3.1b) formation. The dendroid hairs look like stars and cover the surface of some *Salvia* like *S. cryptantha*. The pilose hairs sometimes are formed from many cells or multicellular (Figure 3.1c,d,e) and sometimes from a single cell or unicellular (Figure 3.1f).



**Figure 3.1.** Indumentum types.

The long villous (Figures 3.1g and 3.2a) hair covers the entire leaf or calyx surface of some *Salvia* species however within the same species pilose glandular hairs (Figure 3.2b) can be found.



**Figure 3.2.** SEM of Indumentum types: Villous (a), and glandular pilose (b).

### 3.1.2 Inflorescence

The inflorescence varies considerably among *Salvia* species. There are two main types recognized based on branching. However at least three forms of branching were noticed. In Central Anatolia there are 17 racemose (unbranched). Examples of racemose are *S. cadmica*, *S. tchihatcheffii*, *S. cryptantha*, and *S. vermifolia*.

The paniculate (branched) taxa of *Salvia* are mostly candilebriform like *S. aethiopsis*, *S. ekimiana* and *S. syriaca*. While the *S. divaricata*, *S. recognita* and *S. nemorosa* are paniculate-cymose.

- Racemose (unbranched); with the flowers arranged densely: *S. tchihatcheffii* (Figure 3.3a )
- Paniculate (branched); forming cymose or candilebriform: *S. recognita* (Figure 3.3b )



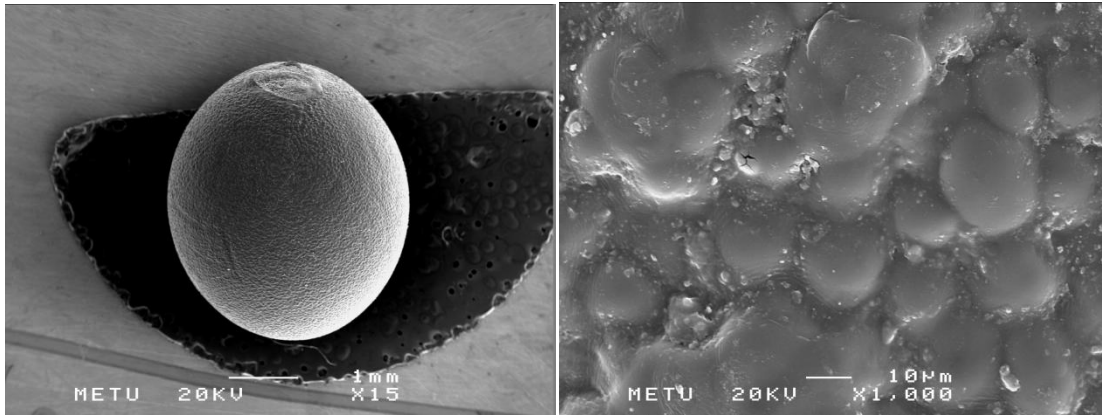


**Figure 3.3.** The racemose inflorescence of *S. tchihatcheffii* (a) and the paniculate inflorescence of *S. recognita* (b).

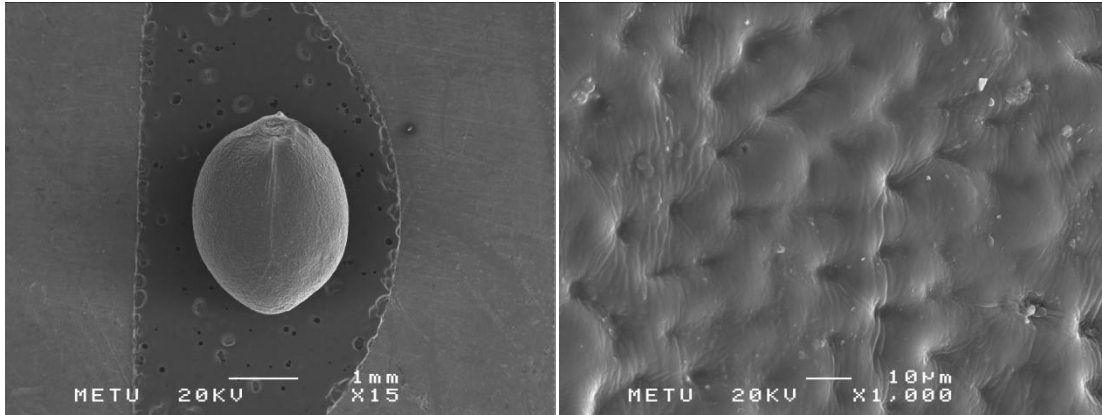
### 3.1.3 Fruit and seed

Nutlet morphology is used in taxa description (Hedge, 1970; Oran, 1996; Kahraman and Doğan, 2009). While the surface sculpturing in *Salvia* species varies as recorded by Oran (1996), there are some common features among them. The fruit of schizocarp divides into four nutlets. The nutlets are ellipsoidal and rounded to somewhat acute at the apex. The seeds are ellipsoidal and flattened longitudinally. At maturity, the seeds contain little or no endosperm. The embryo is straight.

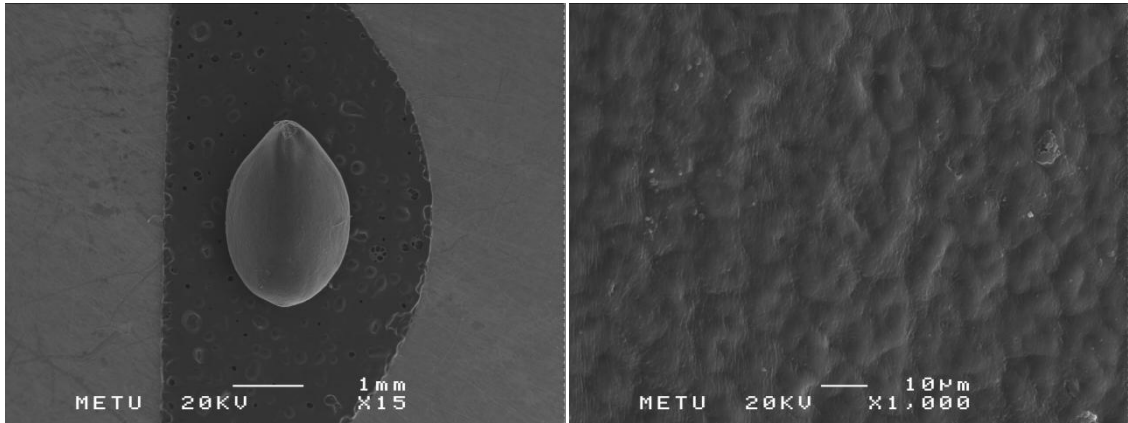
SEM and light microscope were employed to observe the seed surface and other morphological characteristics. The nutlet shape, size and surface sculpturing are the most significant diagnostic characteristics. These observations and measurements are recorded in the infrageneric description of the each *Salvia*. The largest seeds belong to the sect. *Hymenosphace* and sect. *Salvia*. The smallest seeds are in sect. *Hemisphace* and sect. *Plethiosphace*. Seed shapes vary from oblong, ovate, spherical, trigonous, suborbicular and ovoid. Observation under 1000x amplification revealed that most *Salvia* seeds are glabrous, however some seeds show, the presence of small hairs. The surface varies from smooth to roughly waved. Below there are SEM photographs of the seeds from the six sections present in the Central Anatolian region: (Figure 3.4 - 3.9).



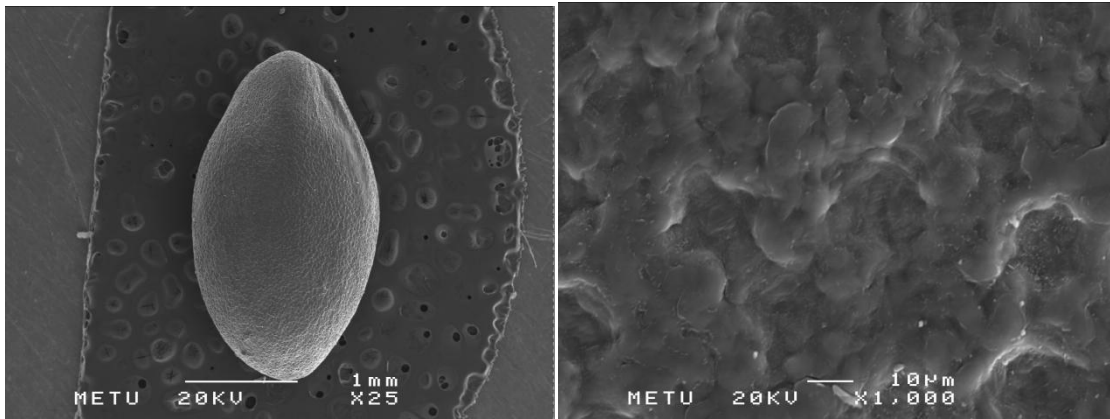
**Figure 3.4.** Nutlet shape and surface sculpturing of *S. euphratica* var. *leiocalycina* (Sect. *Hymenosphace*). Nutlets suboblate to rounded trigonous, 4.3-5.4 x 3.5-4.5 mm.



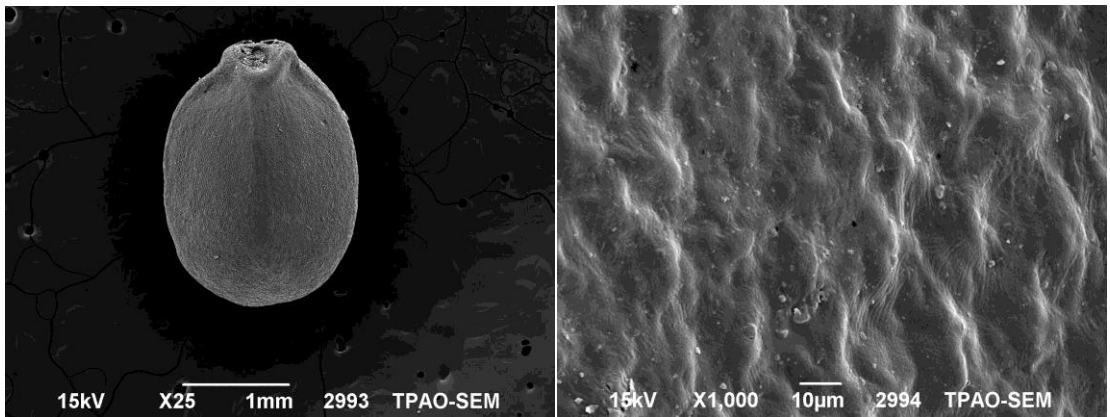
**Figure 3.5.** Nutlet shape and surface sculpturing of *S. freyniana* (Sect. *Salvia*) Nutlets rounded- trigonous and suboblate, 3.1 – 4 x 2.5 - 3 mm, surface slightly tuberculate.



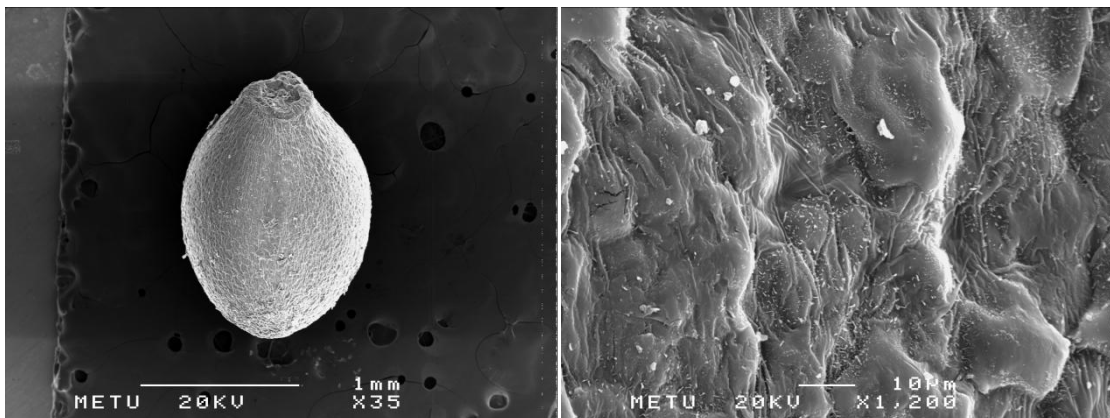
**Figure 3.6.** Nutlet shape and surface sculpturing of *S. aethiopsis* (Sect. *Aethiopsis*) Nutlets rounded trigonous, ovate 3 x 2 mm.



**Figure 3.7.** Nutlet shape and surface sculpturing of *S. viridis* (Sect. *Horminum*) Nutlets oblong-elliptic, 3 x 1.5 mm.



**Figure 3.8.** Nutlet shape and surface sculpturing of *S. verticillata* (Sect. *Hemisphace*) Nutlets c. 2.2 x 1.3 mm.

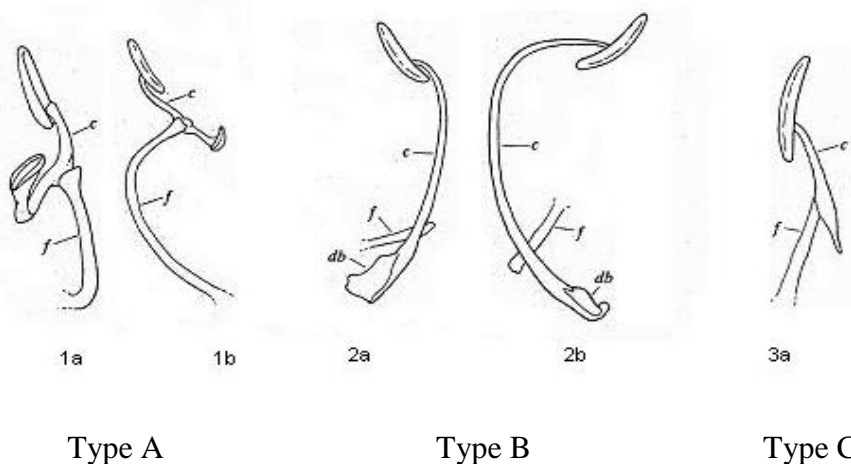


**Figure 3.9.** Nutlet shape and surface sculpturing of *S. nemorosa* (Sect. *Plethiosphace*) Nutlets rounded trigonous, ± ovoid, c. 2 x 1.5 mm.

### 3.1.4 Stamens types

The stamen morphology has figured prominently in infrageneric taxonomy of *Salvia* for a long time (Bentham, 1848; Zalewska, 1928). There are two stamens in *Salvia* and are oriented along the dorsal side of the upper lip of the corolla. The stamens are always epipetalous. The relative length of staminal filaments and corolla tube vary from species to species; thus the filaments may be longer than the tube with the anthers clearly exerted or shorter with the anthers completely hidden within the tube.

There are 3 major types of stamens according to Flora of Turkey (Davis, 1965). Others have reported four (El-Gazzar et al., 1968) and as much as five (Walker, 2004) stamen types in *Salvia*. The three types are indicated in the Figure 3.10. While type A stamens have both their upper and lower theca, the lower theca is sterile. Both type B and C only have the upper theca and the lower theca is absent in type C and reduced in type B. The designations a and b in each stamen type indicates the variations within each type. Of the six sections of *Salvia* found in Central Anatolia, two are type A (Sect. *Salvia*, and Sect. *Hymenosphace*); three are type B (Sect. *Aethiopsis*, Sect. *Plethiosphace*, and Sect. *Horminum*); and one is type C (Sect. *Hemisphace*).



**Figure 3.10.** *Salvia* species stamen types (Hedge, 1982A) f filament, c connective, db dolabriform sterile tissue.

### 3.1.5 Palynology

The basic shapes of the pollen grains are oblate, spheroidal to prolate (P/E: 0.85-1.09). The outline in polar view is more or less circular while that in equatorial view is circular-ovoid. Pollen grains of the *Salvia* taxa are often hexacolpate: with six equidistant furrows in the exine, radially symmetrical and isopolar. In polar view, two mezocolpia are larger than the other four. Hexacolpate pollen grains have been reported previously in *Salvia* (Trudel & Morton, 1992; Afzal-Rafii, 1983; Henderson et al., 1968)). Colpi are distributed symmetrically and their ends are acute. Colp length (Clg) ranges from 23.95 to 47.33  $\mu\text{m}$  and its membranes are finely or coarsely granular. Mezocolpial area or colpus width (Clt) varies between 3.39 and 8.51  $\mu\text{m}$  (Table 3.1).

**Table 3.1.** Pollen analysis data. Summary of pollen morphological data for the taxa examined (mean value  $\pm$  standard deviation in  $\mu\text{m}$ ). \* indicates endemic to Turkey.

Taxa	Polar axis (P)	Equatorial axis (E)	Colpus Length (Clg)	Colpus width (Clw)	Exine thickness	Intine thickness	Apocolpium (t)
<i>S. divaricata</i> *	50.87 $\pm$ 7.08	46.76 $\pm$ 5.30	44.55 $\pm$ 6.84	3.43 $\pm$ 0.93	1.12 $\pm$ 0.12	0.50 $\pm$ 0.03	8.67 $\pm$ 0.48
<i>S. tomentosa</i>	38.62 $\pm$ 3.29	44.73 $\pm$ 3.61	32.63 $\pm$ 3.80	4.72 $\pm$ 0.43	1.16 $\pm$ 0.14	0.72 $\pm$ 0.10	
<i>S. recognita</i> *	46.85 $\pm$ 4.14	50.22 $\pm$ 6.09	41.48 $\pm$ 4.18	5.37 $\pm$ 0.61	1.23 $\pm$ 0.20	0.65 $\pm$ 0.12	
<i>S. bracteata</i>	41.73 $\pm$ 1.72	47.77 $\pm$ 5.89	34.92 $\pm$ 2.20	5.81 $\pm$ 2.26	1.42 $\pm$ 0.19	0.65 $\pm$ 0.12	8.78 $\pm$ 0.82
<i>S. wiedemannii</i> *	43.81 $\pm$ 5.84	42.21 $\pm$ 3.76	37.29 $\pm$ 5.92	4.37 $\pm$ 0.72	1.19 $\pm$ 0.26	0.63 $\pm$ 0.13	
<i>S. freyniana</i> *	42.10 $\pm$ 8.87	39.17 $\pm$ 6.61	37.38 $\pm$ 7.59	4.28 $\pm$ 0.85	1.02 $\pm$ 0.09	0.62 $\pm$ 0.09	
<i>S. tchihatcheffii</i> *	41.56 $\pm$ 7.11	40.55 $\pm$ 6.89	36.57 $\pm$ 5.18	3.39 $\pm$ 0.76	1.21 $\pm$ 0.20	0.73 $\pm$ 0.17	
<i>S. heldreichiana</i> *	49,61 $\pm$ 1,83	52,39 $\pm$ 4,74	41,16 $\pm$ 1,74	4,08 $\pm$ 0,52	0,81 $\pm$ 0,08	0,68 $\pm$ 0,08	
<i>S. caespitosa</i> *	43.95 $\pm$ 3.92	49.85 $\pm$ 5.40	38.59 $\pm$ 3.35	5.27 $\pm$ 0.82	1.33 $\pm$ 0.15	0.83 $\pm$ 0.15	
<i>S. suffruticosa</i>	45.76 $\pm$ 4.78	44.01 $\pm$ 4.21	38.79 $\pm$ 5.21	4.56 $\pm$ 1.11	1.22 $\pm$ 0.19	0.79 $\pm$ 0.17	6.55 $\pm$ 1.91
<i>S. cadmica</i> *	49.36 $\pm$ 3.99	51.44 $\pm$ 3.82	44.14 $\pm$ 3.92	8.20 $\pm$ 0.64	1.34 $\pm$ 0.12	0.62 $\pm$ 0.01	
<i>S. blepharochlaena</i> *	55.71 $\pm$ 7.35	58.37 $\pm$ 3.88	47.33 $\pm$ 6.78	5.98 $\pm$ 2.32	1.37 $\pm$ 0.13	0.73 $\pm$ 0.10	9.84 $\pm$ 2.70
<i>S. euphratica</i> var. <i>euphratica</i> *	54.25 $\pm$ 8.68	49.59 $\pm$ 6.60	45.17 $\pm$ 8.89	3.70 $\pm$ 1.13	1.47 $\pm$ 0.22	0.68 $\pm$ 0.17	8.23 $\pm$ 1.98
<i>S. euphratica</i> var. <i>leiocalycina</i> *	42.73 $\pm$ 3.44	39.55 $\pm$ 6.84	34.95 $\pm$ 2.20	3.84 $\pm$ 1.82	1.61 $\pm$ 0.19	0.63 $\pm$ 0.10	6.32 $\pm$ 0.92
<i>S. multicaulis</i>	41.34 $\pm$ 7.81	39.53 $\pm$ 5.41	36.00 $\pm$ 6.90	4.58 $\pm$ 1.15	1.10 $\pm$ 0.15	0.68 $\pm$ 0.13	
<i>S. cryptantha</i> *	38.27 $\pm$ 3.38	45.09 $\pm$ 3.49	32.09 $\pm$ 4.22	8.06 $\pm$ 0.86	1.43 $\pm$ 0.16	0.68 $\pm$ 0.12	
<i>S. syriaca</i>	39.23 $\pm$ 6.48	44.88 $\pm$ 8.48	32.85 $\pm$ 5.63	7.06 $\pm$ 0.52	1.61 $\pm$ 0.20	0.51 $\pm$ 0.06	
<i>S. viridis</i>	39.34 $\pm$ 3.00	38.34 $\pm$ 5.73	33.82 $\pm$ 2.52	5.13 $\pm$ 0.85	1.14 $\pm$ 0.13	0.58 $\pm$ 0.07	
<i>S. hypargeia</i> *	51.50 $\pm$ 4.05	52.42 $\pm$ 4.47	43.64 $\pm$ 3.91	3.57 $\pm$ 0.96	1.16 $\pm$ 0.15	0.54 $\pm$ 0.06	11.58 $\pm$ 0.72
<i>S. eriophora</i> *	44.53 $\pm$ 5.17	48.78 $\pm$ 5.92	39.24 $\pm$ 5.33	4.87 $\pm$ 0.39	1.09 $\pm$ 0.09	0.46 $\pm$ 0.06	6.85 $\pm$ 0.82
<i>S. sclarea</i>	32,64 $\pm$ 1,22	34,58 $\pm$ 1,87	26,8 $\pm$ 1,84	5,37 $\pm$ 0,56	1,12 $\pm$ 0,17	0,67 $\pm$ 0,13	
<i>S. aethiopsis</i>	39.29 $\pm$ 1.42	44.10 $\pm$ 2.31	33.71 $\pm$ 1.00	7.21 $\pm$ 0.63	1.27 $\pm$ 0.15	0.65 $\pm$ 0.08	
<i>S. ceratophylla</i>	40.33 $\pm$ 3.17	45.77 $\pm$ 4.38	34.65 $\pm$ 3.35	4.00 $\pm$ 0.58	1.25 $\pm$ 0.14	0.76 $\pm$ 0.08	

**Table 3.1. (Continue):** Pollen analysis data. Summary of pollen morphological data for the taxa examined (mean value  $\pm$  standard deviation in  $\mu\text{m}$ ). \* indicates endemic to Turkey.

<i>S. longipedicellata</i> *	40.27 $\pm$ 4.26	44.08 $\pm$ 2.82	32.61 $\pm$ 4.84	4.53 $\pm$ 1.27	1.38 $\pm$ 0.10	0.73 $\pm$ 0.12	8.28 $\pm$ 1.06
<i>S. microstegia</i>	46,96 $\pm$ 1,34	52,49 $\pm$ 2,88	37,05 $\pm$ 1,76	4,56 $\pm$ 0,8	0,69 $\pm$ 0,07	0,63 $\pm$ 0,13	
<i>S. frigida</i>	37.86 $\pm$ 4.10	40.59 $\pm$ 3.65	33.10 $\pm$ 3.93	5.06 $\pm$ 0.50	1.15 $\pm$ 0.13	0.70 $\pm$ 0.11	
<i>S. yosgadensis</i> *	35.61 $\pm$ 1.71	39.13 $\pm$ 1.77	29.60 $\pm$ 1.38	5.57 $\pm$ 0.36	1.29 $\pm$ 0.07	0.70 $\pm$ 0.07	
<i>S. modesta</i> *	43,47 $\pm$ 2,24	47,81 $\pm$ 2,8	36,43 $\pm$ 2,76	5,42 $\pm$ 0,31	1,24 $\pm$ 0,33	1,06 $\pm$ 0,18	
<i>S. candidissima</i> ssp. <i>candidissima</i>	46.73 $\pm$ 1.49	46.81 $\pm$ 2.07	41.55 $\pm$ 1.52	7.57 $\pm$ 0.74	1.45 $\pm$ 0.24	0.72 $\pm$ 0.08	
<i>S. candidissima</i> ssp. <i>Occidentalis</i> *	54,56 $\pm$ 3,9	50,69 $\pm$ 4,12	43,58 $\pm$ 4,36	4,91 $\pm$ 0,75	1,04 $\pm$ 0,1	0,72 $\pm$ 0,12	
<i>S. cyanescens</i> *	49.45 $\pm$ 2.36	55.67 $\pm$ 3.39	42.18 $\pm$ 1.85	8.51 $\pm$ 0.54	1.80 $\pm$ 0.10	0.62 $\pm$ 0.11	
<i>S. vermifolia</i> *	33.57 $\pm$ 4.80	30.79 $\pm$ 3.20	29.01 $\pm$ 4.31	4.47 $\pm$ 0.65	1.21 $\pm$ 0.19	0.64 $\pm$ 0.14	
<i>S. virgata</i>	36.20 $\pm$ 1.51	42.30 $\pm$ 3.58	29.75 $\pm$ 1.08	3.71 $\pm$ 0.33	1.28 $\pm$ 0.31	0.62 $\pm$ 0.06	
<i>S. halophila</i> *	35.09 $\pm$ 3.04	40.44 $\pm$ 2.05	29.68 $\pm$ 1.98	3.68 $\pm$ 0.38	1.11 $\pm$ 0.20	0.69 $\pm$ 0.09	
<i>S. nemorosa</i>	35.44 $\pm$ 2.93	40.95 $\pm$ 3.62	29.34 $\pm$ 2.94	4.81 $\pm$ 0.75	1.37 $\pm$ 0.14	0.79 $\pm$ 0.15	7.72 $\pm$ 0.92
<i>S. dichroantha</i> *	41.30 $\pm$ 2.89	39.06 $\pm$ 2.04	34.33 $\pm$ 3.31	4.33 $\pm$ 0.50	1.36 $\pm$ 0.14	0.70 $\pm$ 0.08	8.48 $\pm$ 0.94
<i>S. verbenaca</i>	53,17 $\pm$ 4,7	49,94 $\pm$ 3,45	46,9 $\pm$ 5,51	4,7 $\pm$ 0,41	0,81 $\pm$ 0,15	0,76 $\pm$ 0,08	
<i>S. verticillata</i> ssp. <i>amasiaca</i>	32.13 $\pm$ 0.98	33.28 $\pm$ 1.60	26.32 $\pm$ 1.46	6.48 $\pm$ 1.06	1.22 $\pm$ 0.24	0.55 $\pm$ 0.16	
<i>S. russellii</i>	28.42 $\pm$ 0.87	30.72 $\pm$ 1.00	23.95 $\pm$ 0.99	3.67 $\pm$ 0.80	1.03 $\pm$ 0.11	0.59 $\pm$ 0.08	6.04 $\pm$ 0.79
<i>S. aytachii</i> *	37.68 $\pm$ 4.89	41.19 $\pm$ 4.02	33.55 $\pm$ 5.14	5.50 $\pm$ 1.01	1.50 $\pm$ 0.13	0.56 $\pm$ 0.08	
<i>S. hedgeana</i> *	46.24 $\pm$ 3.81	49.30 $\pm$ 3.45	38.97 $\pm$ 3.57	5.54 $\pm$ 1.30	1.62 $\pm$ 0.21	0.55 $\pm$ 0.06	7.34 $\pm$ 1.03
<i>S. anatolica</i> *	50.86 $\pm$ 4.35	51.08 $\pm$ 4.00	43.28 $\pm$ 4.47	8.01 $\pm$ 1.05	1.63 $\pm$ 0.27	0.72 $\pm$ 0.15	

**Table 3.2.** Summary of morphometric data on SEM micrographs of the taxa examined.

Taxa	Primary reticule number in 5 $\mu\text{m}^2$	Primary lumina diameter ( $\mu\text{m}$ )	The thickness of primary lumina ( $\mu\text{m}$ )	Secondary lumina diameter ( $\mu\text{m}$ )	The thickness of secondary lumina ( $\mu\text{m}$ )	Average lumina number in reticule
<i>S. hedgeana</i> (x10000)	7.5	2.25	0.45	0.69	0.3	3-10
<i>S. verticillata subsp. verticillata</i> (x10000)	15	1.45	0.23	0.45	0.15	3-12
<i>S. caespitosa</i> (x10000)	7	2.48	0.46	0.8	0.25	2-14
<i>S. caespitosa</i> (x10000)	8	2.63	0.36	0.81	0.22	4-12
<i>S. hypargeia</i> (x10000)	8.5	3.11	0.36	0.5	0.23	3-26
<i>S. suffruticosa</i> (x10000)	13	1.55	0.35	0.41	0.22	3-8
<i>S. euphratica var. euphratica</i> (x10000)	12	1.42	0.54	0.41	0.23	-----
<i>S. caespitosa</i> (x10000)	7.5	2.63	0.36	0.66	0.24	3-13
<i>S. nemorosa</i> (x10000)	7.5	2.28	0.38	0.58	0.19	3-10
<i>S. longipedicellata</i> (x10000)	8	2.14	0.37	0.43	0.15	1-19
<i>S. divaricata</i> (x7500)	9	2.75	0.28	-----	0.16	-----
<i>S. dichroantha</i> (x8500)	9	1.82	0.27	0.69	0.17	2-8
<i>S. microstegia</i> (x10000)	7	2.3	0.44	0.53	0.14	1-7
<i>S. heldreichiana</i> (x10000)	11.5	2.02	0.32	0.41	0.24	2-19
<i>S. candidissima subsp. occidentalis</i> (x7500)	5	3.92	0.37	-----	-----	5-32
<i>S. wiedemannii</i> (x10000)	8	2.24	0.36	0.56	0.28	2-14
<i>S. aytachii</i> (x7500)	7.5	4.42	0.46	0.76	0.18	-
<i>S. cyanescens</i> (x10000)	7	3.16	0.26	1.06	0.28	7-24
<i>S. recognita</i> (x7000)	9	2.08	0.45	0.5	0.16	-
<i>S. candidissima subsp. candidissima</i> (x10000)	10.5	2.87	0.5	-----	0.3	6-24



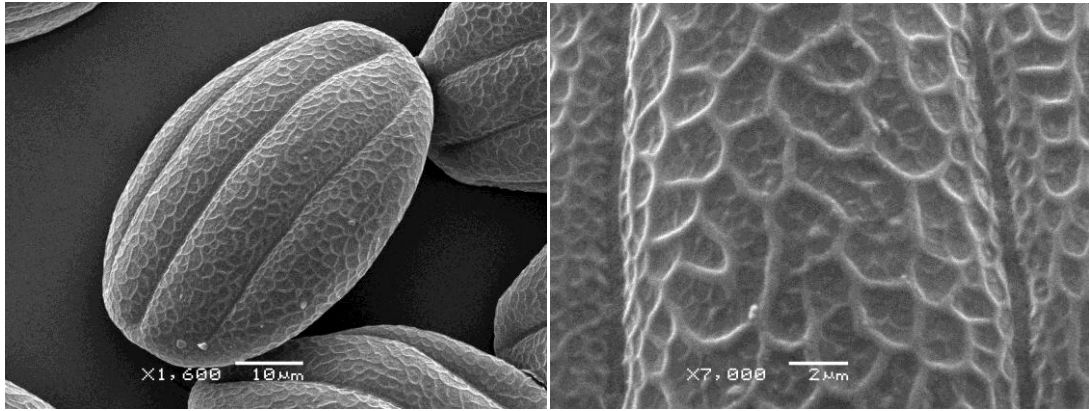
**Table 3.2. (Continue):** Summary of morphometric data on SEM micrographs of the taxa examined.

<i>S. verticillata</i> subsp. <i>amasiaca</i> (x10000)	20.5	1.49	0.27	0.44	0.18	3-15
<i>S. anatolica</i> (x10000)	9.5	2.61	0.45	0.76	0.28	-
<i>S. cryptantha</i> (x9000)	17	1.38	0.28	0.39	0.2	4-12
<i>S. cryptantha</i> (x10000)	16	1.35	0.41	0.45	0.29	1-12
<i>S. frigida</i> (x8500)	8	2.99	0.4	0.56	0.2	4-25
<i>S. yosgadensis</i> (x10000)	12.5	1.55	0.37	0.66	0.17	4-8
<i>S. ceratophylla</i> (x10000)	10.5	2.3	0.43	-	-	-
<i>S. aethiopsis</i> (x10000)	12.5	1.19	0.35	0.63	0.18	1-5
<i>S. virgata</i> (x10000)	13	1.88	0.31	0.49	0.24	4-17
<i>S. halophila</i> (x10000)	9	2.5	0.4	0.7	0.26	2-14
<i>S. cadmica</i> (x10000)	6	2.8	0.34	1.05	0.24	2-7
<i>S. viridis</i> (x10000)	20.5					
<i>S. virgata</i> (x10000)	11	1.18	0.32	0.51	0.15	3-12
<i>S. eriophora</i> (x10000)	16.5	1.18	0.37	0.64	0.14	-
<i>S. frigida</i> (x10000)	13	1.44	0.36	0.36	0.17	4-14
<i>S. frigida</i> (x10000)	12	1.61	0.35	0.35	0.1	1-11
<i>S. dichroantha</i> (x8500)	12.5	1.82	0.27	0.69	0.17	2-8
<i>S. tchihatcheffii</i> (x7500)	8.5	2.31	0.34	-	-	-
<i>S. bracteata</i> (x7500)	14	1.6	0.32	-	-	-
<i>S. caespitosa</i> (x10000)	3	3.21	0.32	0.68	0.26	1-20
<i>S. euphratica</i> var. <i>leiocalycina</i> (x10000)	3	2.66	0.5	0.72	0.3	5-10
<i>S. caespitosa</i> (x10000)	7	2.03	0.44	0.59	0.28	2-8
<i>S. blepharochlaena</i> (x10000)	6.5	2.36	0.55	0.81	0.29	2-8
<i>S. russellii</i> (x10000)	20	0.83	0.3	0.38	0.2	2-3

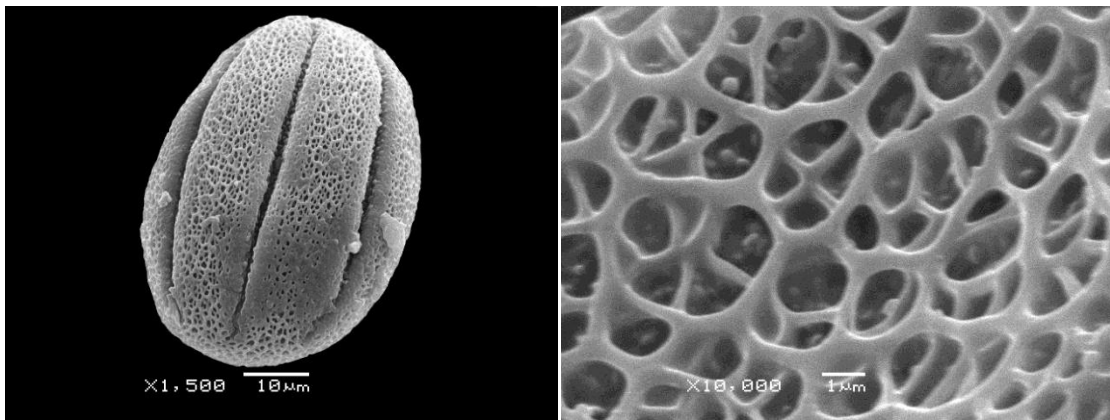
Table 3.1 shows measurements obtained from the pollen grains in the taxa examined. The largest pollen grains were found in *S. euphratica* var. *euphratica* and *S. candidissima* ssp. *Occidentalis* and the smallest were the *S. russellii*, *S. sclarea*, *S. verticillata* subsp. *amasiaca*, *S. virgata* and *S. vermifolia*.

Pollen morphology of Lamiaceae has been studied by many authors (Erdtman, 1945; Harley et al., 1992; Abu-Asab and Cantino, 1993, 1994; Moon et al., 2008, b; Celenk et al., 2008; Salmaki et al., 2008). The studies reveal that the pollen morphology has proved useful in classification of the family. However, there are only a few investigations focused on pollen morphology of *Salvia* using LM and TEM (Henderson et al., 1968), and SEM (Hamzaoglu et al., 2005; Jafari and Nikian, 2008).

We classified Turkish *Salvia* into two main groups: reticulate as in, *S. bracteata*, *S. divaricata*, *S. aytachii*, *S. tomentosa*, *S. tchihatcheffii*, *S. anatolica*, and *S. recognita* (Figure 3.11) and bireticulate as in, *S. candidissima* subsp. *candidissima*, *S. eriophora*, *S. cyanescens*, *S. candidissima* subsp. *occidentalis*, *S. ceratophylla*, *S. longipedicellata*, *S. verticillata* ssp. *amasiaca*, *S. suffruticosa*, *S. nemorosa*, *S. wiedemannii*, *S. microstegia*, *S. frigida*, *S. russellii*, *S. multicaulis*, *S. cryptantha*, *S. Viridis*, *S. vermifolia*, *S. sclarea*, *S. euphratica* var. *euphratica*, *S. frigida*, *S. caespitosa*, *S. aethiopsis*, *S. dichroantha*, *S. hedgeana*, *S. halophila*, *S. yosgadensis*, *S. blepharochlaena*, *S. euphratica* var. *leiocalycina*, *S. virgata*, *S. heldreichiana*, *S. hypargeia*, and *S. cadmica* (Figure 3.12).



**Figure 3.11.** SEM photograph of *S. recognita* pollen.



**Figure 3.12.** SEM photograph of *S. cadmica* pollen.

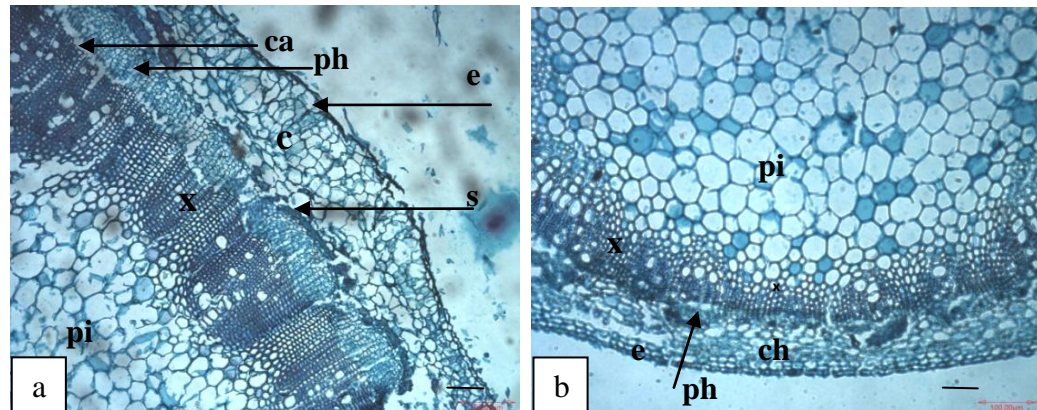
### 3.2 Anatomical information

In addition to vegetative morphological features, vegetative anatomical characters are useful taxonomic tools. Looking inside the stems and leaves serve to refine the relationship among taxa (Stuessy, 1990).

In general the stem transverse section of *Salvia* is quadrangular with the exception of *S. tchihatcheffii* (Aktaş et al. 2009) and *S. divaricata* which are round. *Salvia* stem has a single layer of epidermis, covered with a cuticle. The collenchymatous tissue is present under the epidermis at the corners and consists of oval or rounded cells. Metcalfe and Chalk (1972) also reported a four-cornered stem of *Salvia* containing collenchymatous tissue. The collenchymatous tissue between the corners consists of rounded cells. The cortex constitutes oval parenchymatous cells with intercellular spaces. Vascular bundles

are often separated by parenchymatous cells and those at the corners are larger. The phloem is usually surrounded by 5-10 sclerenchymatous cells or more. Cambium is present between the phloem and xylem elements. The xylem covers a larger region than the phloem. The pith is large and comprises hexagonal or orbicular parenchymatic cells.

The Central Anatolia taxa of *Salvia* studied thus far can be divided into two groups according to their stem epidermis: those with one layered epidermis like, *S. blepharochlaena* (Özkan, 2007), *S. hypargeia* (Kandemir, 2003), *S. sclarea*, *S. virgata*, *S. vermifolia* (Figure 3. 13a) (Bagherpour, 2010) and *S. viridis* as described by Özdemir et al (2009), and those with two layered epidermis; *S. divaricata*, *S. suffruticosa* and *S. aytachii* (Figure 3. 13b).



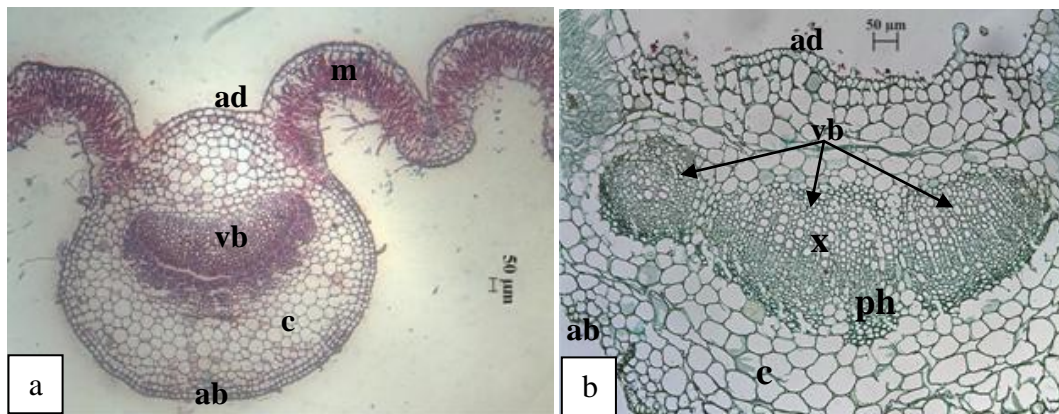
**Figure 3.13.** Stem cross section of *S. vermifolia* (a), and *S. aytachii* (b).

c cortex, ca cambium, ch chlorenchyma, e epidermis, ph phloem, pi pith, s sclerenchymatic cells, x xylem. Bars = 100 um.

The xylem tissue is also used in classification. The Central Anatolia species like; *S. divaricata*, *S. blepharochlaena* as described by Özkan (2007) poses stems with the xylem cell layers very close together and in the *S. hypargeia* (Kandemir, 2003), *S. sclarea* (Özdemir, 1999), *S. virgata*, *S. verbenaca*, and *S. nemorosa* the xylem cell layers are very much apart and separate from each other.

The leaf transverse section of *Salvia* is generally composed of a one-layered (rarely two) epidermis, covered with a cuticle. Both upper and lower epidermal cells consist of uniseriate, oval or rectangular cells. The upper and lower walls of the epidermis cells are thicker than the lateral walls. The stoma cells of varying size and density are present on both sides of the leaf. The midrib region forming a projecting part contains large bundles which are the type of collateral. Their upper side is flat to slightly convex and their lower side is convex.

Leaf anatomical characteristics such as the number of vascular bundles present on the midrib are used for classification. For example in Central Anatolia we find some taxa of *Salvia* with one large vascular bundle in the midrib of the leaves (with one or two small ones on the sides) like *S. blepharochlaena*, *S. euphratica*, *S. eriophora*, *S. sclarea*, *S. virgata*, and *S. divaricata* (Figure 3. 14a). In contrast some have two sets of vascular bundles like in *S. halophila* as described by Kaya (2008) or 3 smaller ones like: *S. viridis* and *S. verticillata* (Figure 3. 14b).



**Figure 3.14.** Leaf cross section of *S. divaricata* (a) and *S. verticillata* (b). vb vascular bundle, ad adaxial epidermis, ab abaxial epidermis, c cortex, m mesophyll, ph phloem, x xylem. Bars = 50 µm.

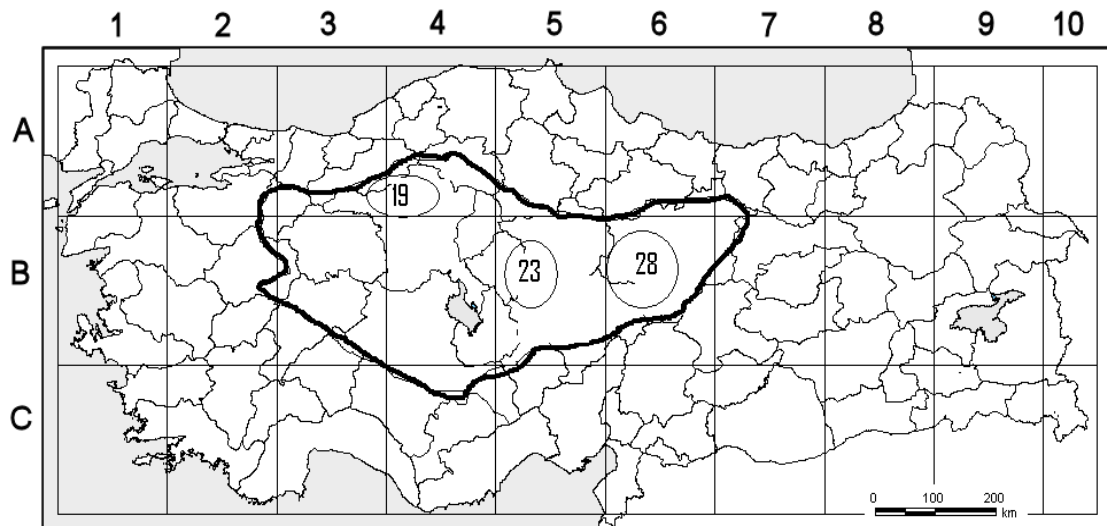
Leaf upper epidermis is another factor used in classification. In Central Anatolia there are many taxa of *Salvia* with the adaxial epidermis (ad) larger than the abaxial (ab) as in

*S. divaricata*, *S. blepharochlaena*(Özkan, 2007), *S. euphratica*, *S. aethiopsis*, *S. longipedicellata*, *S. virgata*, *S. dichroantha*, *S. viridis* (Özdemir et al, 2009,) *S. halophila* (Kaya, 2008). *S. hypargeia* (Kandemir, 2003), and *Salvia tchihatcheffii* (Aktaş et al. 2009). There are taxa of *Salvia* with the adaxial and abaxial epidermis the same size with a very thin layer of cuticle such as *S. verticillata* as described by Koyuncu (2009).

### 3.3 Ecological and Phytogeographical information

#### 3.3.1 Sampling

Distributions of *Salvia* species were somewhat uneven throughout the Central Anatolia. However, most *Salvia* species prefer limestone and igneous slopes and or quercus and calcareous rocky areas. We found three major hot spots in Central Anatolia. As indicated in the map one major area is near Ankara Beypazari. The second distribution hot spot is the Kayseri-Pinarbashi area. The third hot spot is in the greater Sivas area (Map 3.1).



**Map 3.1.** The distribution of *Salvia* in Central Anatolia.

The gypseous characteristic of these three hot spots along with climatic isolation produces the conditions preferred by *Salvia*. As mentioned in the materials and methods Akpulat (2005) suggested that the reduced moisture around gypsum was advantageous to *Salvia* growth and resulted in survival of highly specialized species. Davis in The Cliff Vegetation of Eastern Mediterranean (1951) states that peculiarity of these gypseous, calcareous areas with their lower moisture content is a good foundation for endemism.

Ecological data differ from comparative data used in taxonomy. In this section instead of looking at the plant features we analyze the environmental factors such as soil, elevation and habitat. One of the most important ecological data is soil. *Salvia* is especially impacted by soil type as documented by various authors (Davis, 1951 & Akpulat, 2005). In general the bedrock preferred by *Salvia* is calcareous composite.

According to the soil analysis collected from suitable habitats for taxa of *Salvia* (Table 3.4), they generally prefer clayish soil which are slightly alkali (Ave. pH 7.83) with low organic content (Ave. 1.99%). The preferred N and CaCO<sub>3</sub> content of the soil was 0.13% and 20.71% respectively. The average amounts of P and K present were 4.82 and 151.52 ppm respectively. Salt concentration in Central Anatolia varies from 0.01 to 0.07%. The higher concentration of salt around Salt Lake (Tuz Gölü) produces a habitat in which only a limited number of plants (*S. halophila*) can adapt and survive.

In total 43 species were collected from Central Anatolia (Table 3.3), of these 26 were endemic. Therefore the rate of endemism is about 60%.

**Table 3.3.** Collected *Salvia* species indicating Flora code, Habitat and flowering time (\*indicates endemism).

Flora code		Habitat	Flowering Time
1	<i>S. divaricata</i> *	Mountain slopes, 1500-1800m	6-7
4	<i>S. tomentosa</i>	Associated with pinups on limestone and igneous 90-2000m.	4-8(9)
9	<i>S. recognita</i> *	Limestone slopes with quercus scrubs 900-2200m.	5-8
12	<i>S. bracteata</i>	Limestone slopes with quercus scrubs 50-2000m.	5-7
19	<i>S. wiedemannii</i> *	Limestone slopes 500-1400m	5-7
21	<i>S. freyniana</i> *	Limestone slopes 900-1000m	6-7
24	<i>S. tchihatcheffii</i> *	Limestone slopes with pinus brutia woodland 400-1200m.	5-6
25	<i>S. heldreichiana</i> *	Limestone slopes, 900-2000m	6-8
26	<i>S. caespitosa</i> *	Limestone and igneous slopes rocky areas 1400-2400m.	(5)6-7
29	<i>S. suffruticosa</i>	Banks of steps 300-2000m.	4-6
32	<i>S. cadmica</i> *	Limestone slopes with quercus scrubs 900-1810m.	5-7
34	<i>S. blepharochlaena</i> *	Limestone and igneous serpentine slopes 1000-1620m.	6-7
37	<i>S. euphratica</i> *	Rocky limestone slopes 850-1800m	4-5
40	<i>S. multicaulis</i>	Limestone and igneous slopes, shale and sandy slopes, amongst cedrus 550-2600m.	4-7
41	<i>S. cryptantha</i> *	Limestone and igneous slopes, dry steps, follow fields, roadsides 700-2500m.	5-7
42	<i>S. syriaca</i>	Steps, marly banks, fallow and cultivated fields 450-1850m.	4-7
43	<i>S. viridis</i>	Grassland, fallow fields 700-1150m.	3-7
44	<i>S. hypergea</i> *	Limestone and igneous slopes, fallow fields 800-2000m.	6-7
48	<i>S. eriophora</i> *	Volcanic rocky and stony slopes, alpine steppe and limestone slopes, 1525-1900 m.	6-7
50	<i>S. sclarea</i>	Limestone and igneous slopes and rocky areas, fields, roadsides 1-2000m.	5-8
52	<i>S. aethiopsis</i>	Limestone and igneous slopes, fallow fields, roadsides 1-2100m.	5-8
53	<i>S. ceratophylla</i>	Limestone and igneous slopes and gypsum slopes, corn and fallow fields 300-2150m.	4-6
55	<i>S. longipedicellata</i> *	Disturbed steps, meadows and fallow fields 1620-2040m.	7-8



**Table 3.3. (Continue):** Collected *Salvia* species indicating Flora code, Habitat and flowering time (\*indicates endemism).

57	<i>S. microstegia</i>	Limestone and igneous slopes, screes, fieldsides, 970-3350m.	6-8
60	<i>S. frigida</i>	Limestone with pinus and juniperus woodlands, meadows 1000-2450m.	5-7
61	<i>S. yosgadensis</i> *	Calcareous and igneous disturbed steps 800-1400m.	5-6
62	<i>S. modesta</i> *	Rocky calcareous slopes, 1700-2000	6-7
63	<i>S. tobeyi</i>	Subalpine meadows, grassy slopes, 1400 -2100	5-6
66	<i>S. candidissima candidissima</i>	Calcareous rocky areas, roadsides, fallow fields 700-2000m.	5-9
67	<i>S. cyanescens</i> *	Limestone and igneous shade banks, roadsides, fallow fields 400-2300m.	6-9
68	<i>S. vermifolia</i> *	Limestone slopes, serpentine 1450m.	6-7
76	<i>S. virgata</i>	Scrubs, meadows, roadsides, fallow fields 1-2300m.	5-9
77	<i>S. halophila</i> *	Salty and steps, 950-1000m	8-10
78	<i>S. nemorosa</i>	Rocky slopes in steps, fallow fields, sloping meadows, waste ground. 1000-2300m.	(5-)6-9
81	<i>S. dichroantha</i> *	Steps, clearing of forest, roadsides, fallow fields 800-1800m.	7-9
83	<i>S. verbenaca</i>	Scrubs, meadows, roadsides, fallow fields 1-900m.	3-5
84	<i>S. verticillata</i>	Woodland, roadsides, fallow fields 1-2300m.	6-8
85	<i>S. russellii</i>	Rocky areas, roadsides, fallow and cultivated fields 100-1600m	5-7
87	<i>S. aytachii</i> *	Steps, marly places and gypsum soils 650-870m.	5-7
89	<i>S. hedgeana</i> *	Steps, calcareous slopes 1400-1500m	
90	<i>S. anatolica</i> *	Steps, clearing of forest, calcareous slopes 1600m.	6-7
	<i>S. ekimiana</i> *	Associated with Pinus and Alpi. 1700-2100 m.	6

While there are some highly specialized *Salvia* species such as *S. caespitosa* that grow on high elevations (above 1400 m), there are many species that are found none discriminating. There seems to be a very determinate line drawn for the habitat of some species in Central Anatolia. For example *S. recognita* follows an almost assigned line from Kayseri to Ankara going through Elma Mountain and the area of Kalecik and Eldowan Mountain down to the Cobuk dam of northwestern Ankara.

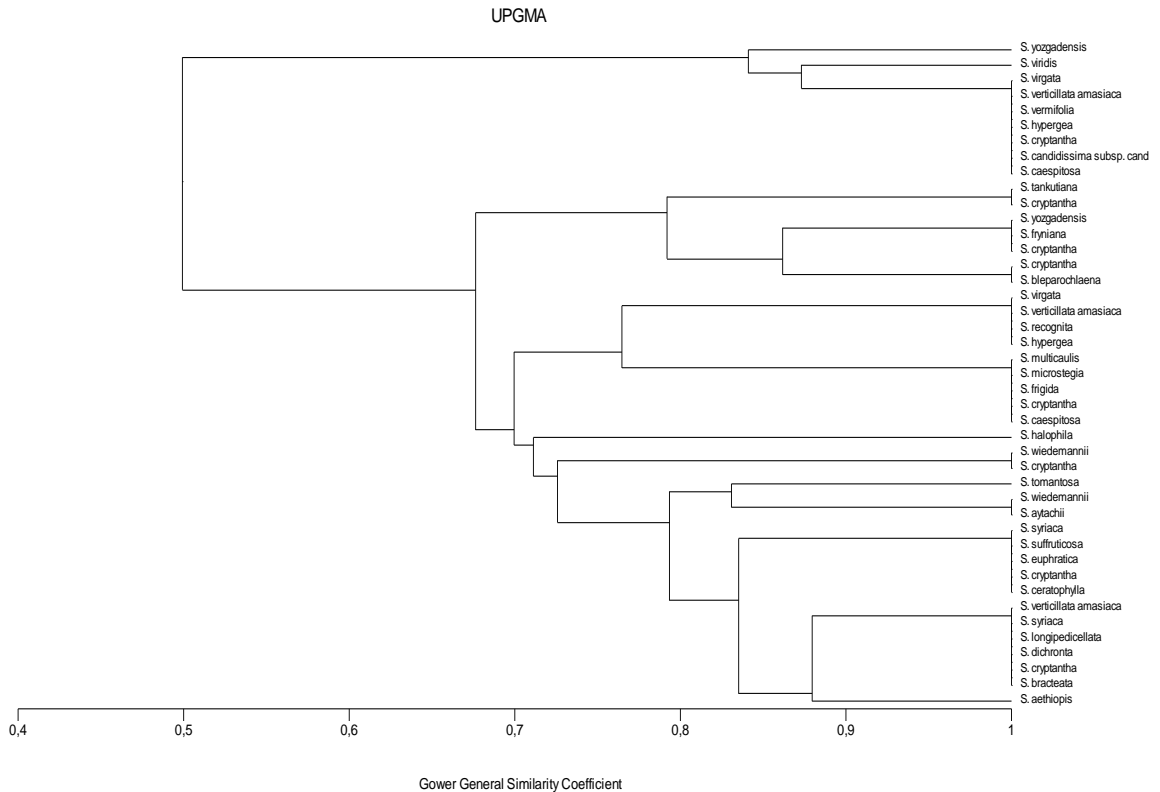
**Table 3.4.** Soil analysis data. C=Clay, L = Loam, CL= Clay Loam, SiCL= Silt-Clay Loam.

species name	Moisture %	Texture	EC (ds/m)	Total Salt %	Soil pH	CaCO <sub>3</sub> %	Soil content for plant nutrition (ppm)		Organics%	Total Nitrogen%	Organic Carbon%	Soil structure		
							Phosphor (P)	Potassium (K)				Sand %	Silt %	Clay %
<i>S. aethiopsis</i>	65	CL	1.255	0.052	7.71	28.01	1.32	74.18	1.66	0.08	0.96	22.1	30.3	47.6
<i>S. anatolica</i>	50	CL		0.019	7.76	35.29	5.97	150.49	1.07					
<i>S. aytachii</i>	48	L	1.692	0.052	7.80	39.00	4.35	149.86	0.53	0.03	0.31	18.2	23.5	58.3
<i>S. bleparochlaena</i>	76	C	1.168	0.057	7.75	25.53	7.75	174.67	2.00	0.10	1.16	53.4	25.8	20.8
<i>S. bracteata</i>	66	CL	1.235	0.052	7.84	42.54	2.56	119.56	2.62	0.13	1.52	21.5	35.5	43.0
<i>S. caespitosa</i>	38-68	L-CL	0.63-1.1	0.015-0.048	7.58-7.98	1.43-3.19	1.24-7.58	30.11-130.55	0.62-4.22	0.03-0.21	0.36-2.45	21.5-87.2	5.4-31.3	7.4-47.2
<i>S. candidissima</i> subsp. <i>candidissima</i>	70-38	L-CL	0.63	0.015-0.023	7.98-8.2	3.19-26.64	1.24-1.62	30.11-209.11	0.22-0.62	0.03	0.36	87.2	5.4	7.4
<i>S. candidissima</i> subsp. <i>occidentalis</i>	77	C		0.03	7.84	7.77	79.44	828.35	7.38					
<i>S. ceratophylla</i>	67	CL	1.116	0.048	7.72	41.83	0.93	112.48	0.44	0.02	0.26	12.0	29.3	58.7
<i>S. cryptantha</i>	38-76	C-CL	0.63-1.235	0.015-0.057	7.58-8.08	1.43-42.54	0.93-7.97	30.11-210.53	0.44-4.22	0.02-0.58	0.26-2.45	12.0-87.2	5.4-35.5	7.4-58.7
<i>S. cyanescens</i>	49	L		0.021	7.79	24.16	2.31	227.33	0.82					
<i>S. dichronta</i>	66	CL	1.235	0.052	7.84	42.54	2.56	119.56	2.62	0.13	1.52	21.5	35.5	43.0
<i>S. divaricata</i>	49	L		0.013	8.18	7.77	0.94	74.68	0.28					
<i>S. ekiminia</i>	64	CL	0.977	0.040	6.81	-	6.81	162.04	5.15	0.26	2.99	58.4	23.6	18.0
<i>S. euphratica</i>	67	CL	1.116	0.048	7.72	41.83	0.93	112.48	0.44	0.02	0.26	12.0	29.3	58.7
<i>S. frigida</i>	68	CL	1.103	0.048	7.58	1.43	7.58	130.55	4.22	0.21	2.45	21.5	31.3	47.2
<i>S. freyniana</i>	55	CL	1.092	0.038	7.86	21.27	7.86	166.20	1.50	0.08	0.87	43.2	24.3	32.5
<i>S. halophila</i>	72	C	1.299	0.060	8.57	56.72	5.12	174.67	3.28	0.16	1.90	14.3	23.1	62.6
<i>S. hedgeana</i>	70	CL		0.023	8.20	26.64	1.62	209.11	0.22					
<i>S. heldreichiana</i>	63	CL		0.019	7.690	1.48	4.87	339.36	6.38					

**Table 3.4. (Continue):** Soil analysis data. C=Clay, L = Loam, CL= Clay Loam, SiCL= Silt-Clay Loam.

<i>S. hypergea</i>	38-78	C-L	0.63-1.315	0.015-0.66	7.84-7.98	3.19-21.98	1.24-2.92	30.11-170.41	0.62-5.50	0.03-0.28	0.36-3.19	25.7-87.2	5.4-27.4	7.4-46.9
<i>S. longipedicellata</i>	66	CL	1.235	0.052	7.84	42.54	2.56	119.56	2.62	0.13	1.52	21.5	35.5	43.0
<i>S. microstegia</i>	39-68	L-CL	1.103	0.013-0.048	7.58-8.18	1.43-7.77	0.94-7.58	130.55	0.28-4.22	0.21	2.45	21.5	31.3	47.2
<i>S. modesta</i>	39	L		0.020	7.62	1.70	0.94	306.83	1.54					
<i>S. multicaulis</i>	39-68	L-CL	1.103	0.020-0.048	7.58-7.62	1.43-1.70	0.94-7.58	130.55-306.83	1.54-4.22	0.21	2.45	21.5	31.3	47.2
<i>S. nemorosa</i>	52	CL		0.016	7.56	0.94	9.36	113.55	2.07					
<i>S. recognita</i>	78	C	1.315	0.066	7.84	21.98	2.92	170.41	5.50	0.28	3.19	25.7	27.4	46.9
<i>S. russellii</i>	57	CL		0.032	7.74	17.17	4.47	285.95	2.10					
<i>S. sclarea</i>	49	L		0.013	8.18	7.77	0.94	74.68	0.28					
<i>S. suffruticosa</i>	67	CL	1.116	0.048	7.72	41.83	0.93	112.48	0.44	0.02	0.26	12.0	29.3	58.7
<i>S. syriaca</i>	66-70	CL	1.116-1.235	0.023-0.048	7.72-8.20	26.64-42.54	0.93-2.56	112.48-209.11	0.44	0.02-0.13	0.26-1.52	12-21.5	29.3-35.5	43.0-58.7
<i>S. tankutiana</i>	40	L	0.841	0.022	7.97	12.76	7.97	52.61	1.53	0.08	0.89	54.6	27.2	18.2
<i>S. tomentosa</i>	63	CL	1.724	0.070	7.54	48.21	3.42	71.31	0.66	0.03	0.04	20.9	29.2	49.9
<i>S. vermifolia</i>	38	L	0.63	0.015	7.98	3.19	1.24	30.11	0.62	0.03	0.36	87.2	5.4	7.4
<i>S. verticillata amasiaca</i>	38-78	L-C	0.63-1.315	0.015-0.066	7.84-7.98	3.19-42.54	1.24-2.92	30.11-170.41	0.62-5.50	0.03-0.28	0.36-3.19	25.7-87.2	5.4-35.5	7.4-46.9
<i>S. virgata</i>	38-78	L-C	0.63-1.315	0.015-0.066	7.84-7.98	3.19-21.98	1.24-2.92	30.11-170.41	0.62-5.50	0.03-0.28	0.36-3.19	25.7-87.2	5.4-27.4	7.4-46.9
<i>S. viridis</i>	38	L	1.115	0.027	8.04	6.74	2.64	63.00	0.31	0.02	0.18	76.8	7.5	15.7
<i>S. wiedemannii</i>	48-72	L-C	1.012-1.692	0.047-0.052	7.80-8.08	32.62-39.00	2.1-4.35	149.86-210.53	0.53-1	0.03-0.58	0.31-0.58	18.2-24	19-23.5	57-58.3
<i>S. yozgadensis</i>	44-55	L-CL	0.626-1.092	0.018-0.038	7.63-7.86	0.71-21.27	1.71-7.86	166.20-178.98	0.16-1.50	0.01-0.08	0.09-0.87	43.2-82.2	12-24.3	5.8-32.5

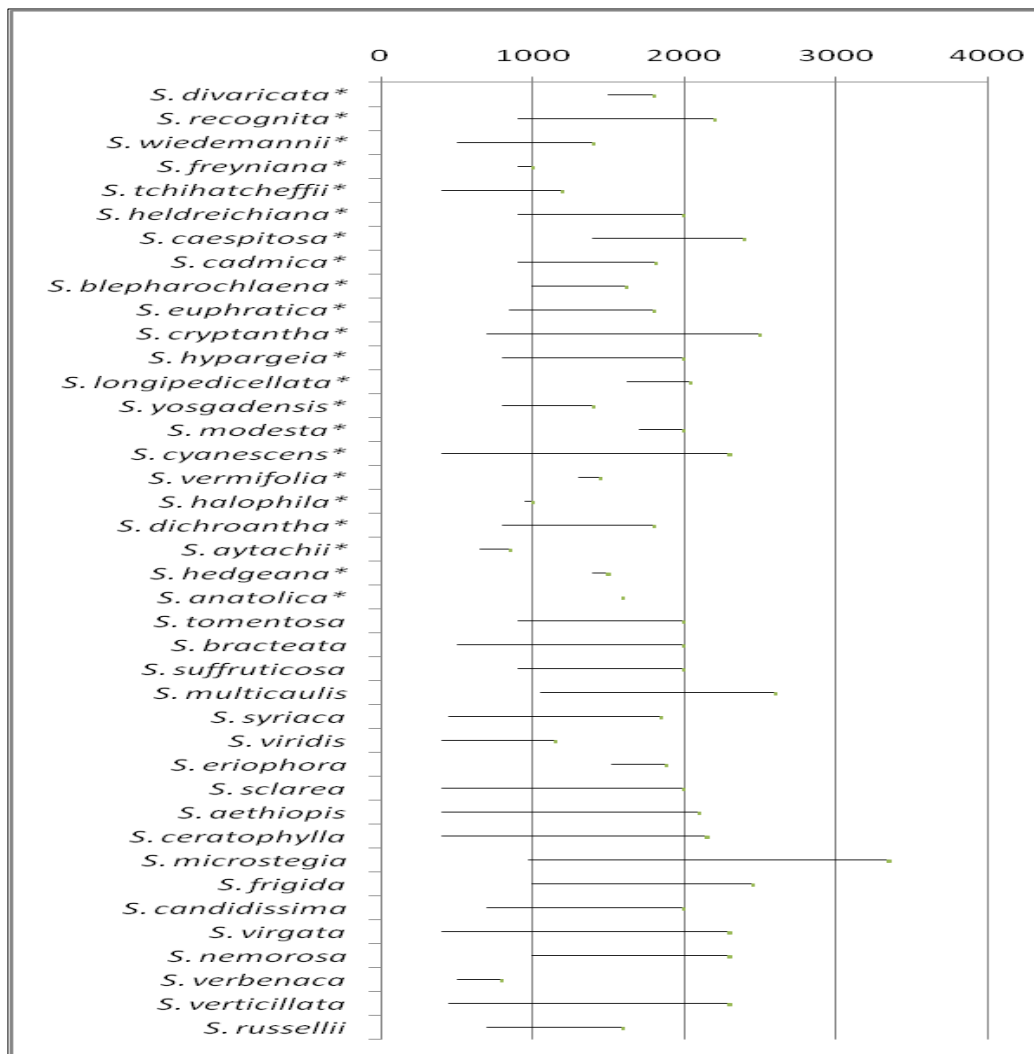
After analyzing the data in the above table the resulting clusters (Figure 3.15) indicate the closeness of these species to each other in regard to soil type. In Central Anatolia some species are found generally all over. This list includes *S. cryptantha*, *S. aethiopsis* and *S. syriaca*. The endemic species such as *S. cryptantha* and *S. wiedemannii* share the same soil type with *S. aethiopsis* and *S. syriaca* (none endemics); however they limit themselves to Central Anatolia borders. This fact shows the effect of climate on restrictions of endemics to Central Anatolia.



**Figure 3.15.** Cluster analysis indicates the closeness of *Salvia* species to each other in regards to soil type.

### 3.3.2 Distribution range by altitude

The bulk of ecological data is often characterized by elevation. Taxa of *Salvia* in Central Anatolia are limited to elevations of about 400-3200 meters. The lowest point is near Eskisehir; a valley within Sundukan Mountains. The highest point is Mt. Ercies in Kayseri. The majority of *Salvia* taxa can be found at 1000 meters. It is worth noting that all the tree hot spots in Central Anatolia are between 900- 1100 meters.

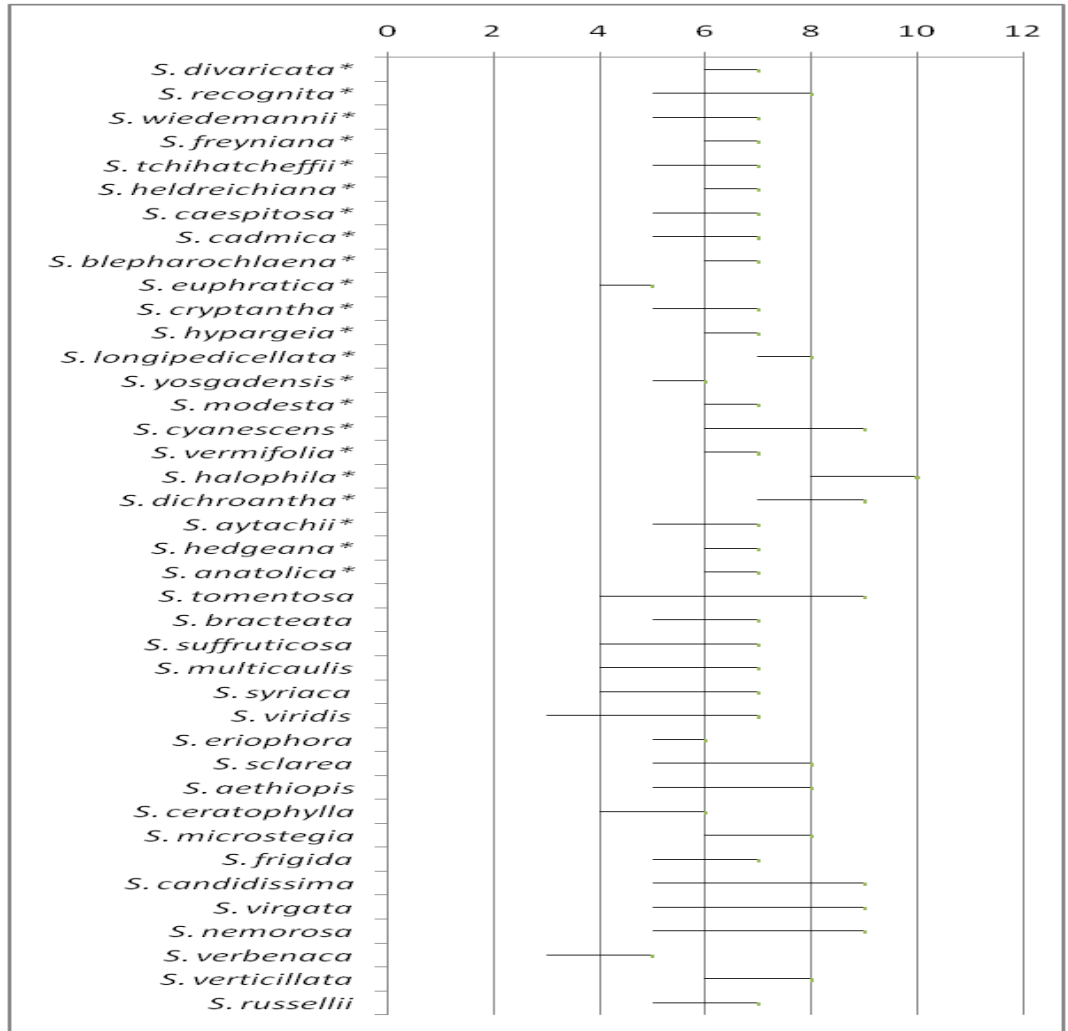


**Figure 3.16.** Altitude distribution chart for *Salvia* species of Central Anatolia.

There are very few *Salvia* found above the 2000 m level and only one above 3000 m in Central Anatolia. By observing Figure 3.16 we can deduct that many species live indiscriminate to elevation while others have a very limited preference of elevation.

### **3.3.3 Phenology**

Flowering time varies greatly among taxa of *Salvia* in Central Anatolia (Figure 3.17). The taxa of *Salvia* can be seen in full bloom during the rainy season of March. *S. viridis* which prefers lower elevation and moister grassland climate is the first *Salvia* to be seen around this area. *S. halophila* ends the flowering season in October. In some areas *S. virgata* can still be seen with flower. But the majority of *Salvia* taxa are in flower during the month of June. The flowering times can however shift slightly due to climatic changes as noticed by the author during the drought peak of 2007.



**Figure 3.17.** Flowering time for *Salvia* species of Central Anatolia.

### 3.3.4 Phytogeography and Endemism

According to Davis (1965) most endemism occurs in the Central Anatolia and the Mediterranean regions of Turkey. Since Central Anatolia does not border any countries the endemics are conserved in this region. As noticed by other authors (Ekim et al, 2000), endemics were concentrated in the calcareous areas around Sivas-Gurun and Cankiri and the arid soil around Salt lake.

Anatolian endemics are numerous in the Sivas and the Beypazari areas. The rate of endemism in this area is about 60%. Of the 26 endemic species in Central Anatolia about 14 are residents of the Sivas area. Seven of the remaining 11 are found in the vicinity of Beypazari. Both of these locations are high in gypsum. Overall Central Anatolia provides a unique habitat for these endemics. Some species carry themselves all the way to the borders of Eastern Anatolia without crossing over. *Salvia cryptantha* is a good example. There are some very rare endemics in the region that are known only from one location. This list includes *Salvia vermifolia*, *Salvia freyniana* and *Salvia halophila*. These species are under threat. Davis (1971) produced the first document about the endemism in Turkey. A list of endemics and rare plants of Turkey was published by Ekim (Ekim et. al, 1989). Due to the importance of these rare plants, the threat categories of each species were determined and reported in the description of each species.



**Table 3.5.** The species distributed in the study area and their IUCN categories and criteria. <sup>x</sup>: the species endemic, \*: taxa known only within the study area in Turkey. Ir.-Tur. Irano-Turanian element, DD Data Deficient, CR Critically Endangered, EN Endangered, VU Vulnerable, NT Near Threatened, and LC Least Concern.

Species	Phytogeographic regions	Turkish Red	Regional	National threat	International	IUCN Red List Criteria
<i>S. freyniana</i> <sup>x,*</sup>	Ir.-Tur.	DD	CR	CR	CR	B1ab(i,ii,iv); C2a(ii)
<i>S. anatolica</i> <sup>x</sup>	Ir.-Tur.	CR	CR	CR	CR	B1ab(i,ii,iv); C2a(ii)
<i>S. hedgeana</i> <sup>x</sup>	Ir.-Tur.	CR	EN	EN	EN	B2ab(i,ii,iv)
<i>S. ekimiana</i> <sup>x,*</sup>	Ir.-Tur.	-	EN	EN	EN	B2ab(i,ii,iv)
<i>S. eriophora</i> <sup>x</sup>	Ir.-Tur.	VU	EN	EN	EN	B2ab(i,ii,iv)
<i>S. halophila</i> <sup>x,*</sup>	Ir.-Tur.	VU	EN	EN	EN	B2ab(i,ii,iv)
<i>S. reeseana</i> <sup>x</sup>	Ir.-Tur.	VU	EN	EN	EN	B2ab(i,ii,iv)
<i>S. vermifolia</i> <sup>x,*</sup>	Ir.-Tur.	VU	EN	EN	EN	B2ab(i,ii,iv)
<i>S. aytachii</i> <sup>x,*</sup>	Ir.-Tur.	VU	VU	VU	VU	B2ab(i,ii,iv)
<i>S. modesta</i> <sup>x</sup>	Ir.-Tur.	VU	VU	VU	VU	B2ab(i,ii,iv)
<i>S. longipedicellata</i> <sup>x</sup>	Ir.-Tur.	NT	VU	VU	VU	B2ab(i,ii,iv)
<i>S. blepharochlaena</i> <sup>x</sup>	Ir.-Tur.	NT	VU	VU	VU	B2ab(i,ii,iv)
<i>S. tchihatcheffii</i> <sup>x</sup>	Ir.-Tur.	NT	VU	VU	VU	B2ab(i,ii,iv)
<i>S. recognita</i> <sup>x</sup>	Ir.-Tur.	LC	VU	VU	VU	B2ab(i,ii,iv)
<i>S. yosgadensis</i> <sup>x</sup>	Ir.-Tur.	LC	VU	VU	VU	B2ab(i,ii,iv)
<i>S. wiedemannii</i> <sup>x</sup>	Ir.-Tur.	LC	VU	VU	VU	B2ab(i,ii,iv)
<i>S. heldreichiana</i> <sup>x</sup>	Ir.-Tur.	LC	VU	NT	NT	B2ab(i,ii,iv)
<i>S. euphratica</i> var. <i>euphratica</i> <sup>x</sup>	Ir.-Tur.	NT	NT	NT	NT	B2ab(i,ii,iv)
<i>S. euphratica</i> var. <i>leiocalycina</i> <sup>x</sup>	Ir.-Tur.	NT	NT	NT	NT	B2ab(i,ii,iv)
<i>S. cadmica</i> <sup>x</sup>	Ir.-Tur.	LC	NT	NT	NT	B2ab(i,ii,iv)
<i>S. cyanescens</i> <sup>x</sup>	Ir.-Tur.	LC	NT	NT	NT	B2ab(i,ii,iv)
<i>S. divaricata</i> <sup>x</sup>	Ir.-Tur.	LC	NT	NT	NT	B2ab(i,ii,iv)

**Table 3.5. (Continue):** The species distributed in the study area and their IUCN categories and criteria. <sup>x</sup>: the species endemic, \*: taxa known only within the study area in Turkey. Ir.-Tur.: Irano-Turanian element, Medit: Mediterranean element, Unk. or Multi.: Unknown or Multiregional. DD Data Deficient, CR Critically Endangered, EN Endangered, VU Vulnerable, NT Near Threatened, and LC Least Concern.

Species	Phytogeographic regions	Turkish Red	Regional	National threat	International	IUCN Red List Criteria
<i>S. caespitosa</i> <sup>x</sup>	Ir.-Tur.	LC	NT	NT	NT	B2ab(i,ii,iv)
<i>S. hypargeia</i> <sup>x</sup>	Ir.-Tur.	LC	NT	NT	NT	B2ab(i,ii,iv)
<i>S. dichroantha</i> <sup>x</sup>	Ir.-Tur.	LC	NT	NT	NT	B2ab(i,ii,iv)
<i>S. cryptantha</i> <sup>x</sup>	Ir.-Tur.	LC	NT	NT	NT	B2ab(i,ii,iv)
<i>S. aethiopsis</i>	Unk. or Multi.	-	LC	LC	LC	Widely distributed
<i>S. bracteata</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. candidissima</i> subsp. <i>candidissima</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. candidissima</i> subsp. <i>occidentalis</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. ceratophylla</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. frigid</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. microstegia</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. multicaulis</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. russellii</i>	Ir.-Tur.	-	VU	LC	LC	Widely distributed
<i>S. sclarea</i>	Unk. or Multi.	-	LC	LC	LC	Widely distributed
<i>S. suffruticosa</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. syriaca</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. tomentosa</i>	Medit.	-	LC	LC	LC	Widely distributed
<i>S. verticillata</i> ssp. <i>amasiaca</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. virgata</i>	Ir.-Tur.	-	LC	LC	LC	Widely distributed
<i>S. viridis</i>	Medit.	-	LC	LC	LC	Widely distributed
<i>S. nemorosa</i>	Medit	-	LC	LC	LC	Widely distributed
<i>S. verbenaca</i>	Medit	-	LC	LC	LC	Widely distributed

Of the three major phytogeographical regions in Turkey, all of the Central Anatolia rests in the Irano-Turanian phytogeographical region. As discussed in the materials and methods, it is well isolated by various mountains. About 60% of the *Salvia* taxa in Central Anatolia are endemic. Among the specimens collected from the area one taxon was re-discovered after 116 years (Bagherpour, 2009).

In final assessment, of the 43 *Salvia* species in Central Anatolia only 4 are from the Mediterranean origin, 2 are multi regional or from unknown origins and the remainder are Irano-turanian based (% 85.7). Endemic Central Anatolian taxa of *Salvia* consist of two CR (Critically Endangered), 7 EN (Endangered), 8 VU (Vulnerable), and 9 NT (Near Threatened).

## CHAPTER 4

### REVISION OF THE GENUS *SALVIA* L. (LABIATAE) IN CENTRAL ANATOLIA, TURKEY

#### 4.1 Infrageneric Grouping

Boissier (1879), in his *Flora Orientalis*, recognized 107 species of *Salvia*; some of which were either described or recorded from Turkey. For the first time, he placed these species under seven sections, which had been all recognized previously by Bentham (1833) and Dumort. These sections are as follows: *Eusphace*, *Hymenosphace*, *Drymosphace*, *Aethiopsis*, *Plethiosphace*, *Horminum* and *Hemisphace*. Section *Eusphace* Benth. Later designated as the type section of the genus *Salvia* (Hedge, 1972, Reales et al., 2004). However the section *Drymosphace* is not found in Central Anatolia.

In Flora of Turkey Vol.7, concerning the genus *Salvia*, no infrageneric grouping was made. Therefore, as an initial part of the revisional study conducted on this genus since 2005 an infrageneric grouping is done. Towards achieving this goal, multivariate analysis was carried out in order to elucidate the sectional delimitation as well as understand taxonomic relationships in the genus.

Following is a list of characters chosen and their possible status value:

**Table 4.1.** Morphological characters screened for the numerical taxonomic analysis.

No	Character	Scoring
<b>HABITAT OF SPECIES</b>		
1.	Limestone soil	0
	Calcareous rocks	1
	Serpentine rocks	2
<b>FORMATION TYPES</b>		
2.	Perennial	0
	Annual	1
3.	Plant erect	0
	Plant caespitose	1
	Plant mat-forming	2
	Plant ascending	3
	Plant procumbent	4
4.	Shrubby	0
	Suffruticose	1
	Herbaceous	2
<b>STEM CHARACTERISTICS</b>		
5.	Stem with capitate glandular hair	0
	Stem without capitate glandular hair	1
6.	Stem branched above	0
	Stem branched below	1
	Stem unbranched	2
7.	Stem indumentum with mostly antrose hairs	0
	Stem indumentum with mostly retrorse hairs	1
	Stem with spreading hairs	2
	Others	3
8.	Stem glabrous, glaucous	0
	Stem pilose	1
	Stem villous	2
	Stem scabridulous	3
	Stem arachnoid	4
	Stem pubescent	5
	Stem tomentosa	6
<b>BRACT CHARACTERISTICS</b>		
9.	Bracts or floral leaves equal or shorter than calyx	0
	Bracts or floral leaves longer than calyx	1
10.	Bracts linear	0
	Bracts lanceolate	1

**Table 4.1. (Continue):** Morphological characters screened for the numerical taxonomic analysis.

	Bracts elliptic	2
	Bracts oblong	3
	Bracts ovate	4
	Bracts rhombic	5
	Bracts absent	6
11.	Bracts length (average)	(mm)
12.	Bracts width (average)	(mm)
13.	Bracts pink to mauve	0
	Bracts green	1
	Bracts absent	2
14.	Bracts membranous	0
	Bracts not membranous	1
	Bracts absent	2
FLOWER STRUCTURE		
15.	Inflorescence paniculate	0
	Inflorescence not paniculate	1
16.	Verticillasters distant	0
	Verticillasters close	1
17.	Verticillaster 1-2 flowered	0
	Verticillaster 2-8 flowered	1
	Verticillaster 8- 40 flowered	2
18.	Pedicel length	(mm)
19.	Calyx campanulate	0
	Calyx infundibular	1
	Calyx tubular	2
	Calyx t tubular-campanulate	3
	Calyx obtriangular	4
20.	Calyx membranous in fruit	0
	Calyx not membranous in fruit	1
21.	Calyx not or scarcely accrescent (in fruit)	0
	Calyx strongly accrescent (in fruit)	1
22.	Calyx upper lip tri-dentate	0
	Calyx upper lip flat	1
	Calyx actinomorphic	2
	Calyx upper lip one dentate	3
	Calyx upper lip truncate	4

**Table 4.1. (Continue):** Morphological characters screened for the numerical taxonomic analysis.

23. Calyx length (average)	(mm)
a. Fruiting Calyx length (average)	(mm)
24. Calyx green	0
Calyx green and purplish	1
25. Calyx with capitate hair	0
Calyx without capitate hair	1
26. Calyx teeth spinulose	0
Calyx teeth acute	1
Calyx teeth acuminate	2
Calyx teeth obtuse	3
Calyx teeth absent	4
27. Corolla more than 20 mm	0
Corolla less than 20 mm	1
28. Corolla lilac	0
Corolla blue	1
Corolla red	2
Corolla yellow	3
Corolla white	4
Corolla mauve-pink	5
29. Upper lip of corolla same color	0
Upper lip of corolla different color	1
30. Lower lip of corolla spotted	0
Lower lip of corolla unspotted	1
31. Upper lip of corolla narrowed at base	0
Upper lip of corolla not narrowed at base	1
32. Corolla squamulate	0
Corolla non-squamulate	1
33. Corolla tube gradually wider towards throat	0
Corolla tube ventricose	1
34. Corolla upper lip strait	0
Corolla upper lip falcate	1
35. Corolla tube annulate	0
Corolla tube non-annulate	1
36. Petioles ciliate with long white eglandular hairs	0
Petioles without ciliate hairs	1
37. Stamen type A	0

**Table 4.1. (Continue):** Morphological characters screened for the numerical taxonomic analysis.

	Stamen type C	2
38.	Stamens included upper lip of corolla	0
	Stamen clearly exceeding upper lip of corolla	1
<b>LEAF CHARACTERISTICS</b>		
39.	Leaves pinnatisect	0
	Leaves lyrate	1
	Leaves undivided	2
40.	Terminal leaflet broad	0
	Terminal leaflet linear-oblong	1
	Simple, terminal leaflet absent	2
41.	Leaves linear	0
	Leaves lanceolate	1
	Leaves elliptic	2
	Leaves oblong	3
	Leaves ovate	4
	Leaves orbicular	5
	Leaves obovate	6
42.	Leaves petiolate	0
	Leaves sessile	1
43.	Leaf length (average)	(mm)
44.	Leaf width (average)	(mm)
45.	Leaf indumentum of unbranched hairs, or absent	0
	Leaf indumentum of dendroid to dendroid-stellate	1
	Leaf indumentum absent	2
46.	Leaf indumentum with gland or glandular hair	0
	Leaf indumentum without gland or glandular hair	1
47.	Leaves not fleshy	0
	Leaves fleshy	1
<b>NUTLET AND POLLEN CHARACTERISTICS</b>		
48.	Nutlets suborbicular	0
	Nutlets ovoid	1
	Nutlets trigonous	2
49.	Nutlet length	(mm)
50.	Nutlet width	(mm)
51.	Pollen polar length	(um)
52.	Pollen equatorial length	(um)



The morphometric analysis was carried out by measuring 53 morphological characters, selected according to two criteria: (a) their common use for taxonomic identification in this section; (b) the variability among different taxa. The compiled data from each OTU analysis was inserted into the MVSP program for cluster analysis. Using Gover's general similarity index (Gover, 1971) which is applicable to both continuous and discontinuous data, and the unweighted pair-group method using arithmetic averages the following cluster emerged. As a result of the analysis, we obtained the dendograms shown in Figure 4.1, in which we can distinguish six major clusters. In these clusters, we find all those sections that were determined by Bentham. Of the seven sections determined by Bentham, Section *Drymosphace* Benth. is not found within Central Anatolia. The cut-off line across the phenogram at 0.76- 0.80 similarity level distinguishes the species.

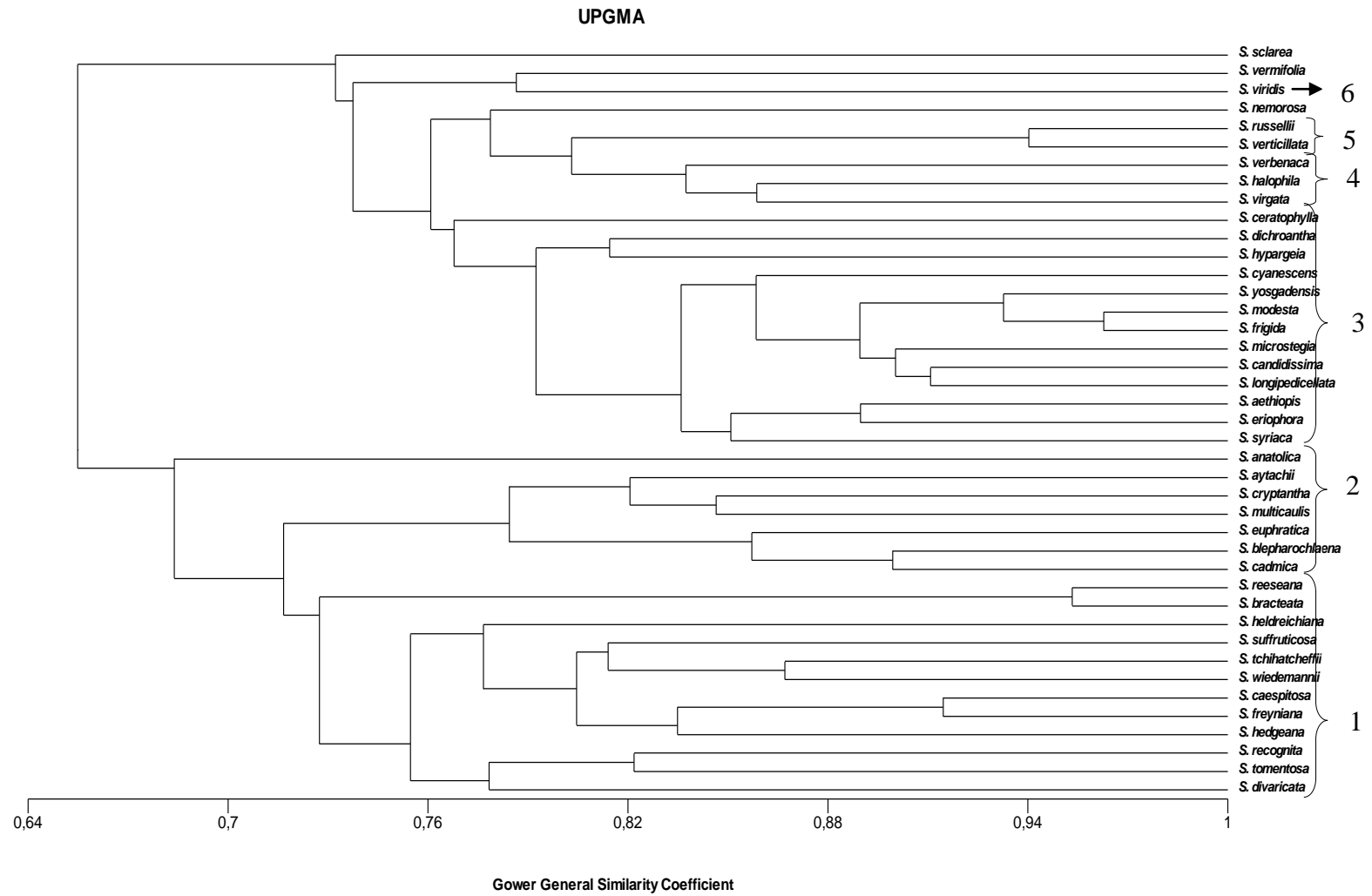
**Table 4.2.** Averaged measurement results of morphological characters in Table 3. 6.

OTUs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23F	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	P	E		
<i>S. divaricata</i>	0	0	0	2	1	0	1	1	0	6	0	0	2	2	0	0	0	23.5	3	1	0	0	15	15	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	2	2	3	0	57.5	15.5	0	0	0	0	4	3.5	50.87	46.76	
<i>S. tomentosa</i>	1	0	0	1	1	2	0	1	1	4	13.5	7.5	1	1	1	0	1	6.5	2	1	0	0	9.5	14	1	0	1	0	0	0	1	1	1	0	0	0	1	0	0	2	2	3	0	55	24.5	0	0	0	2	3	3	38.62	44.73		
<i>S. recognita</i>	1	0	0	2	0	0	2	0	0	2	9.5	4.5	1	1	1	0	1	4	3	1	0	0	11.5	15.5	1	0	2	0	0	0	1	1	1	0	0	0	1	0	0	0	0	4	0	62	26	0	0	1	3.5	3	46.85	50.22			
<i>S. bracteata</i>	1	0	3	1	0	0	3	1	1	4	19.9	12.5	0	1	0	0	1	2.5	2	1	0	3	8.5	11.5	1	0	2	0	5	0	1	1	1	0	0	0	0	0	0	0	0	4	0	25	17	0	1	0	0	3.5	3	41.73	47.77		
<i>S. hedgeana</i>	0	0	1	2	0	1	1	1	0	1	11.5	2.5	1	1	1	0	1	7	0	1	0	0	12.5	12.5	1	0	2	1	1	0	0	1	1	0	1	0	0	0	0	0	2	1	0	25	4	0	0	0	1	3.25	2.26	46.24	49.3		
<i>S. wiedemannii</i>	0	0	0	1	1	0	0	3	0	4	6	3	1	1	1	0	1	3	3	1	0	0	8.5	10.5	1	1	2	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	17.5	2.5	0	0	0	2	3	2	43.87	42.27		
<i>S. freyniana</i>	0	0	3	1	0	2	0	1	0	4	4.5	2.5	1	1	1	0	1	2.5	0	1	0	0	6.5	8	1	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	19	4	0	0	0	2	4	3	42.1	39.17		
<i>S. tchihatcheffii</i>	0	0	4	1	1	2	1	5	0	4	9	5.5	1	1	1	1	1	3.5	3	1	0	0	9	10	0	1	2	1	4	0	1	1	1	0	0	0	0	0	0	0	1	0	0	11.5	1.5	2	0	0	2	3	2	41.56	40.55		
<i>S. heldreichiana</i>	0	0	0	0	1	1	1	0	4	22	8.5	1	1	1	1	1	1	3	2	1	0	0	15.5	15.5	0	2	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	19	8.5	0	0	0	0	4	3	49.67	52.39			
<i>S. caespitosa</i>	1	0	4	1	0	1	0	5	0	4	11.5	6	1	1	1	0	1	4.5	0	1	0	0	12	12	1	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0	13	8	0	0	0	2	2.7	2.5	43.95	49.85		
<i>S. suffruticosa</i>	0	0	3	1	1	0	3	0	0	4	12.5	8	1	1	1	0	1	5.5	0	1	0	0	11	11	0	1	2	0	3	1	1	1	1	0	0	0	0	0	0	0	1	1	0	40	12.5	0	0	2	4.5	3.5	45.76	44.07			
<i>S. cadmica</i>	1	0	3	2	0	1	2	2	0	4	15	15	1	1	1	0	1	3	0	0	1	1	17	17	0	0	4	0	4	0	1	1	1	0	0	0	1	0	0	2	2	4	0	33	15	0	0	0	2	3.5	3.2	49.36	51.44		
<i>S. blepharochlaena</i>	1	0	3	2	0	1	2	2	0	4	26	14	1	1	1	0	1	1	1	0	1	0	16	22	0	0	4	0	4	0	1	1	1	0	0	0	0	0	0	0	1	3	0	15	6	0	0	2	4.5	3.5	55.71	58.37			
<i>S. euphratica</i>	1	0	4	1	0	1	3	1	0	4	22.5	20	1	1	1	0	1	6.5	0	0	1	1	20	20	1	0	3	0	5	0	1	1	1	0	0	0	1	0	0	2	2	4	1	52.5	22.5	0	0	2	5	4	54.25	49.55			
<i>S. multicaulis</i>	1	0	0	2	0	2	3	2	0	4	11.5	6.5	0	0	1	0	1	3	0	0	1	0	12	15	1	0	4	1	5	0	1	1	1	0	0	0	1	0	0	2	0	4	0	35.5	16	1	1	0	2	3.5	3	41.34	39.53		
<i>S. cryptantha</i>	0	0	0	2	1	2	3	1	0	4	13	10	1	1	1	0	1	2.5	0	0	1	1	14.5	18.5	1	4	1	4	0	1	1	1	0	0	1	0	0	0	0	2	2	4	0	39.5	15	1	0	0	2	3.5	3	38.27	45.05		
<i>S. syriaca</i>	0	0	0	2	1	1	3	1	0	4	4.5	3.5	1	1	0	0	1	2.5	2	1	0	0	5.5	6	0	0	0	1	4	0	1	1	1	1	0	1	1	1	1	0	2	2	4	0	70	47	0	1	0	2	3	39.23	44.88		
<i>S. viridis</i>	1	1	0	2	0	1	3	1	0	4	10	10	0	1	1	0	1	2.5	2	1	0	4	12	12	1	0	2	1	0	1	1	1	0	0	1	1	1	1	1	0	2	2	3	0	50	25	0	0	1	3	1.5	39.34	38.34		
<i>S. hypargeia</i>	0	0	0	2	0	2	3	4	0	4	15	12	1	1	1	0	1	2.5	2	1	0	4	10	10	0	0	2	0	1	0	1	1	1	1	1	1	1	1	1	0	2	2	0	60	7.5	0	0	0	2	3.5	2.5	51.5	52.42		
<i>S. eriophora</i>	1	0	0	2	1	0	3	4	0	4	10	8	0	1	0	0	1	2	3	1	0	0	9	9	1	1	0	1	1	0	1	0	1	0	1	1	1	1	0	2	1	3	0	40	8	0	1	0	2	3	2	44.53	48.78		
<i>S. sclarea</i>	1	0	0	2	0	0	3	5	1	4	25	17.5	0	0	0	0	1	2.5	0	1	0	0	10	10	1	0	2	0	0	1	1	1	0	1	1	1	1	1	1	0	2	0	4	0	110	75	0	0	0	2	3	2	32.64	34.58	
<i>S. aethiopsis</i>	1	0	0	2	1	0	3	4	0	4	12	15	1	1	0	0	1	2	2	1	0	0	12	12	0	1	0	1	4	0	1	0	1	1	1	1	1	1	1	0	2	1	4	0	105	70	0	1	0	2	3	2	39.25	44.1	
<i>S. ceratophylla</i>	1	0	0	2	0	0	3	2	0	4	15	12	1	1	0	0	1	3	0	1	0	0	17	17	0	1	0	1	3	1	0	1	0	1	1	1	1	1	1	0	1	3	0	185	60	0	1	0	0	3.5	3	40.33	45.77		
<i>S. longipedicellata</i>	0	0	0	2	0	0	3	1	0	4	12.5	10.5	1	1	0	0	1	9.5	3	1	0	0	10	10	0	0	2	1	4	0	1	1	0	1	1	1	1	1	1	0	2	2	4	0	150	70	0	0	0	1	3	2	40.27	44.08	
<i>S. microstegia</i>	0	0	0	2	0	0	3	1	0	4	13	11	1	1	0	0	1	3.5	0	1	0	0	13	13	0	0	0	0	4	0	1	1	0	1	1	1	1	1	1	1	0	2	2	4	0	120	55	0	1	0	1	3	2.5	46.96	52.49
<i>S. frigida</i>	0	0	1	2	0	0	3	1	0	4	9.5	7.5	1	1	0	0	1	1.5	0	1	0	0	7.5	10	0	0	0	1	4	0	1	0	1	1	1	1	1	1	0	2	2	4	0	65	30	0	0	0	1	3.5	2.5	37.86	40.55		
<i>S. yosgadensis</i>	0	0	1	2	1	0	3	1	0	4	9.5	7.5	1	1	0	0	1	2.5	1	1	0	0	8	10.5	1	0	1	4	0	1	1	0	1	1	1	1	1	1	1	0	2	2	4	0	78.5	32.5	0	0	0	1	3.5	2.5	35.67	39.13	
<i>S. modesta</i>	0	0	1	2	0	0	3	1	0	4	7	6.5	1	1	0	0	1	2.5	0	1	0	0	7.5	12	1	0	0	1	4	0	1	1	0	1	1	1	1	1	1	1	0	2	2	4	0	70	30	0	0	0	1	3.5	3	43.47	47.87
<i>S. candidissima</i>	1	0	0	2	0	0	3	1	0	4	7	4.5	1	1	0	0	1	3	3	1	0	0	15	15	0	0	2	0	4	0	1	1	0	1	1	1	1	1	1	0	2	2	4	0	62.5	50	0	0	0	2	2.5	1.7	46.73	46.87	
<i>S. cyanescens</i>	1	0	0	2	1	0	3	1	0	4	4.25	3.25	1	1	0	0	1	2.25	3	1	0	0	9.5	9.5	1	0	2	1	0	0	1	1	0	1	1	1	1	1	1	0	2	2	3	0	60	42.5	0	0	0	2	2.5	1.7	49.45	55.67	
<i>S. vermifolia</i>	2	0	0	2	0	2	3	5	0	1	5.5	4.5	1	1	1	0	0	3.5	3	1	0	0	10.5	12	0	0	2	1	4	1	1	1	0	0	1	1	1	1	0	2	2	0	0	36	8	0	0	1	2	2.5	1.7	33.57	30.75		
<i>S. virgata</i>	1	0	0	2	0	0	3	1	0	4	5	4	1	1	0	0	1	2.5	3	1	0	0	6.5	8.5	0	0	2	1	1	0	1	1	1	0	1	1	1	1	1	0	2	0	4	0	98	103.5	0	1	0	1	2.5	2	36.2	42.3	
<i>S. halophila</i>	0	0	0	2	0	0	3	1	0	4	7	4.5	1	1	1	0	1	2	1	1	0	0	7	8	0	0	2	1	0	1	1	1	1	0	1	1	1	1	1	0	2	2	4												

We found remarkable variation in the characters among two sections Section *Hymenosphace*, *Salvia* and the other four sections found in Central Anatolia. While these two sections are very similar their separation from other four sections is very distinct. The Section *Hymenosphace* and *Salvia* are similar in the upper lip of corolla, more or less straight and tube hairy-ringed inside.

Sect. *Aethiopsis* is the largest section of the Central Anatolian *Salvia* taxa and is similar with Section *Plethiosphace*. These two sections are similarly perennial, rarely annual herbs. Calyx campanulate; upper lip concave. Upper lip of corolla straight or falcate; tube not hairy-ringed. Also similar to Section *Hemisphace*. The section *Horminum* with one species separates itself from all others by being annual.

A description of all species and subspecies studied are recorded, including distribution according to the collected specimens. We found some species like *S. sclarea* and *S. vermifolia* placed close to *S. viridis* while they belong to section *Aethiopsis*. *S. nemorosa* and *S. dichroantha* which both belong to section *Plethiosphace* were found outside this group. The distribution of the characters and their values among the six clusters shows how these characters behave and how helpful they are for a taxonomic differentiation of the groups studied.



**Figure 4.1.** The cluster analysis dendrogram showing the six sections of *Salvia*: *Salvia* (1), *Hymenosphace* (2), *Aethiopsis* (3), *Plethiosphace* (4), *Hemisphace* (5) and *Horminum* (6) as determined by Bentham.

Finally the analysis of matrices representing similarities and dissimilarities among taxonomic units and their ordering into taxa based on their affinity has been greatly simplified by the use of computers. The following table represents the actual similarity among species as we see them in the field. The cluster analysis resulted in separation of highly correlated species. As observed the closest species *S. frigida* and *S. modesta* are similar species at 0.963. *Salvia bracteata* and *reeseana* are practically same with only a hair difference. Additionally the table indicates many other species with high affinity to each other on the remaining nodes in the cluster:

**Table 4.3.** Cluster analysis results.

Node	Group 1	Group 2	Simil.	in group
1	<i>S. frigida</i>	<i>S. modesta</i>	0,963	2
2	<i>S. bracteata</i>	<i>S. reeseana</i>	0,953	2
3	<i>S. verticillata</i>	<i>S. russellii</i>	0,940	2
4	Node 1	<i>S. yosgadensis</i>	0,933	3
5	<i>S. freyniana</i>	<i>S. caespitosa</i>	0,915	2
6	<i>S. longipedicellata</i>	<i>S. candidissima</i>	0,911	2
7	Node 6	<i>S. microstegia</i>	0,900	3
8	<i>S. cadmica</i>	<i>S. blepharochlaena</i>	0,899	2
9	<i>S. eriophora</i>	<i>S. aethiopsis</i>	0,890	2
10	Node 7	Node 4	0,890	6
11	<i>S. wiedemannii</i>	<i>S. tchihatcheffii</i>	0,867	2
12	<i>S. virgata</i>	<i>S. halophila</i>	0,859	2
13	Node 10	<i>S. cyanescens</i>	0,858	7
14	Node 8	<i>S. euphratica</i>	0,857	3
15	<i>S. syriaca</i>	Node 9	0,851	3
16	<i>S. multicaulis</i>	<i>S. cryptantha</i>	0,847	2
17	Node 12	<i>S. verbenaca</i>	0,837	3
18	Node 15	Node 13	0,836	10
19	<i>S. hedgeana</i>	Node 5	0,835	3
20	<i>S. tomentosa</i>	<i>S. recognita</i>	0,822	2
21	Node 16	<i>S. aytachii</i>	0,821	3
22	<i>S. hypargeia</i>	<i>S. dichroantha</i>	0,814	2
23	Node 11	<i>S. suffruticosa</i>	0,814	3
24	Node 19	Node 23	0,805	6
25	Node 17	Node 3	0,803	5
26	Node 18	Node 22	0,792	12
27	<i>S. viridis</i>	<i>S. vermifolia</i>	0,786	2
28	Node 14	Node 21	0,784	6
29	Node 25	<i>S. nemorosa</i>	0,779	6
30	<i>S. divaricata</i>	Node 20	0,778	3
31	Node 24	<i>S. heldreichiana</i>	0,777	7
32	Node 26	<i>S. ceratophylla</i>	0,768	13
33	Node 32	Node 29	0,761	19
34	Node 30	Node 31	0,755	10
35	Node 33	Node 27	0,737	21
36	Node 35	<i>S. sclarea</i>	0,732	22
37	Node 34	Node 2	0,728	12
38	Node 37	Node 28	0,717	18
39	Node 38	<i>S. anatolica</i>	0,684	19
40	Node 39	Node 36	0,655	41

#### 4.1.1 General features of the Genus, *Salvia*

*Salvia* is one of the largest member of the Labiatae family. Herbaceous or shrubs, often aromatic form numerous glands: stems square, leaves opposite, usually simple, flowers irregular (zygomorphic), in distant lateral clusters (verticillasters) which often form whorls around the stem numbering from (1) 2-10(50): calyx with 5 teeth, and 2-lipped corolla, the lower lip 3-lobed and the upper lip 2. Stamens 2 and fruit consisting of 4 nutlets hidden at the base of the persistent calyx. While one *Salvia* is annual, majority of *Salvia* taxa are perannual and the remainder biannual.

#### 4.1.2 Sectional key

- 1. Annuals **Sect. *Horminum***
- 1. Biennials or Perennials
  - 2. Corolla tube annulate (hairy-ringed inside)
    - 3. Connective longer than filament and not articulated with it, arms unequal, the sterile arm shorter, subulate **Sect. *Hemisphace***
    - 3. Connective as long as filament or shorter; arms subequal, the anterior ending in a more or less sterile cell
      - 4. Calyx membranous and strongly accrescent in fruit **Sect. *Hymenosphace***
      - 4. Calyx not membranous and not strongly accrescent in fruit **Sect. *Salvia***
  - 2. Corolla tube not annulate (not hairy-ringed inside)
    - 5. Calyx campanulate, upper lip concave and 2-sulcate in fruit **Sect. *Plethiosphace***
    - 5. Calyx tubular or campanulate, upper lip is not concave and not 2-sulcate in fruit. **Sect. *Aethiopis***

#### 4.1.3 Species key

- 1. Annual; purple sterile bracts present on the stem apex. **43. *viridis***
- 1. Biennials or Perennials; no colored sterile bracts present on the stem apex.
  - 2. Fruiting Calyx membranous; infundibular shape, strongly accrescent with rounded lobes.
    - 3. Leaves pinnatisect; long eglandular ciliate indumentum present on the petioles.
      - 4 . Pinnate leaves terminal segment linear-oblong, pinnate leaf with 3-5 lateral segments. **14. *blepharochlaena***
      - 4 . Pinnate leaves terminal segment broadly oblong, pinnate leaf (simple) with 1-2 lateral segments. **19. *anatolica***
    - 3. Leaves simple (seldom 1-2 lateral lobes present); long ciliate indumentum absent on the petioles.
      - 5. Mat-forming; lower part of stem woody, fruiting calyx up to 35 mm long. **15. *euphratica***
      - 5. Herbaceous plants with woody rootstock; fruiting calyx up to 28 mm long.
        - 6 . Corolla 27-33 mm; stem glandular pilose or eglandular villous. **13. *cadmica***

6. Corolla 15-22 mm; stem eglandular branched or dendroid hairs.  
7. Calyx generally green colored; stem branched with dendroid hairs. **17. cryptantha**
7. Calyx generally purple; stem glabrous, glandular or dendroid hairs.  
8. Corolla 10-18 mm; pedicel 1-5 mm. **16. multicaulis**  
8. Corolla 23-25 mm; pedicel 6-7 mm. **18. aytachii**
2. Fruiting Calyx non-membranous, thick textured, tubular to infundibular, with acute lobes.  
9. Stamen connective equal or shorter than filaments; upper theca larger than the poorly developed lower theca, lower theca bears at least some fertile pollen. (Stamen type A); corolla with upper lip straight and corolla tube annulate.  
10. Leaves simple or lyrate or pinnatifid **1. divaricata**  
11. Leaves mostly basal; flowering stem up to 35 cm long, stem below with glandular hairs. **13. cadmica**  
11. Leaves distributed over stem; flowering stem 100-120 cm long; eglandular below. **2. tomentosa**
10. Leaves pinnatisect or trisect  
12. Leaves terminal segment broadly oblong to ovate; petioles usually without prominently ciliate hairs.  
13. Bracts or floral leaves clearly longer than calyces.  
14. Stems indumentum entirely eglandular. **12. reeseana**  
14. Stems with or without long spreading eglandular hairs (seldom glandular). **11. bracteata**
13. Bracts or floral leaves equal or shorter than calyces.  
15. Stems below glabrous. **19. anatolica**  
15. Stems glandular-villous below and above. **3. recognita**
12. Leaves terminal segment ± linear-oblong or shortly obovate-cuneate; petioles often prominently ciliate with long white eglandular hairs.  
16. Corolla yellow or yellowish-white. **9. suffruticosa**  
16. Corolla pink or white, violet to blue colored.  
17. Dwarf mat-forming sub shrubs.  
18. Leaves trifoliolate or trisect **4. hedgeana**  
18. Leaves pinnatisect with 2-4 pair lateral segment. **6. caespitosa**
17. Taller growing ascending or erect sub shrubs.  
19. Inflorescence clearly condensed ± ovoid or oblong spike.  
20. Stems eglandular above and below; corolla 10-15 mm **8. tchihatcheffii**  
20. Stems capitate glandular above; corolla (20) 25-30 mm **10. heldreichiana**
19. Inflorescence of distant or approximating verticillasters.  
21. Indumentum scabridulous. **7. wiedemannii**  
21. Indumentum softly pilose. **5. freyniana**
9. Stamen connective clearly longer, lower theca reduced to a usually dolabriform plate of tissue, corolla with upper lip falcate and corolla tube usually not annulate (Stamen type B).  
22. Upper lip of corolla straight (not falcate), corolla tube annulate; verticillasters 8-40 flowered; lower theca subulate (Stamen type C)  
22. Leaves linear-oblong; calyx teeth not mucronate. **42. russellii**  
22. Leaves oblong to ovate; calyx teeth mucronate. **41. verticillata**
22. Upper lip of corolla slightly falcate, corolla tube not annulate; verticillasters 2-8 flowered; lower theca is reduced and generally dolabriform (Stamen type B).  
23. Corolla more than 20 mm.  
24. Corolla tube not squamulate, ventricose or not. **32. hypargeia**  
24. Corolla tube squamulate, ventricose.  
25. Upper lip of corolla lilac.  
26. Bracts clearly longer than calyx. **35. sclarea**  
26. Bracts scarcely longer than calyx. **31. cyanescens**



25. Upper lip of corolla white.
27. Leaves linear, linear-lanceolate or linear-oblong **34. vermifolia**
27. Leaves oblong, ovate to orbicular.
28. Calyx short papillose or glandular pilose hairs; inflorescence ± slender **25. candidissima**
28. Calyx with long spreading capitate glandular hairs; inflorescence ± sturdy **26. microstegia**
23. Corolla less than 20 mm.
29. Flowers lilac or violet or pinkish
30. Corolla tube squamulate.
31. Inflorescence axis, bracts and calyxes ± dark violet blue; calyx teeth subulate; stems eglandular **21. eriophora**
31. Inflorescence axis, bracts and calyxes ± green; calyx teeth acuminate; glandular or not. **31. cyanescens**
32. Stems above and below eglandular-pilose **30. yosgadensis**
32. Stems above glandular-pilose to villous
33. Corolla 16-20 mm; Leaves pilose to lanate beneath; calyx teeth short spinulose. **31. cyanescens**
33. Corolla shorter than 16 mm; leaves arachnoid to sublanate beneath; calyx teeth long spinulose.
34. Corolla 12-16 mm, generally white; bracts 8-12 x 7-11 mm **27. frigida**
34. Corolla 8-11 mm, generally purple; bracts 6-18 x 6-8 mm **28. modesta**
30. Corolla tube not squamulate.
35. Bracts strongly colored violet to blue or purple.
36. Inflorescence axis, bracts and calyxes ± dark violet blue; calyx teeth subulate; stems eglandular **21. eriophora**
36. Inflorescence axis, bracts and calyxes green; stems glandular or not. **39. nemorosa**
35. Bracts green or lightly tinged purple.
38. Leaves oblong
39. Stems eglandular above and below; leaves crenulate. **36. dichroantha**
39. Stems glandular above; leaves pinnatifid to subentire **40. verbenaca**
38. Leaves ovate-oblong to broadly ovate.
40. Leaves ± fleshy, margins subentire (saline habitats). **38. halophila**
40. Leaves not fleshy, margins subentire to erose to pinnatifid (non-saline habitats).
41. Calyx 5-7 mm; stems usually less than 30 cm. **40. verbenaca**
41. Calyx 6-10 mm; stems 30-100 cm. **37. virgata**
29. Flowers white, yellow or cream
42. Leaves pinnatifid with spreading linear segments; biennial; corolla generally sulphor yellow, with upper lip rarely lilac. **33. ceratophylla**
42. Leaves not pinnatifid; perennial, rarely biennial.
43. Inflorescence candilebriform; stems eglandular lanate; perennial or biennial.
44. Leaves ovate-elliptic- oblong , 10-31 x 5-9 cm, leaf margins erose; Upper lip of corolla 7-9 mm **22. aethiopsis**
44. Leaves oblong (seldom ovate-oblong), 2.5-7.5 x 1-2.5 cm, crenulate serrulate, upper lip of corolla 3.5-4.2 mm **23. ekimiana**
43. Inflorescence not candilebriform; stems pilose or villous; perennials.
45. Pedicels 7-12 mm **24. longipedicellata**
45. Pedicels shorter than 5 mm.
46. Leaves ovate, cordate, serrulate; corolla c. 10 mm **20. syriaca**
46. Leaves oblong to broadly ovate or orbicular, cordate, cuneate, margins crenulate to erose; corolla 8-20 mm
47. Upper lip of calyx bisulcate in flower, clearly so in fruit and recurved. **37. virgata**
47. Upper lip of calyx not bisulcate and not recurved in fruit.

48. Leaves ± densely lanate.  
 49. Corolla 17-20 mm; upper lip strongly falcate **26. microstegia**
49. Corolla 7-11 mm, upper somewhat falcate. **23. ekimiana**
48. Leaves not lanate.  
 50. Stem eglandular above and below; calyxes' eglandular. **39. yosgadensis**
50. Stem glandular above; calyxes glandular.  
 51. Inflorescence rescence with vilose hair **29. tobeyi**
51. Inflorescence without vilose hair  
 52. Corolla 8-11 mm, purple; bracts 6-18 x 6-7.5 mm **28. modesta**
52. Corolla 12-16 mm, white or lilac; bracts 8-12 x 7-11 mm. **27. frigida**

## 4.2 Species descriptions

### 4.2.1 Section *Salvia* Hedge (Sect. *Euphace* Benth.):

Shrubs or perennial herbs. Calyx generally not accrescent or only slightly so. Upper lip of corolla more or less straight; tube hairy-ringed inside. Connective as long as filament or shorter; arms subequal, the anterior ending in a more or less sterile cell.

Species for Sect. *Salvia* Hedge:

1. *S. divaricata* Montbret & Aucher ex Bentham in Ann. Sci. Nat. ser. 2, 6:37 (1836).  
 Syn: *S. trigonocatyx* Woronow in Monit. Jard. Bot. Tiflis 22:10 (1912).

Perennial herb with woody rootstock. **Stems** 30-60 cm, erect, branched above, green to purplish, shortly eglandular (sometimes glandular retrose pilose) with some sessile glands below, glabrous above. **Leaves** mostly basal, simple, rarely with a pair of small lateral lobes, narrowly oblong, (2- ) 3-8 (-9) x 0.8-2.5 cm, upper surface sparsely eglandular pilose and beneath densely tomentose with sessile glands, rugose, crenulate. **Petiole** 1-5 (-7) cm, ciliate. **Inflorescence** an elongate, widely branched panicle. **Verticillasters** 2-4(-6)-flowered, clearly distant. **Bracts and bracteoles** absent. **Pedicels** 10-35 mm, glabrous, rigid, erecto-patent. **Calyx** tubular-campanulate, 12-18 mm, slightly longer in fruit, fruiting calyx thick-textured, often purplish, densely glandular pilose and sometimes a few eglandular villous hairs; upper lip obsoletely tridentate, acuminate. **Corolla** pink or lilac, 25-35 mm; tube straight below, widening above, 15-25

mm, incompletely annulate; upper lip ± straight. **Stamens** A. **Styles** 27-37 mm. **Nutlets** c. 4-5 x 3-3.5 mm, black. Chromosome count: 2n=14.

The **pollen** of *S. divaricata* is isopolar and prolate with  $P = 50.87 \pm 7.08 \mu\text{m}$  and  $E = 46.76 \pm 5.30 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $44.55 \pm 6.84 \times 3.43 \pm 0.93 \mu\text{m}$ . The exine is  $1.12 \pm 0.12 \mu\text{m}$  thick and the intine is  $0.50 \pm 0.03 \mu\text{m}$ . Its ornamentation is reticulate.

*Fl:* 6-7, limestone slopes and mountain slopes, 1030-1870 m.

**Type Specimen:** [Turkey B7] in Cappadocia Orientalis [ad Euphratem], Aucher [1528]

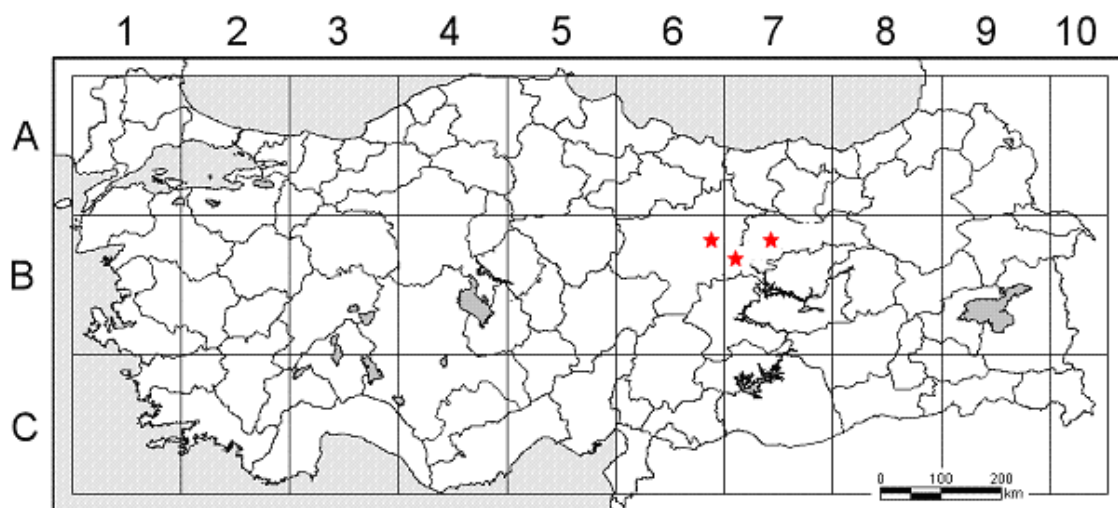
**Mainly E. Anatolia. A8 Çorum:** Gorgotachan, S. of Artvin, 19 vii 1911, Woronow 920 (type of *S. trigonocatyx*) (E! K!). **B6 Sivas:** Sivas-Zara-Divriği road, N. of 26 km, 11 vii 2006, GAKaydın 10994! **B7 Sivas:** 26 km from Divriği to Kemaliye, 39 31 14 N 38 09 40 E, 1535 m, 9 vii 2006, AKahraman1260! **Erzincan:** Çilhoraz Mountain, 39 35 30 N 38 44 09 E, 1870 m, 9 vii 2006, AKahraman1267! **Mercan Mountains,** 39 38 064 N 39 30 637 E, 1528 m, 26 vii 2008, AKahraman 1595!

**Endemic. Ir.-Tur. element.** Threat category: **NT**

*S. divaricata* is distantly related to *S. aucheri* on account of the habit and the stem indumentum, but very distinct in terms of the narrowly oblong mostly basal leaves, the wide-branching glabrous panicles and the very long pedicels.



**Figure 4.2.** General appearance of *S. divaricata* Montbret & Aucher ex Bentham.



**Map 4.1.** *S. divaricata* distribution map.

2. *S. tomentosa* Miller, Gard. Dict. ed. 8, no. 2 (1768). Syn: *S. grandiflora* Etl., *Salvia* 17 (1777); *S. grandiflora* Etl. subsp. *aegaea* (Bornm.) Rech. fil. in Bot. Jahrb. 69:501 (1939); *S. grandiflora* Etl. subsp. *rotundifolia* (Vis.) Rech. fil., Fl. Aeg. 519 (1943). Ic: Jacq., Eclog. Pl. Rar. 1: t. 36 (1811-16).

Perennial Clump-forming suffruticose herb. **Stems** to 1 m, stiffly erect, quadrangular, often branched above, eglandular-tomentose with sessile glands (rarely with capitate glandular hairs above). **Leaves** simple, narrowly oblong to ovate, 0.8-11 x 0.5-6 cm, rounded to cordate at base (rarely with small basal lobules), entire to crenulate; **petiole** 0.8-6.0 cm. **Inflorescence** branched. **Verticillasters** 4-10 flowered, distant or condensed above. **Bracts** broadly ovate, 3-20 x 2-11 mm, deciduous; **bracteoles** present. **Pedicels** 2-10 mm. **Calyx**  $\pm$  tubular, 7-16 mm, accrescent to 11-18 mm in fruit, usually violet, pilose to villous, with or without capitate glandular hairs; upper lip shortly tridentate. **Corolla** lilac to purple, or white, c. 21-30 mm; tube straight, 18-22 mm, incompletely annulate; upper lip straight. **Stamens** A. **Nutlets** rounded trigonous,  $\pm$  spherical, 3.5 x 3.2 mm. Chromosome count:  $2n = 14, 15, \text{ and } 16$ . The **pollen** of *S. tomentosa* is isopolar and oblate with  $P = 38.62 \pm 3.29 \mu\text{m}$  and  $E = 44.73 \pm 3.61 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $32.63 \pm 3.80 \times 4.72 \pm 0.43 \mu\text{m}$ . The exine is  $1.16 \pm 0.14 \mu\text{m}$  thick and the intine is  $0.72 \pm 0.10 \mu\text{m}$ . Its ornamentation is reticulate.

*Fl.* 4-8(-9). Often associated with *Pinus brutia* and *P. nigra*, *Quercus pubescens*, in macchie, on limestone or igneous slopes, 90-2000 m.

Described from cultivated material, Miller (holo. BM!).

**Mainly Outer Anatolia, Islands.** A2 (E) Istanbul: Rumeli Kavak, Azn. 1740! A2 (A) Bursa: Çekirge, A. & T. Bay top (ISTE 2451)! A3 Zonguldak: Zonguldak to Çaycuma, 450 m, D. 37636. A4 Ankara: Eldivan Mountain near fire department, 40 29 738 N 33 30 371 E, 1081 m, 17 vii 2008, SBagherpour 502! A5 Sinop: Sinop to Gerze, 90 m, Hub.-Mor. 15292! A6 Ordu: Fatsa to Aybasti, 400 m, Tobey 1327! A7 Gümüşane: Gümüşane to Trabzon, Zigana Pass, 1200 m, Lamond 2602! B1 Izmir: kamal Paşa Mountain, 38 25 061 N 27 24 015 E, 490 m, 2 vi 2008, SBagherpour 455! B2 Kütahya: Gediz to Uşak, 620 m, Demiriz 1817! B2 Uşak: pass the Kula 2 Km, 38 39 868 N 29 07 582 E, 592 m, 31 v 2008, SBagherpour 455! B3 Eskişehir: Sündiken Da., Ekim 633! B5 Kayseri: Sakar Çıfıllığı road above the village, about 5-6 km into the forest, 38 27 014 N 35 24 296 E, 1595 m, 22 vii 2006, SBagherpour 375! B6 Maraş: d, Goksun, Hobek Da., 1600 m, D. 20227! C1



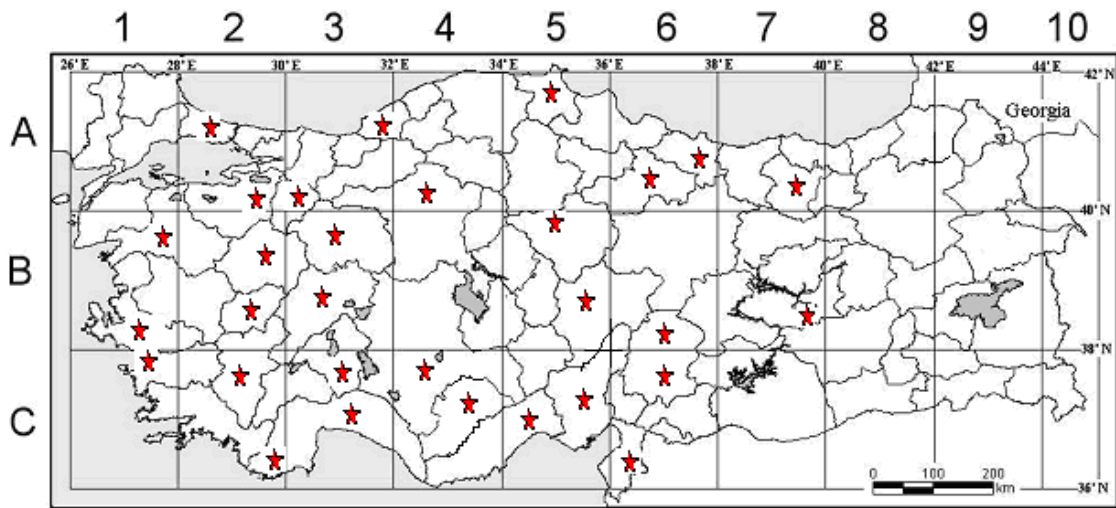
Izmir: Samsun Da. above Giizelcamli, Fitz & Spitz. 664! C2 Antalya: Kuhu Da. S. of Elmali, Çiğlikara, Fitz & Spitz. 221! C3 Isparta: Ağlassun to Isparta, 1600 m, Khan et al. 341! C4 Konya: Ermenek to Kahraman, 1040 m, Hub.-Mor. 8384! C5 Adana: d. Feke, Suphandere to Belankoy, 1000 m, D. 19563! C6 Hatay: d. Antakya, Harbiye to Şenkoy, 500 m, D. 27209! Is: Samos, mt. Kerki, 500 m, Runem. & Snog. 19267!

France, Crimea, Lebanon, Latakia, Balkans, Soviet Armenia. Mediterranean element. A very frequent species throughout its range, but relatively oligomorphic. Occasionally gynodioecious forms occur. The allied W. and S. Mediterranean species *S. officinalis* L., culinary sage (in Turkish, 'tibbi adaçayı') differs from *S. tomentosa* in the narrower oblong-cuneate leaves. It is sometimes cultivated in Turkey.

Threat category: **LC**



**Figure 4.3.** General appearance of *S. tomentosa* Miller.



**Map 4.2.** *S. tomentosa* distribution map.

**3. *S. recognita*** Fisch. & Mey. in Ann. Sci. Nat. ser. 4, 1:33 (1854).

Perennial herb. **Stems** 40-90(up to 160) cm, erect, quadrangular, branched above, glandular-villous' above and below with long spreading hairs, glabrous and glaucous in middle and sometimes capitates glandular. **Leaves** pinnate. (Rarely simple) with a large oblong-ovate terminal segment, 3-9(-13) x 1-5 cm and 1-2 pairs of small lateral segments, rugose, crenulate, glandular-pilose; **petiole** 1-13 cm. **Verticillasters** 4-6-flowered, clearly distant. **Bracts** 12-15 x 1-7 mm, deciduous. **Pedicels** 3-5 mm, ± erect. **Calyx** ovate tubular-campanulate, 8-15 mm, to 18 mm in fruit, glandular-villous, upper lip straight, very shortly tridentate, not mucronate. **Corolla** lilac-pink, 20-40 mm; tube straight, widening above, ± annulate c. 14 mm from base; upper lip straight. **Stamens** A. **Nutlets** ± spherical, c. 3.5 x 3 mm. Chromosome count:  $2n = 14, 16$ .

The **pollen** of *S. recognita* is isopolar and oblate with  $P = 46.85 \pm 4.14 \mu\text{m}$  and  $E = 50.22 \pm 6.09 \mu\text{m}$ . The aperture is often hexacolpate (rarely octacolpate) and the colpi =  $41.48 \pm 4.18 \times 5.37 \pm 0.61 \mu\text{m}$ . The exine is  $1.23 \pm 0.20 \mu\text{m}$  thick and the intine is  $0.65 \pm 0.12 \mu\text{m}$ . Its ornamentation is reticulate.

*Fl.* 5-8. Limestone and, igneous slopes and screes in steppe, *Quercus scrub*, 900-2200 m.

Type: [Turkey B5 Kayseri] Ali-Da, prope Kaiseriam, 1849, Tchihatcheff, (holo. P?).

**Mainly C. Anatolia, rare in S. & E.** A4 Çankiri: Eldivan to Ankara road at the Eldivan dam next to Mavici Çeşmesi, 40 31 331 N 33 27 093 E, 1199 m, 01 vi 2006, SBagherpour 257! A4 Ankara: Kalecik to Akyurt. Pass the rail road on the right side on the bank of the river, 40 08 724 N 33 21 351 E, 1052 m, 7 vii 2005, SBagherpour 154! B5 Kayseri: Ali Mountain, 38 40 437 N 35 33 451 E, 1600 m, 10 vi 2008, SBagherpour 470! B5 Nevşehir: Urgiip, 1300 m, Stainton 8466! B5 Kayseri: Ercies Mountain 2-3 km after ski center on the left side of the road, 38 27 985 N 35 31 101 E, 1833 m, 22 vii 2006, SBagherpour 378! B5 Kayseri: About 6 km N. of Develi, Çamaklı köy, Hills above Çamaklı Çay, 38 27 985 N 35 31 552 E, 1740 m, 22 vii 2006, SBagherpour 380! B6 Adana: Saimbeyli, Maniss. 1007! B7 Tunceli: above Selepur, 1500 m, D. 31607. C4 Icel: 33 km E. of Mut, 1260 m, Hub.-Mor. 9602! C5 Niğde: Ala Da., 1980 m, Wood & Gibson 144! C5 Adana: Ala Da., N. of Pozanti, Bisby'29! To Maraş, c 10 km N. of Andirin, c. 950 m, Sorger 73-1-3-35!

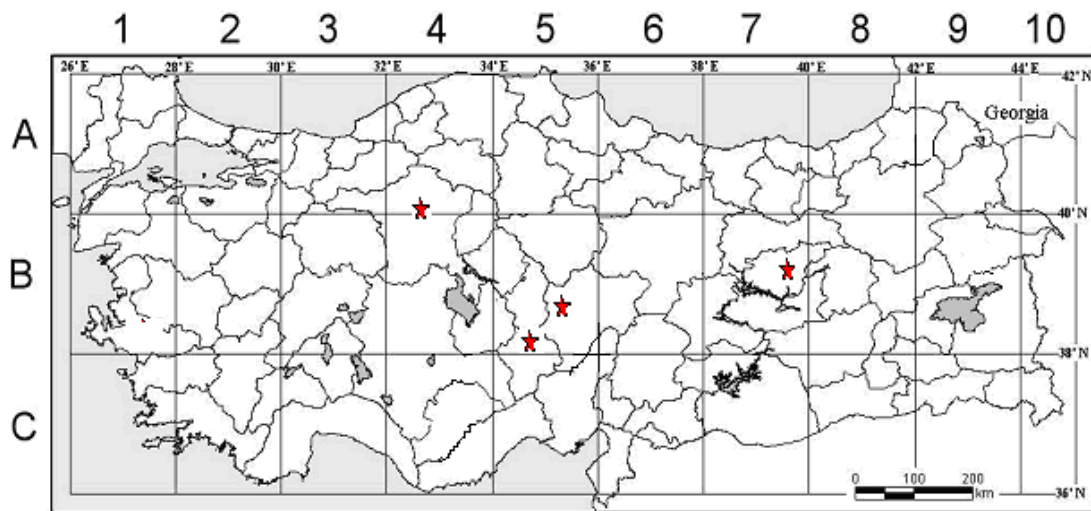
**Endemic. Ir.-Tur. element.** Treat category: **VU**

Characterized by the stem indumentum and large corollas. In the same broad alliance as *S. pilifera*, *S. pinnata* and *S. tigrina*, but clearly differing from them in several features.





**Figure 4.4.** General appearance of *S. recognita* Fisch. & Mey.



**Map 4.3.** *S. recognita* distribution map.

**4. *S. hedgeana*** Dönmez sp. nov., Bot. J. Linn. Soc. 137: 413-416 (2001).

Dwarf perennial suffruticose herb. **Stems** 5-10 (-15) cm, procumbent, ascending, branched at base, with sterile shoots, retrorsely pilose hairs with sessile glands on stem and inflorescence. **Leaves** trifoliolate, lanceolate in outline, with one pair of lateral segments, lateral segments (4-) 6-9 (-11) x 1-2 mm, terminal leaf segment lanceolate, 20-30 (-40) x 3-5 mm, margin entire, slightly involute. **Petiole** 10-20 mm, winged, ciliate. **Inflorescence** racemose, (3-) 5-8 x 2-3 cm, slightly exceeding the leaf level with (3-) 4-5 (-6) verticillasters. **Verticillasters** 2-4 (-6)-flowered. Floral leaves similar to stem leaves. **Bracts** clearly shorter than calyces, lanceolate at base, 8-15 x 2-3 mm, lower bracts up to 40 mm; bracteoles present, lanceolate, (4-) 6-10 (-13) x 1-2 (-4) mm. **Pedicels** 5-9 mm. **Calyx** campanulate, 10-15 mm, up to 17 mm in fruit, (13-) 14 (-15) veined, retrorsely pilose, with sessile glands, violet mainly on upper half, bilabiate, lobes divided to nearly mid length, lower lobe with two teeth, broadly lanceolate, 6-8 mm, upper lobe with small three teeth, triangular 1-2 mm. **Corolla** 15-20 mm, blue, with white spot on lower lip, sparsely villous outside, densely long hairs on outside of upper lip; tube 8-14 mm, non-squamulate, with an annulus in throat; upper lip falcate. **Stamens** A, included upper lip of corolla, staminal connectives shorter than filaments; filaments c. 5 mm, upper thecae 3.5 mm, lower thecae 1-1.2 mm. **Style** 30-35 mm, exerted from corolla lips. **Nutlets** oblong to ovoid, 2.5-4 x 2-2.5 mm, dull green, entire to slightly papillate. Chromosome count: unknown.

The **pollen** of *S. hedgeana* is isopolar and oblate with  $P = 46.24 \pm 3.81 \mu\text{m}$  and  $E = 49.30 \pm 3.45 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $38.97 \pm 3.57 \times 5.54 \pm 1.30 \mu\text{m}$ . The exine is  $1.62 \pm 0.21 \mu\text{m}$  thick and the intine is  $0.55 \pm 0.06 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl: June, limestone slopes and steppe, 1200-1600 m.*

**Type Specimen:** [Turkey] B7 Sivas: Divriği, Dumluca dağ, Karasar pass, above Kayaburun village, 1600 m, steppe, 15.6.1995, AAD 4579, slide no: AD 1390, AD 1391 (holo HUB! iso E).

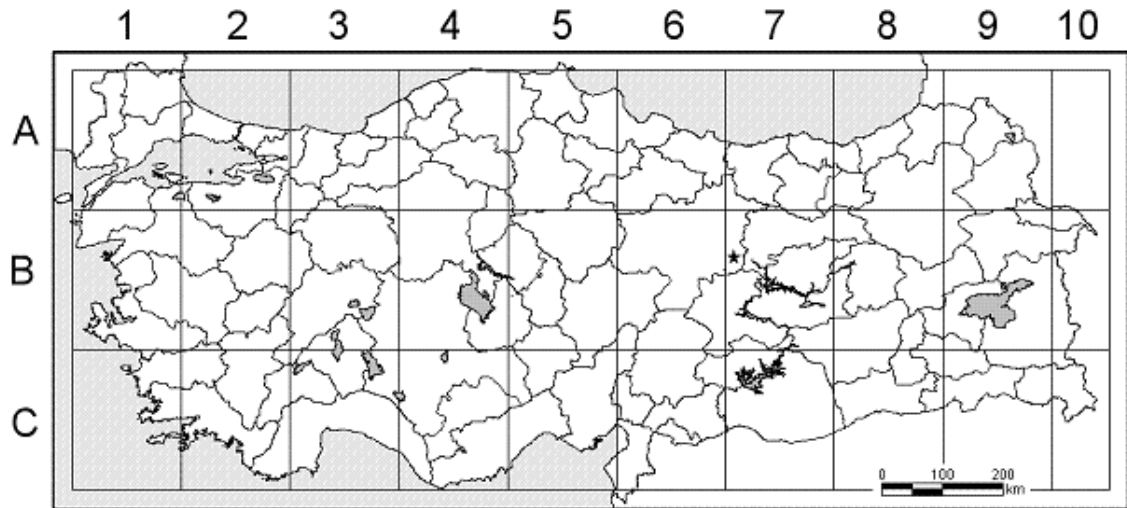


**E. & C. Anatolia border. B7 Sivas:** Divriği, Dumluca dağ, Karasar pass, above Kayaburun village, S. of Uzunkaya village, N. slopes of hills, 39 16 53 N 38 00 00 E, 1460 m, 6 vi 2006, AKahraman 1159! 4 km from junction of Divriği-Mursal road, 39 15 889 N 38 00 466 E, 1200 m, 2 vi 2008, AKahraman 1521A! above Mursal road, 39 15 572 N 38 00 622 E, 1343 m, 2 vi 2008, AKahraman 1521B!

**Endemic. Ir.-Tur. element.** Threat category: **EN**



**Figure 4.5.** General appearance of *S. hedgeana* Dönmez.



**Map 4.4.** *S. hedgeana* distribution map.

5. *S. freyniana* Bornm. in Öst. Bot. Zeitschr. 42: 349, 375 (1892).

Perennial suffruticose herb with a woody rootstock. **Stems** many, ascending to erect, 15-35 cm, unbranched (rarely branched), grayish-green, dense eglandular antrorsely pilose-pubescent with some villous hairy. **Leaves** pinnatisect with 1-2 pairs of lateral segments, terminal segments linear-oblong, 1.5-5 x 0.3-1 cm, grayish-green, densely eglandular-pubescent to pilose with sessile glands, margins entire to crenulate toward apex, petiole 0.4-2.5 cm, slightly widened at base, dense antrorsely pubescent to pilose with long ciliate hairy. **Inflorescence** racemose, clearly exceeding leaves with 3-6 verticillasters, each **verticillaster** with 2-8 flowered  $\pm$  distant. **Bracts** ovate to lanceolate, dense white capitate glandular pilose, 4-10 x 2-5 mm. **Bracteoles** present. Pedicel 2-5 mm. **Calyx** campanulate, c. 7 mm to c. 11 mm in fruit, eglandular and glandular villous. Corolla lilac-blue with white center, 10-18 mm, tube 10-13 mm straight, annulate upper lip straight. **Stamens** A, staminal connectives shorter than filaments, upper theca 1.9–2.7 mm, the lower theca 1–1.3 mm, filaments c. 2.7–3.2 mm. **Style** glabrous, 16–20 mm long, exerted from corolla lips and divided in two part at apex. **Nutlets** rounded-trigonious and suboblate, dark brown, c. 3.15 - 4 x 2.5 - 3 mm, surface slightly tuberculate. Chromosome count: Unknown.

The **pollen** of *S. freyniana* is isopolar and oblate-spheroidal to prolate-spheroidal with  $P = 42.10 \pm 8.87 \mu\text{m}$  and  $E = 39.17 \pm 6.61 \mu\text{m}$ . The aperture is hexacolpate and the colpi are long  $C = 37.38 \pm 7.59 \times 4.28 \pm 0.85 \mu\text{m}$ . The exine is  $1.02 \pm 0.09 \mu\text{m}$  thick and the intine is  $0.62 \pm 0.09 \mu\text{m}$ . Its ornamentation is bireticulate.

Fl. 6. *Dry sandy calcareous slopes 1082m.*

Type: [Turkey B5 Kayseri/Yozgat] inter Caesaream (Kayseri) et Yosgad (inter pagos Köprükői et Keller), 900-1100 m, 23 vi 1890, Bornmüller 1730 (iso. BM! G! K! LD! W! Z!).

The first specimens belonging to *S. freyniana* Bornm. were collected by J.F.N. Bornmüller from Yozgat B5 near Köprükői et Keller in 1890 and than described as a new species in 1892. Near yenipazari at the village of Kaşkışla on sandy hillsides above the village cemetery, 39 30 553 N 35 06 970 E, 1082 m, 04 vi 2006, SBagherpour 277.

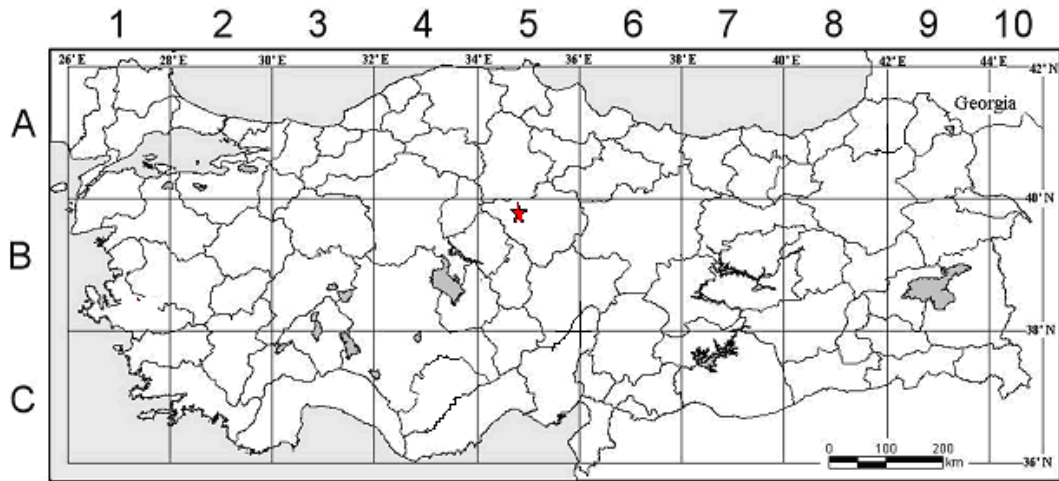
Endemic. Ir.-Tur. element. A rather problematical species, known only from one location (CR). Apparently closest to *S. wiedemannii* but differing by softer indumentum, larger sometimes serrulate terminal leaflet and campanulate calyx.

**Endemic. Ir.-Tur. element.** Treat category: **CR**



**Figure 4.6.** General appearance of *S. freyniana* Bornm.





**Map 4.5.** *S. freyniana* distribution map.

**6. *S. caespitosa*** Montbret & Aucher ex Bentham in Ann. Sci. Nat. ser. 2, 6:39 (1836). Syn: *S. pectinifolia* Fisch. & Mey., op. cit ser. 4, 1:33 (1854). Ic: Bull. Alp. Card. Soc. 39:105 (1971).

Dwarf suffruticose perennial forming mats to c. 60 cm diam. **Stems** pro-cumbent to ± erect, eglandular pubescent below, pubescent to villous above with some capitate glandular hairs. **Leaves** pinnatisect, obovate in outline, crenate, terminal segments ± lanceolate, 0.6-3 x 0.1-1 cm, with 2-4-pairs of lateral ± oblong segments; **petiole** 0.5-2 cm, often long-ciliate. Racemes condensed, scarcely exceeding leaf level. **Verticillasters** 2-6-flowered. **Bracts** ovate, acuminate, 11-15 x 5-12 mm; **bracteoles** present. Pedicels 3-6 mm. **Calyx** campanulate, often purplish, 10-16 mm, to 18 mm in fruit, indumentum variable, from eglandular pilose/villous with sessile glands to densely capitate-glandular. **Corolla** violet-blue to lilac-pinkish (rarely white), 18-30 mm; tube straight, 11-20 mm annulate. **Stamens** A. **Nutlets** rounded trigonous, ± spherical, 2.7x2.5 mm. Chromosome count:  $2n = 14$ .

The **pollen** of *S. caespitosa* is isopolar and oblate with  $P = 43.95 \pm 3.92 \mu\text{m}$  and  $E = 49.85 \pm 5.40 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $38.59 \pm 3.35 \times 5.27 \pm 0.82 \mu\text{m}$ . The exine is  $1.33 \pm 0.15 \mu\text{m}$  thick and the intine is  $0.83 \pm 0.15 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* (5- )6-7. Rocky limestone and igneous slopes, terraces, 1400-2700 m.

Type: [Turkey B6 Sivas] in Monte Saru-tchitchek (Sarıçiçek) in Cappadocia Orientali, Montbret [2015] (iso. W!).

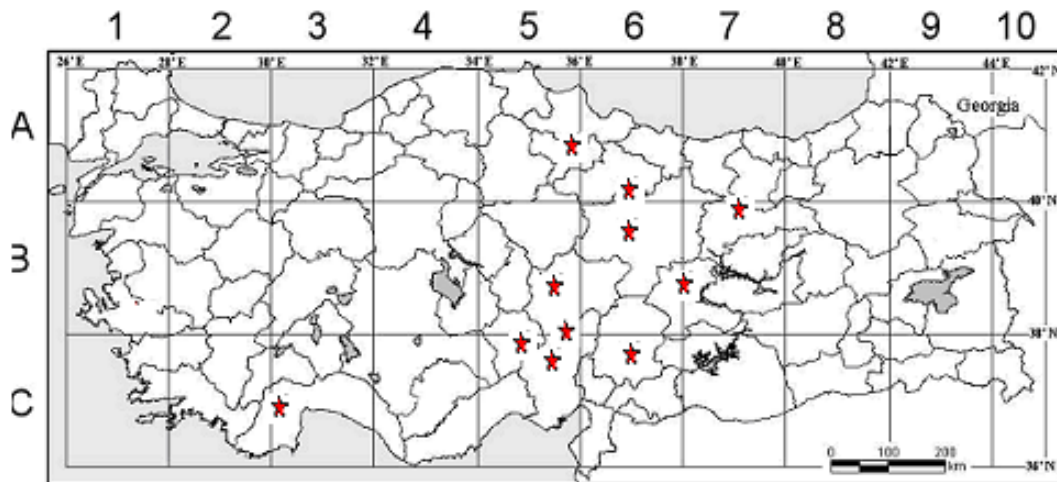
**Mainly C. & S. Anatolia.** A6 Sivas: 36 km N. of Sivas, 2000 m, Sorger 69-53-13! B5 Kayseri: Bakir Da. at Akoluk Y. above Kisge, 2000 m, D. 19455. B6 Sivas: Sivas to Ulaş, 27 km S. of Sivas, 1450 m, Hub.-Mor. 13037! Sivas: Ulaş, between Kurtlukaya village to Boğazdere village, 39 23 142 N 36 55 898 E, 1405 m, 17 v 2008, SBagherpour 523! Kayseri: Pınarbaşı S. of Y.Bayçayırı toward Sariz, 8 km past Kızkaçlı köy, 38 29 931 N 36 26 848 E, 1698 m, 8 vi 2006, SBagherpour 320! Pınarbaşı Şirvan Dağı batısı near TRT radar station old US military road, 38 39 694 N 36 23 765 E, 2127 m, 8 vi 2006, SBagherpour 325! Pınarbaşı Şirvan Dağı doğusu Keklikpınar village hills, 38 42 824 N 36 24 624 E, 1609 m, 11 vi 2008, SBagherpour 431! Sivas: Pınarbaşı-Gürün arası, Güneşli köyü road crossing 1-2 km after the hills, 38 49 947 N 42 03 517 E, 1869 m, 6 vii 2007, AKahraman 1404! Yağdonduran geçidi çevresi, near radio station, 1650-1850 m, 8 vii 2006, AKahraman 1248! Maraş: Nurihak Da. to Elbistan, 2400 m, Stn. & Hend. 5630! Kahramanmaraş: Göksun, Ericcek, Berit Da, above Kınıköz village, 38 00 793 N 36 49 966 E, 2496 m, 24 vii 2006, FCElep 1195! Adana: d. Saimbeyli, Bozoglan Da. above Obruk Y., 2000 m, D. 19712. B7 Sivas: Arapkir-Divriği arası, Sarıçiçek köyü, 1772 m, 25 vii 2008, AKahraman 1587! Erzincan: Hochadur Da. (Sernek Da. nr Gemergop), Sint. 1890:2676! Malatya: Ak Da., between Malatya and Kjachta, 2400 m, Hand.-Mazz. 2319! C3 Antalya: Tahtalı Da., Kemer, 2200 m, D. 14173. Antalya: Kemer, top of Tahtalı Mountain, 36 32 338 N 30 26 347 E, 2200-2300 m, 9 vi 2008, FCElep 1520! Antalya: Merkez, above Feslikan Yaylası, Karçukuru mevki, 36 48 693 N 30 23 098 E, 1929-1950 m, 3 vii 2006, FCElep 1154! C5 Niğde: Ala Da., N. part, Ulupınar Y., 2000 m, Spitzenberger 146!

Close to *S. pachystachys*. A variable species in leaf shape, indumentum and flower color. In this and the following species, indumentum characters have been unduly emphasized in the past; in the same population there may occur glandular and eglandular forms or strongly villous/ pilose and sub glabrous forms.

**Endemic. Iran Turan Element.** Treat category **NT**



**Figure 4.7.** General appearance of *S. caespitosa* Montbret & Aucher ex Benth.



**Map 4.6.** *S. caespitosa* distribution map.

7. *S. wiedemannii* Bois., Fl. Or. 4:599 (1879). Syn: *S. wiedemannii* Boiss. var. *polychaeta* Bornm. in Feddes Rep. 5: 168 (1908).



Perennial suffruticose herb. **Stems** ± erect, 15-30 cm, usually branched above, eglandular-scabridulous with short or longer often antrorse white hairs and some sessile glands. **Leaves** pinnatisect with two pairs of lateral segments, terminal segment linear-oblong to linear-obovate, 1-3(-4) x 0.1-0.6(-1) cm, eglandular with very short antrorse hairs, depressed punctate, margins entire; petiole 0.2-1 cm, long-ciliate. **Verticillasters** 2-8(-10)-flowered, ± approximating. **Bracts** ovate, 2-10 x 1-5 mm; **bracteoles** present. **Pedicels** 2-5 mm. **Calyx** reddish-purple, tubular-campanulate to campanulate, 6-14 mm, to 10-15 mm in fruit, villous with many sessile glands. **Corolla** lilac-blue, 12-22 mm; tube c. 12 mm, annulate; upper lip straight. Stamens A. **Nutlets** rounded trigonous, oblong, c. 3 x 2 mm. Chromosome count: 2n = 14, 15, and 16.

The **pollen** of *S. wiedemannii* is isopolar and prolate-spheroidal with P = 43.81 ± 5.84 µm and E = 42.21 ± 3.76 µm. The aperture is hexacolpate and the colpi = 37.29 ± 5.92 x 4.37 ± 0.72 µm. The exine is 1.19 ± 0.26 µm thick and the intine is 0.63 ± 0.13 µm. Its ornamentation is bireticulate.

*Fl. 5-7. Limestone slopes, in Artemisia steppe with Pinus nigra, roadsides and fieldsides, 500-1400 m.*

Type: [Turkey A3 Ankara] prope Kadikioi, Wiedemann [340] (holo. G!).  
C. (western) Anatolia.

A3 Ankara: Beypazari, Elma Beli, 40 10 289 N 31 51 520 E, 741 m, 04 vi 2005, SBagherpour 117! A3 Ankara: Fasil Dorugu Sariyar above Hassan polatkan dam. 40 02 542 N 31 26 735 E, 598 m, 31 05 2006, SBagherpour 237! A4 Ankara: 13 km E. of Beypazari, 700 m, Sorger 73-42-9! A4 Ankara to polatli, 20 km past ümitköy, 500 m to Başkent organize sanayi. 39 45 699 N 32 27 646 E, 822 m, 31 v 2006, SBagherpour 216! A4 Ankara: 21km past polatli, 39 34 541 N 31 55 304 E, 751 m, 10 v 2008, SBagherpour 413! B3 Eskişehir: 20 km past Alpu, toward Mehiliçik, hills above old Osmanli symmetry, 39 49 102 N 31 09 677 E, 849 m, 11 v 2008, SBagherpour 418! B3 Kütahya: 38 km from Kütahya to Eskisehir, 900 m, Hub.-Mor. 12718! Eskişehir: m Balcihisar, 950 m, D. 37182! B4 Ankara: m Tatlikuyu, Haymana to Sivrihisar, 800 m, Demiriz 2943! B4 Sıvrhisar 10 km to

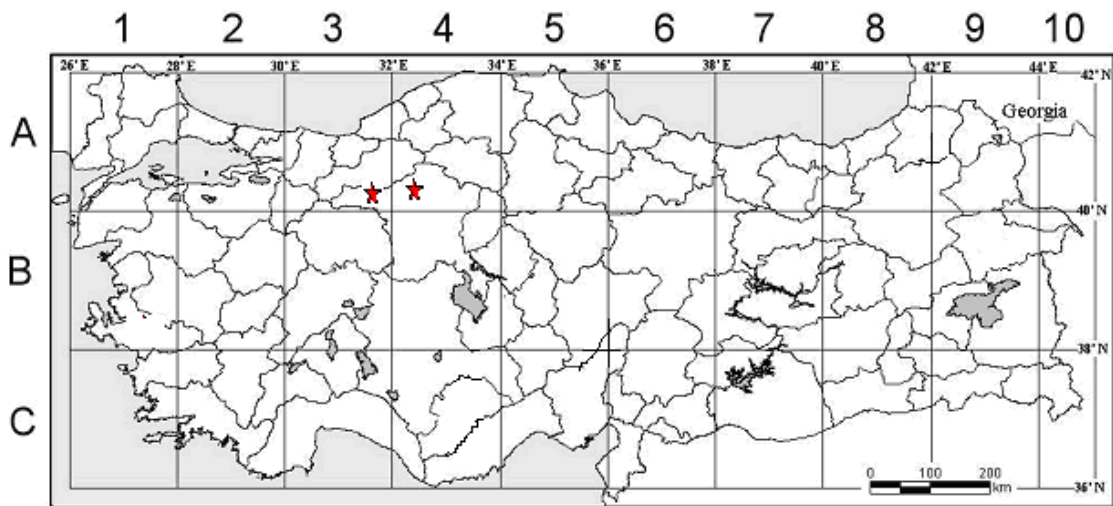
Beylikova, 39 37 053 N 31 09 018 E, 888 m, 31 v 2006, SBagherpour 231! B4  
Konya: 28 km from Sarayonu to Cihanbeyli, 830 m, Hub.-Mor. 14207.

Closest to *S. pisidica* but margins of leaflets always entire.

**Endemic. Ir.-Tur. element. Treat category: VU**



**Figure 4.8.** General appearance of *S. wiedemannii* Boiss.



**Map 4.7.** *S. wiedemannii* distribution map.

8. *S. tchihatcheffii* (Fisch. & Mey.) Boiss., Fl. Or. 4:598 (1879). Syn: *Dracocephalum tchihatcheffii* Fisch. & Mey. in Ann. Sci. Nat. ser. 4, 1:34 (1854)!

Perennial suffruticose herb. Sterile **stems** prostrate, leafy; fertile stems procumbent-ascending, unbranched, 10-20 cm, eglandular-pubescent .with sessile glands, hairs  $\pm$  retrorse. **Leaves** trisect or pinnatisect with 2 pairs of lateral segments, terminal segment linear oblong, 0.7-2.5 x 0.1-0.6 cm, glabrescent with sessile glands, entire or terminal segment apically toothed; **petiole** 0.3-0.8 cm, ciliate. **Inflorescence** a condensed  $\pm$  dense 'spike'. **Verticillasters** 2-6(-8)-flowered. **Bracts** ovate-acuminate 6-16 x 4-7 mm; **bracteoles** present. **Pedicels** 3-4 mm. **Calyx** tubular-campanulate, 8-11 mm, to 9-12 mm in fruit;" puberulent-ciliate with sessile glands. **Corolla** not squamulate, light violet to white, 10-15 mm; tube 7-10 mm, annulate; upper lip  $\pm$  straight. **Stamens** A. **Nutlets** rounded trigonous, ovoid, c. 3 x.2.3 mm. Chromosome count:  $2n=18$ .

The **pollen** of *S. tchihatcheffii* is isopolar and oblate-spheroidal to prolate-spheroidal with  $P = 41.56 \pm 7.11 \mu\text{m}$  and  $E = 40.55 \pm 6.89 \mu\text{m}$ . The aperture is hexacolpate and the colpi are long  $C = 36.57 \pm 5.18 \times 3.39 \pm 0.76 \mu\text{m}$ . The exine is  $1.21 \pm 0.20 \mu\text{m}$  thick and the intine is  $0.73 \pm 0.17 \mu\text{m}$ . Its ornamentation is reticulate.

*Fl.* 5-6. Limestone slopes, *Pinus brutia* woodland, vineyards, 400-1200 m.

Type: [Turkey B4 Ankara] [in vallibus herbosis sylvaticis montis] Kuredagh (Galatia), 950 m, Tchihatcheff (G!).

**C. (western) Anatolia.** A3 Eskişehir: Mayıslar, 400 m, Ekim 201! A4 Çankiri: 7 km S. of Çankiri, 670 m, Simon 69-403! A4 Ankara: Ankara ODTU. 39 51 586 N 32 47 481 E, 972 m, 24 v 2005, SBagherpour 102! A4 Ankara: Ankara to Kizilcahamam, 2 vi 1953, Çetik! B2 Kütahya: Kütahya to Bozüyük, 22 km S. of Inonu, 950 m, Hub.-Mor. 12720! B3 Eskişehir: Eskişehir to Kütahya, 880 m, Demiriz 1780! B3 Kütahya: 40 km from Kütahya to Eskişehir, 930 m, A. Bay top (ISTE 25368)! B4 Ankara: Polatlı to Haymana, 1100 m, Kasapligil 350!

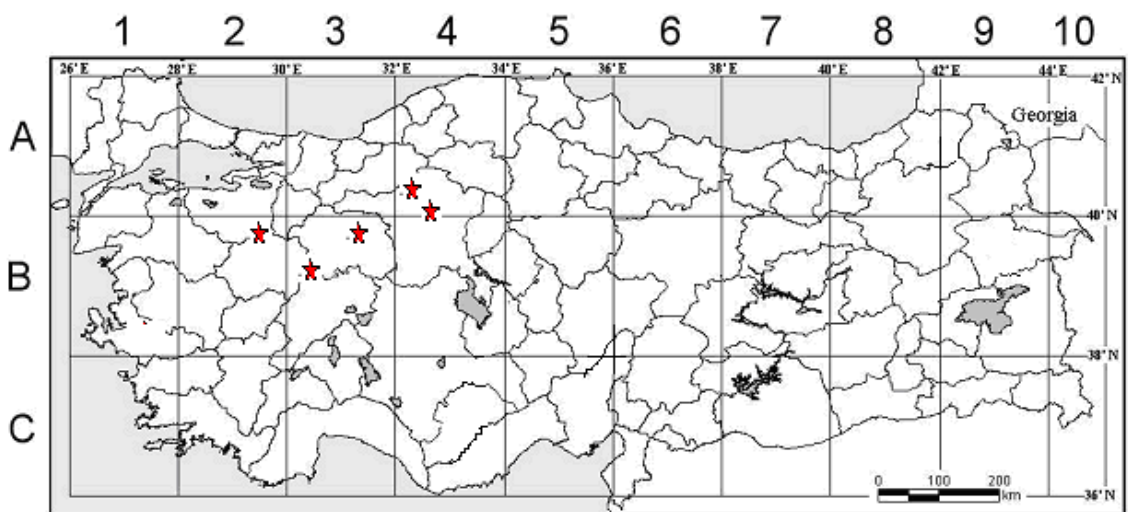


Endemic. Ir.-Tur. element. Distinctive among the suffruticose pinnatisect leaved species on account of the spike-like inflorescence, puberulent-ciliate calyces and small corollas.

**Endemic. Ir.-Tur. element. Treat category: VU**



**Figure 4.9.** General appearance of *S. tchihatcheffii* (Fisch. & Mey.) Boiss.



**Map 4.8.** *S. tchihatcheffii* distribution map.

9. *S. suffruticosa* Montbret & Aucher ex Benth in Ann. Sci. Nat. ser. 2, 6:39 (1836). Syn: *S. alexandri* Pobed. in Fl. URSS 21:653 (1954).

Perennial herb, somewhat suffruticose at base. **Stems** many, ascending, 30-60 cm, branched above, often yellowish-green, usually glabrous, occasionally pilose. **Leaves** pinnatisect, with 2-3 (-4) pairs of smaller lateral segments, ovate in outline, terminal segment lanceolate, 2.5-5.5 x 0.5-2 cm, , pilose on veins with 2-3 (-4) pairs of smaller lateral segments, pilose on veins with some sessile glands, serrulate to serrate. **Petiole** 1-3 cm. **Inflorescence** paniculate. **Verticillasters** 2-8 (-10)-flowered, distant. **Bracts** shorter than calyces, ovate-acuminate, 8-17 x 4-8 mm; bracteoles present. **Pedicels** 3-8 mm. **Calyx** campanulate, 10-12 mm, to c. 15 mm in fruit and broadening, sub glabrous to pilose-villous with dark sub sessile glands; upper lip tridentate. **Corolla** sulphur yellow or with lilac coloration, 22-25 (-28) mm, simple hairs on outside of upper lip; tube c. 15 mm, annulate; upper lip  $\pm$  straight. **Stamens** A, included upper lip of corolla, staminal connectives shorter than filaments. **Nutlets** rounded trigonous, ovoid, 4.5 x 3.5 mm. Chromosome count: Unknown.

The **pollen** of *S. suffruticosa* is isopolar and prolate-spheroidal with  $P = 45.76 \pm 4.78 \mu\text{m}$  and  $E = 44.01 \pm 4.21 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $38.79 \pm 5.21 \times 4.56 \pm 1.11 \mu\text{m}$ . The exine is  $1.22 \pm 0.19 \mu\text{m}$  thick and the intine is  $0.79 \pm 0.17 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl. 4-7, banks in steppe, fallow fields, cornfields, vineyards, 300-2000 m.*

**Type Specimen:** [Turkey B6 Maraş] ad Akdog in Tauro Orientalis, [1834], Aucher [2131] (holo. G, iso. W! K!).

**Inner Anatolia (mainly eastern and southern parts).** A4 Çankırı: Kalecik to Çankırı, D. 21453. B4 Ankara: Middle Technical University, next to indoor swimming pool, 39 51 586 N 32 47 481 E, 972 m, 10 v 2005, SBagherpour 104!, Mamak, foots of Hüseyingazi hills, 1000 m, 19 v 1980, K. Alpınar 52401 (ISTE!).

B5 Kayseri: Yahyalı, Sazak, Zamantı Vadisi, 1350 m, 1 vi 1978, A. Baytop, E. Tuzlacı and K. Alpınar 40150 (ISTE!). B6 Sivas: Divriği to Kangal 1km to Kayaburun Köy at Mürsel cross road, 39 17 465 N 38 01 875 E, 1183 m, 17 v 2008, SBagherpour 429! Divriği to Kemaliye, near Maltepe village, 39 29 32 N 38 06 51 E, 1395 m, 6 vi 2006, AKahraman 1180! Malatya: Kangal-Hekimhan road, near Hasançeşlebi village, 2 vi 2008, AKahraman 1527! B8 Muş: Muş to Erzurum, 26 km N. of Muş, c. 1400m, M. Zohary 57121. B9 Van: Van to Değirmen köy, 38 30 773 N 43 29 572 E, 1932 m, 8 vi 2008, AKahraman 1574! Muş: Malazgirt, Aktuzla village, 1600 m, 21 iv 2001, S. 1243 (VANF!) C4 Konya: 50 km from Konya to Bozkır, 1070 m, Hub.-Mor. 8374. C5 Niğde: Ulukışla, 12 vi 1937, Reese. C6 Maraş: 15 km W. of Maraş, valley of Ceyhan river, 500 m, 5 v 1957, D. 27440 (E!), Hatay: İskenderun, Amanos Mountains, 700 m, 5 v 1968, Y. Akman 7695 (ANK!). C7 Urfa: Urfa to Hilvan, 600 m, D. 28189 (ANK!). C8 Mardin: 5-10 km from Nusaybin and Mardin, 600 m, 22 v 1957, D. 28402 (ANK!), Siirt: Ramana Da., 20 km from Hasankeyf to Batman, 730 m, D. 42978.

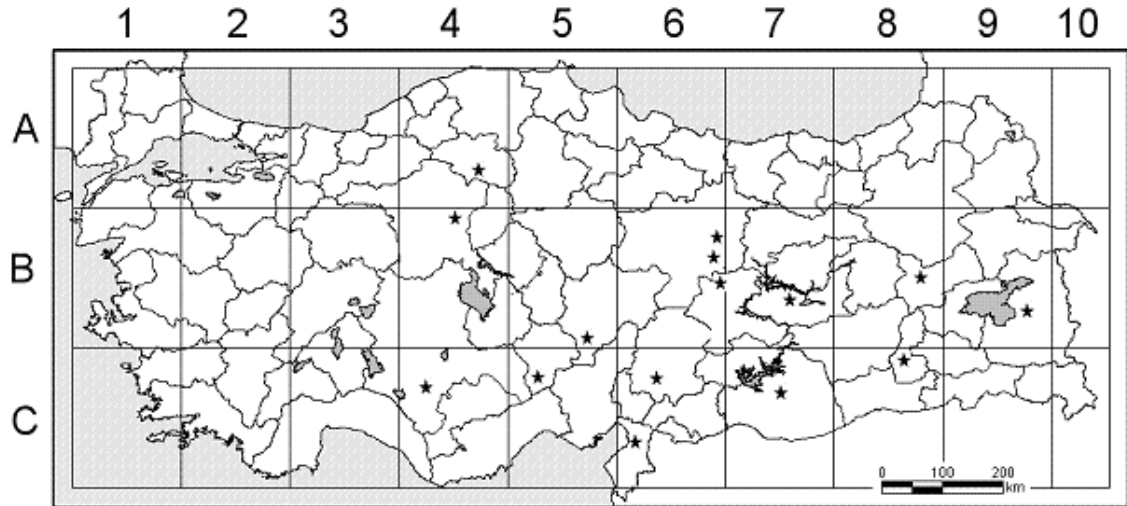
**Soviet Armenia, Syrian Desert, N. Iraq, N.W. and W. Iran. Ir.-Tur. element.** Threat category: **LC**

In its most typical form, *S. suffruticosa* is characterized by the large yellow corollas, the almost glabrous stems and pinnatisect leaves. It is, however, variable in bract size, number of flowers to the verticillasters and the density and type of calyx indumentum. Color variants in which lilac is present may indicate hybridization with *S. bracteata* (see below).





**Figure 4.10.** General appearance of *S. suffruticosa* Montbret & Aucher ex Bentham.



**Map 4.9.** *S. suffruticosa* distribution map.

**10.** *S. heldreichiana* Boiss. ex Bentham in DC., Prodr. 13: corrigendum — post p. 737 (1852). Syn: *S. benthamiana* Boiss. ex Bentham in DC, Prodr. 12:269 (1848)! non Gardn. & Field (1844); *S. russeggeri* Fenzl, Del. Sem. Vindob. 4 (1851) nom. nud.; *S. brevispicata* Davis in Kew Bull. 6:96 (1951)!

Perennial shrub **stems** much branched, 25-50 cm, to 1.5 m. Young shoots  $\pm$  erect, leafy, pilose and villous with some sessile glands below, short hairs  $\pm$  retrorse, glandular-pilose to -villous above with capitate glandular hairs. **Leaves** trisect, terminal segment much larger than laterals, broadly elliptic to obovate, 1-2.6 (-3) x 0.5-1.8 cm, glabrous, pubescent and villous with numerous sessile glands to glabrescent, serrulate to crenulate; **petiole** 0.4-1.8 cm, long ciliate. **Inflorescence** ca. 5-10 cm long. **Verticillasters** 2-6-flowered, forming an ovoid or elongated oblong spike. Bracts ovate-acuminate, often tinged reddish-purple, c. 20-35 x 7-12 mm; **bracteoles** present. **Pedicels** 1-4 mm. **Calyx**  $\pm$  tubular infundibular, 14-17 mm, **scarcely accrescent** to 16-20 mm in fruit, often purplish, glandular-ciliate, bilabiate, upper lip tridentate, ovate-lanceolate, acute to acuminate, median tooth shorter. **Corolla** blue-purple, (20-) 25-35 mm; tube straight and gradually wider towards throat c. 20 mm, not squamulate, annulate. **Stamens** A. Anther 3-4 mm, upper theca ca. 3 mm, lower theca ca. 1 mm, filaments ca.



5-6 mm. **Nutlets** rounded, oblong, c. 4 x 3 mm, brown. Chromosome count:  $2n = 14, 15, 16$ .

The **pollen** of *S. heldreichiana* is isopolar and oblate with P = 49,  $61 \pm 1$ , 83  $\mu\text{m}$  and E = 52,  $39 \pm 4$ , 74  $\mu\text{m}$ . The aperture is hexacolpate and the colpi = 41,  $16 \pm 1$ , 74 x 4,  $08 \pm 0$ , 52  $\mu\text{m}$ . The exine is 0,  $81 \pm 0$ , 08  $\mu\text{m}$  thick and the intine is 0,  $68 \pm 0$ , 08  $\mu\text{m}$ . Its ornamentation is bireticulate.

*Fl. 6-8. Limestone slopes, with Pinus nigra and Quercus, screes, fieldsides, 900-2000 m.*

Syntypes: [Turkey C5 Icel] in monte Tauro prope Gülek Bogas, Kotschy 437 (G!); [Turkey B4 Konya] in collibus aridis Lycaoniae ad Karaman, Heldreich (G!).

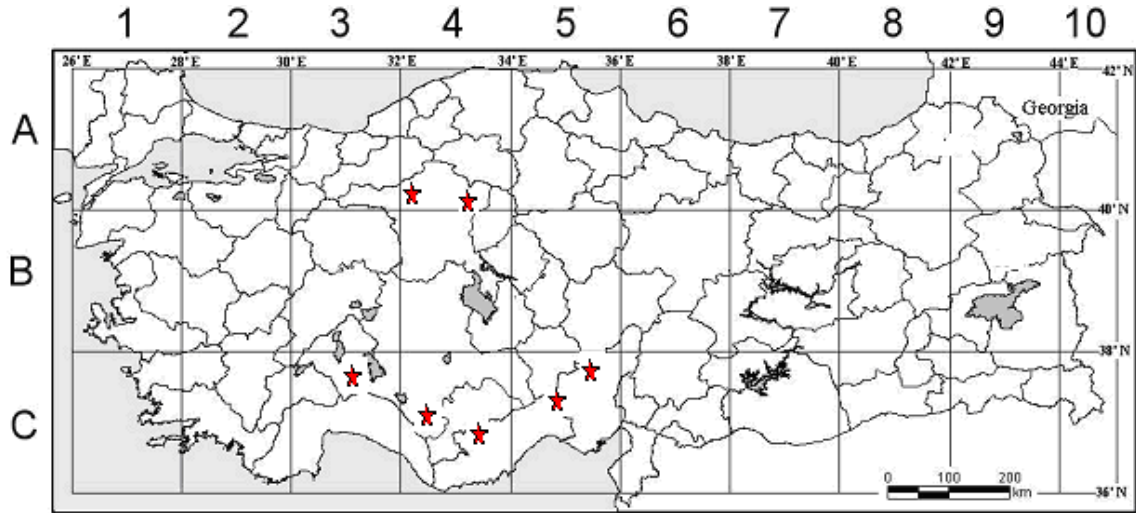
**Mainly S. Anatolia.** B/C3 Isparta: Sarkikaraagac to Beyşehir, Sezik & Cubukcu 14! B3 Isparta: Sarkikaraagac, Kale Da., 1250 m, Simon 75-079. B4 Ankara: Elma dağ on the road to kırıkale, 39 55 346 N 33 15 826 E, 1084 m, 05 vii 2005, SBagherpour 136! C3 Konya: 19 km from Sarkikaraağaç to Beyşehir, 1100 m, Hub.-Mor. 8380! Isparta: 17 km S.W. of Sarkikaraagac, 1350 m, Sorger 66-44-18! C4 Konya: Karaman to Mut, 11 km S. of Karaman, 1350 m, Hub.-Mor. 17190! Icel: 33 km W. from Silifke to Gülnar, c. 900 m, Hub.-Mor. 9590! C5 Adana: d. Karaisali, Pozanti to Asmancik Y., 1230 m, Hub.-Mor. 15299! Niğde: 20km from Ulukisja, 12 vi 1937, Reese! Konya: d. Eregli, Aydos Da., 1700 m, Erik 2445!

Distinctive among this group of trifoliate-pinnatisect species on account of the shrubby habit, large terminal leaflets, large usually colored bracts and spike-like inflorescences.

**Endemic. E. Medit. element.** Treat category **NT**



Figure 4.11. General appearance of *S. heldreichiana* Boiss. Ex Bentham.



Map 4.10. *S. heldreichiana* distribution map.

**11. *S. bracteata*** Banks & Sol. in Russell, Aleppo 2(2):242 (1794).

Perennial herb, somewhat suffruticose at base. **Stems** several, branching above, 20-50 cm, often purplish, ascending or erect, densely glandular pilose-villous, sometimes with long eglandular-villous hairs. **Leaves** pinnatisect, with an ovate to oblong terminal segment 1-7 x 0.7-3.5 cm and 1-2 pairs of smaller lateral segments, ± densely eglandular-glandular and sessile gland present pilose, serrulate; petiole 1-5 cm, sparsely ciliate. **Inflorescence** paniculate. **Verticillasters** 5-10-flowered, distant, ± enclosed by sub membranous floral leaves, c. 15-30 x 9-17 mm. **Bracts** many 0.9-3.2 x 0.5-2.0 cm, purplish; **bracteoles** present. **Pedicels** 1-5 mm. **Calyx** tubular-infundibular, 5-16 mm, scarcely expanding in fruit, glandular-villous. **Corolla** pink to purplish, 20-30 mm; tube 14-20 mm, irregularly annulate; upper lip straight. **Stamens** A. **Nutlets** ± spherical, C. 3.5 x 3 mm. Chromosome count: Unknown

The **pollen** of *S. bracteata* is isopolar and oblate with  $P = 41.73 \pm 1.72 \mu\text{m}$  and  $E = 47.77 \pm 5.89 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $34.92 \pm 2.20 \times 5.81 \pm 2.26 \mu\text{m}$ . The exine is  $1.42 \pm 0.19 \mu\text{m}$  thick and the intine is  $0.65 \pm 0.12 \mu\text{m}$ . Its ornamentation is reticulate.

*Fl. 5-7. Igneous and calcareous slopes, with Quercus brantii, fallow fields, edge of vineyards, roadsides, waste places, 2000 m.*

Type: [Syria] Aleppo, Russell.

**Widespread, especially in Anatolia.** A1 (E) Tekirdag: Çorlu to Seymen, 50 m, Dudley (D. 34500)! A2(A) Bilecik: Beldos nr Bilecik, 500 m, Bornm. 1899:5426! A4 Ankara: Ayaş road around Ayaş beli, 40 01 371 N 32 20 482 E, 1052 m, 04 vi 2005, SBagherpour 107! A4 Cankiri: Eldivan exiting city limit 1km to Sarayköy, 40 31 756 N 33 29 205 E, 991 m, 01 vi 2006, SBagherpour 254! A5 Amasya: nr Merzi-fon, Maniss. 504! A6 Tokat: Tokat, Wiedemann! A7 Sivas: Suşehri to Refahiye, 1580 m, Hub.-Mor. 11861! A8 Erzurum: nr Ispir, Bourgeau 1862:217! B2 Kütahya: 8 km from Simav to Gediz, 900 m, Demiriz 2095! B3 Afyon: 6 km from Dinar to Denizli, Hub.-Mor. 5198! B3 Eskişehir: Sivirhisar 72 km to Eskişehir, 39 29 303 N 31 16 380 E, 1018 m, 31 v 2006, SBagherpour 229! B4 Ankara: Ankara, Freres E.C. 48! B5 Nevşehir: 8 km S.E. of

Urgüp, 1200 m, Sorger 64-32-32! B5: Pınarbaşı 20-25 km to Sariz 37 50 276 N 42 73 506 E, 1720 m, 13 vii 2005, SBagherpour 199! B6: Sivas: Zara 16 km to Imranli near Adam Faka village, 39 52 280 N 37 56 995 E, 1650 m, SBagherpour 518! B7 Elazig: Elazig to Kale, 1200 m, D. 28946! B8 Erzurum: nr Aşkale, 1950 m, M. Zohary 67162! C2 Denizli: 8 km from Tavas to Cukur Köy, 1150 m, Hub.-Mor. 5194! C3 Burdur: 10 km from Burdur to Bucak, Hub.-Mor. 5201! C4 Konya: 24km from Beyşehir to Akseki, 1110m, Hub.-Mor. 8369! C6 Gaziantep: Karkmiş 2 km to Nazip N36.58205 E 37.46307, 490 m, 21 iv 2007, SB386! C7 Urfa: Karacadag, Siverek to Diyarbakir, 1250 m, D. 28314! C8 Diyarbakir: 8 km from Diyarbakir to Cinar, 650 m, D. 28765!

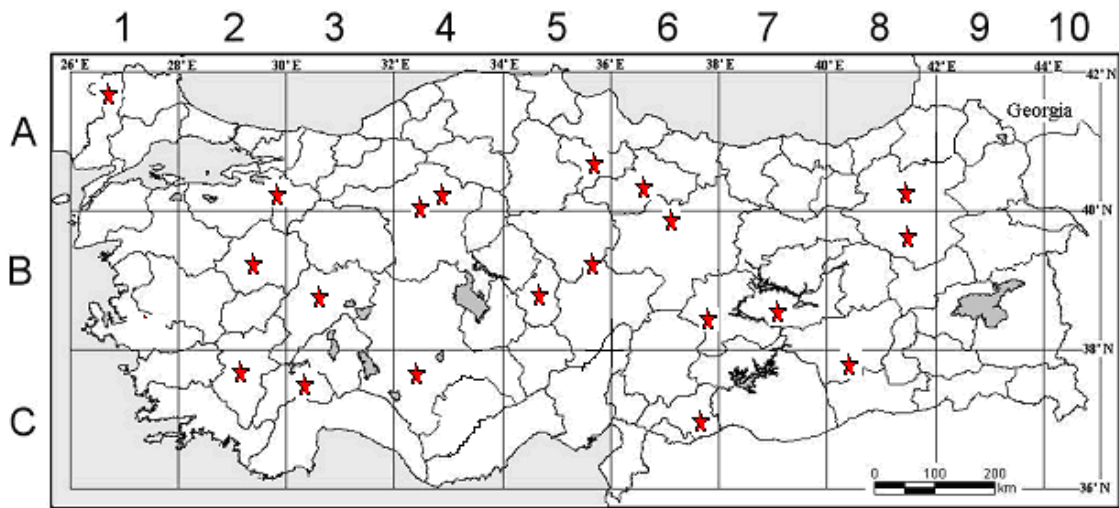
Palestine, Syrian Desert, N. Iraq, N.W. & W. Iran. **Ir.-Tur. Element.** Threat category: **LC**

Characterized by the large colored floral leaves, numerous bracts and pink to purple corollas. A relatively constant species in most of Anatolia, but variable in the S.E. (e.g. C7, C8) where it intergrades with *S. trichoclada*. *S. bracteata* forms fertile hybrids with the clearly distinct *S. suffruticosa* (e.g. B7 Elazig: Elazig to Pertek, 1300 m, D. 29191!). Sex forms are also not uncommon.





**Figure 4.12.** General appearance of *S. bracteata* Banks & Sol.



**Map 4.11.** *S. bracteata* distribution map.

**12.** *S. reeseana* Hedge & Hub.-Mor. In Notes Roy. Bot Gard. Edinburgh 22: 177 (1957).

Perennial herbs, somewhat suffruticose at base. **Stems** several, 35-50 cm, often purplish, ascending or erect, the indumentum which consists entirely of short crisp eglandular hairs  $\pm$  uniform in length. **Leaves** pinnatisect, with an ovate-oblong terminal segment c. 3.5 x 1.5 cm and 1-2-pairs of smaller lateral segments 2.5 x 0.7cm,  $\pm$  densely eglandular-pilose with some sessile glands, serrulate; petiole 1-2 cm, sparsely ciliate. **Inflorescence** paniculate. **Verticillasters** 4-8-flowered, distant,  $\pm$  enclosed by sub-membranous floral leaves, c. 15-30 x 9-17 mm. **Bracts** many, purplish; bracteoles present. **Pedicels** c. 2 mm. **Calyx** tubular-infundibular, c. 10 mm, scarcely expanding in fruit, glandular-villous. **Corolla** pink to purplish, c. 15 mm; upper lip straight. **Stamens** A. **Nutlets** unknown, c. 3.5 x 3 mm. Chromosome count: unknown.

Pollen description: unknown.

FL .6. *Igneous and calcareous slopes, fieldsides, 700-1400 m.*

Type: [Turkey A6 Tokat] 15 km N Tokat, gegen Artova, c. 1400 m, 14.vi.1939, H.Reese (holo. Hb. Hub.-Mor.) (G-00000038) photo!

**Central Anatolia.** A3 Ankara: Beypazari, Elma beli, 700 m, Yamane 957 (ANK)!

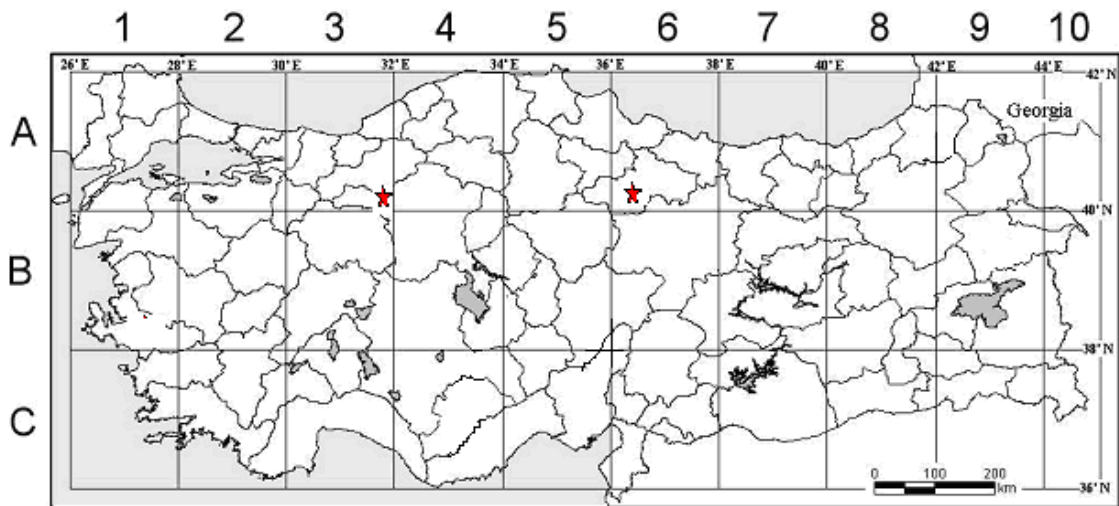
**Endemic. Irano-Turanian element.** Treat category: **EN**



This species is known only these two localities. Similar to *S. bracteata* in facies, vegetative and floral structure but differing by the indumentum which consists entirely of short crisp eglandular hairs  $\pm$  uniform in length. During the last tree years field work this specimen was not found.



**Figure 4.13.** General appearance of *S. reeseana* Hedge & Hub.-Mor. holotype (Huber-Morath Herbarium)



**Map 4.12.** *S. reeseana* distribution map.

#### 4.2.2 Section *Hymenosphace* Benth.:

Shrubs, chamaephytes or perennial herbs. Calyx strongly accrescent. Otherwise similar to Sect. *Salvia*.

Species for Sect. *Hymenosphace*:

#### 13. *S. cadmica* Boiss.

SYNONYM: *S. conradi* Stapf in Denkschr. Akad. Wiss. Wien, Math.-Nat. Kl. 50(2): 97 (1855)., *S. cadmica* Boiss. var. *brachycalcycina* Bornm. in Beih. Bot. Centr. 24(2): 487 (1909).

Perennial herb with a woody rootstock. **Stems** few or many, ascending to erect, usually unbranched or rarely branched, (8) 20- 35 cm, densely (or not) glandular pilose and eglandular villous. **Leaves** mostly basal, ovate, ovate-oblong to elliptic, obovate, simple or with 1-2 pairs of small lateral segments, 10-50 x 5-35 mm, rugulose, crenulate, densely (or not) eglandular villose and glandular pilose with sessile glands; petiole 1.0 – 5 (6) cm. **Inflorescence** racemose, (7) 10-30 cm long, clearly exceeding leaves with 4 – 8 (9) verticillasters, each verticillasters with 2–10 (12) flowered; internodes 1.5 – 4 cm long. **Bracts** broadly ovate - acuminate, 1.0 – 2.1 x 1.4 – 2 cm, green, villose and glandular pilose hairy with sessile glands. **Pedicels** 2-4 mm. Calyx campanulate, 12 – 20



mm, up to 28 mm in fruit, mainly green (or rarely purplish green), eglandular-glandular villose and glandular pillose with sessile glands, broadening and membranous with increasingly divergent lips in fruit; upper lip subentire. Corolla entirely white (with yellow spotted lower lip), 27 – 33 mm, sparsely villose and glandular hairy outside, not squamulate; tube 17 – 25 mm, straight below, gradually widening above, annulate. **Stamens** type A; staminal connectives shorter than filaments; upper theca 2-3 mm; the lower theca 1.5 – 3 mm; connective 4 – 6 mm. Style tip white, glabrous, 25 – 32 mm, long exerted from corolla lips and divided in two part at apex. Nutlets globose, 3-3.5 x 2-3.2 mm, brown and smooth to slightly tuberculate. Chromosome count: 2n=14, 16.

The **pollen** of *S. cadmica* is isopolar and oblate with  $P = 49.36 \pm 3.99 \mu\text{m}$  and  $E = 51.44 \pm 3.82 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $44.14 \pm 3.92 \times 8.20 \pm 0.64 \mu\text{m}$ . The exine is  $1.34 \pm 0.12 \mu\text{m}$  thick and the intine is  $0.62 \pm 0.01 \mu\text{m}$ . Its ornamentation is bireticulate.

Lectotype: [Turkey C2 Denizli] in *Cadmo orientali* (Honaz Da.) supra Colossam (Honaz), vi 1842, Boissier (holo. G! iso. W!).

**N.W., C. & S.W. Anatolia.** A3 Sakarya: Therakli (Tarakli), Wiedemann. A4 Ankara: Ayaş Da., 1500 m, Akman 6636! B2 Eskişehir: Beylikova 7-8 km to Miheliçik off the main road from Beylik 500m to Kayıköy, 1070 m, 31 v 2006, SBagherpour 233! Uşak: Murat Da., nr Gürlek, 1100 m, A. Baytop (ISTE 39430)! B3 Konya: Sultan Da., 1100m, Bornm. 1899:5427! Eskişehir: 13 km from Sivrihisar to Haymana, 1120 m, Demiriz 2973! Afyon: d. Dinar, Karakuyu, 1000 m, Hub.-Mor. 9595! Bilecik: Karakoy, 21 v 1950, Heilbronn & Attila! B4 Ankara: Elmadağ before Odtü Kayak merkezi roadside, 39 49 255 N 32 57 707 E, 1468 m, 09 vi 2005, SBagherpour 125! B4 Ankara: Haymana 35km to Polatlı just few km past Haymana, 39 28 205 N 32 27 888 E, 1004 m, 14 v 2007, SBagherpour 391! C2 Mugla: Ujuklu (Oyuklu) Da., 14 vi 1881, Luschan (type of *S. conradi*, as *S. lycia* Stapf, nomen)! Denizli: Honaz Da., 1300 m, Hub.-Mor. 5192! C3 Burdur: 16km from Burdur to Antalya, 1300 m, Dudley (D. 35673)! Antalya: Irmasan Gedigi, N. of Akseki, 1810 m, Nydegger 10851. Isparta: E. bank of

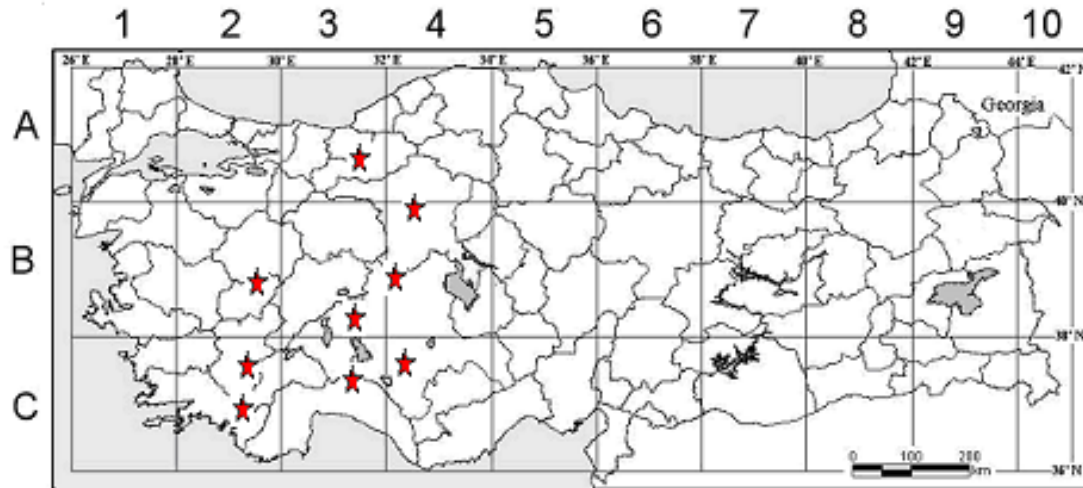
Egridir G., 1060m, Hub.-Mor. 8377! C4 Kenya: Dere Koy, 10 km W. of Konya, 1300m, Hub.-Mor. 8376!

Endemic. Characterised by the dwarf habit, usually entire leaves, long spreading glandular indumentum and the yellow-green, large fruiting calyces. Close to *S. smyrnaea* which is very similar in habit but apparently differing in calyx structure.

**Endemic. Ir.-Tur. element.** Threat category NT



**Figure 4.14.** General appearance of *S. cadmica* Boiss.



**Map 4.13.** *S. cadmica* distribution map.

**14.** *S. blepharochlaena* Hedge & Hub.-Mor. in Notes R.B.G. Edinb. 22: 178 (1957).

Perennial herb, woody at base. **Stems** ascending-erect, 10-30 cm, densely glandular-villous, clothed at base with petiolar remains. **Leaves** mostly basal, pinnatisect, oblong in outline, glandular-villous, with 3-5 pairs of lateral segments; terminal segment oblong-elliptic, serrate to serrulate, sessile, 10-22 x 4-8 mm; **petiole** to 10-50 mm. **Verticillasters** (2- )4c6-flowered,  $\pm$  distant. **Bracts** of median verticillasters broadly ovate, c. 1.2-4 x 0.8- 2 cm, cordate. **Pedicels** 0-3 mm. **Calyx** broadly infundibular, 12-24 mm, green or purplish-suffused, to c. 26 mm in fruit, with divergent lips, densely glandular-villous; upper lip subentire or indistinctly 3-toothed. **Corolla** not squamulate, white with a pale yellow upper lip and violet veined labellum, 27-50 mm; tube to 30 mm, broad, annulate. **Stamens** A. **Nutlets** very rounded trigonous, broadly obovate, c. 4.5 x 3.5 mm. Chromosome count:  $2n=14$ .

The **pollen** of *S. blepharochlaena* is isopolar and oblate with  $P = 55.71 \pm 7.35$   $\mu\text{m}$  and  $E = 58.37 \pm 3.88$   $\mu\text{m}$ . The aperture is hexacolpate and the colpi =  $47.33 \pm 6.78$  x  $5.98 \pm 2.32$   $\mu\text{m}$ . The exine is  $1.37 \pm 0.13$   $\mu\text{m}$  thick and the intine is  $0.73 \pm 0.10$   $\mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 6-7. Limestone and serpentine slopes, 1000-1620 m.

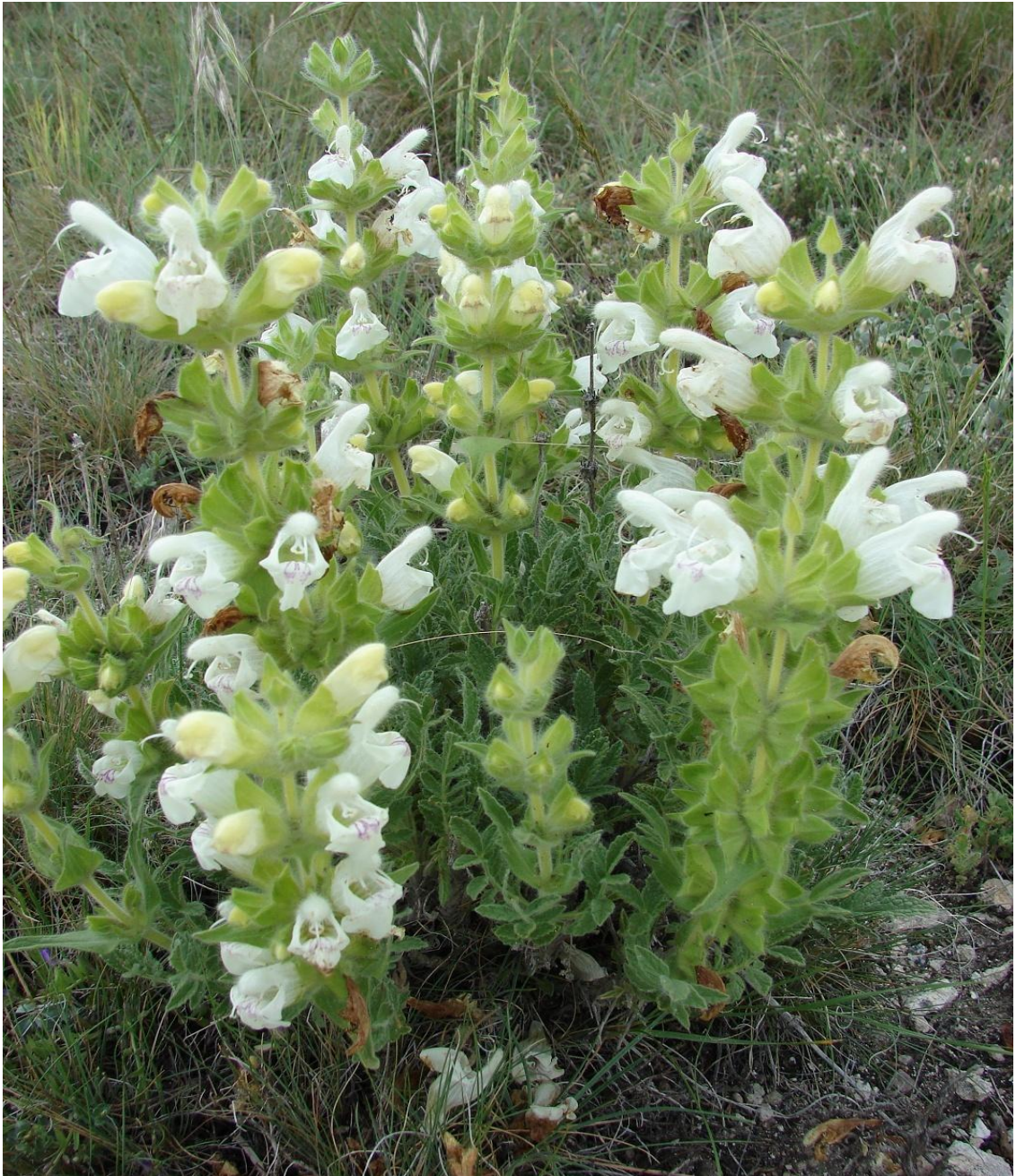
Type: [Turkey B6] Sivas: d. Kangal, Tecer-Giiriin, Gipsschutt, 37 km nordlich Tecer, 1570 m, 27 vi 1955, A. Huber-Morath 13048 (holo. Hb. Hub.-Mor.! iso. E!).

**C. Anatolia.** B4 Eskişehir: 5 km E. of Sofular, 1500 m, Sorger 64-20-1! B5 Nevşehir 8 km N.W. of Urgüp, 1000 m, Sorger 73-39-24! B5 Urgup: Karlik to Yesiloz, on the hills to the right. 38 33 195 N 34 59 481 E, 1304 m, 29 v 2008, SBagherpour 447! B6 Sivas: Gurun to Sivas, 58 km N. of Gurun, 1450 m, Hub.-Mor.·11858! B6 Kayseri: Sariz to Pinarbaşı,Sopan Da., 15 km S. of Pinarbaşı, 1620 m, Hub.-Mor. 1077! B6 Pinarbasi: 2km south of A. Baycayri, 38 38 800 N 36 26 605 E, 1032 m, 08 vi 2006, SBagherpour 321 ! C4 Konya: 10 km S. of Karaman on road to Mut, 14 vi 1950, Reese!

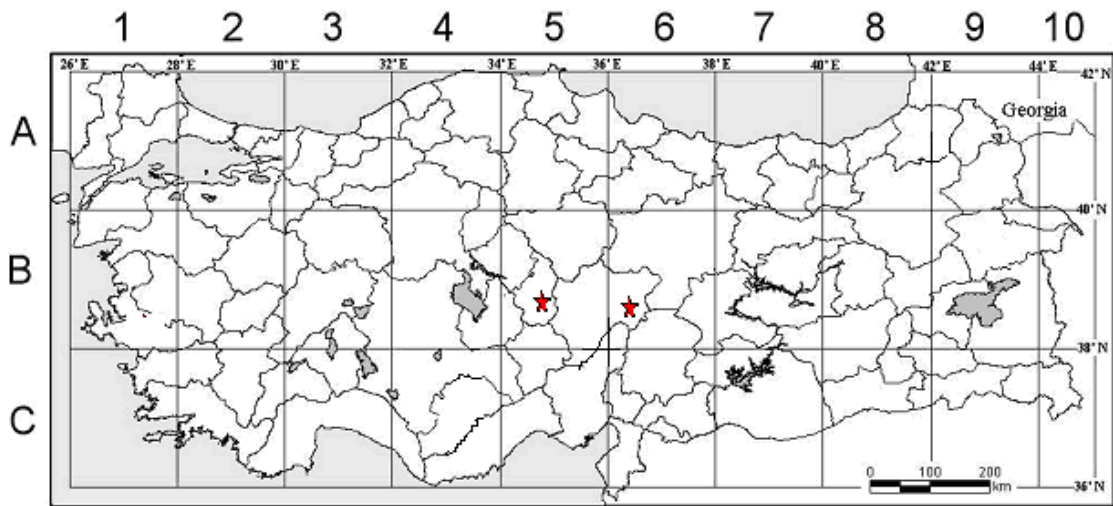
A very handsome plant" with similarities to *S. cadmica* and *S. pachystachys*. From the former it differs by its constantly pinnatisect leaves and larger tri-coloured corollas; from the latter, it differs by the densely glandular-villous indumentum covering the whole plant and the very large fruiting calyces.

**Endemic. Ir.-Tur. element.** Treat category: **VU**





**Figure 4.15.** General appearance of *S. blepharochlaena* Hedge & Hub.-Mor.



**Map 4.14.** *S. blepharochlaena* distribution map.

**15.** *S. euphratica* Montbret. & Aucher ex Bentham var. *euphratica*, Ann. Sci. Nat. Ser. 2, 6:40 (1836)

Tuft-forming aromatic perennial suffruticose herb. **Stem** ascending erect, glandular pilose to villous hairs, rarely eglandular, 25-50 (-60) cm, branched below, with sterile shoots. **Leaves** simple, ovate-oblong to elliptic, (1.5-) 2-7.5 x (0.7-) 1.3-4 cm, rarely with a pair of small lateral basal lobes, pilose to villous with sessile glands, rugose, crenulate to serrate. **Petiole** (8-)10-25 (-30) mm. **Inflorescence** unbranched, glandular pilose to villous, rarely eglandular; **verticillasters** (2) 4-10 (12) flowered, clearly distant. **Bracts** of upper verticillasters broadly ovate, shorter than calyces, 10-25 (35) x 10-23 (30) mm, pilose, green to purplish, lowermost leaf-like. **Pedicels** 3-7 mm, densely (e)glandular pilose to villous. **Calyx** green to purplish, glandular pilose to villous, rarely eglandular, broadly campanulate, (13) 15-20 (25) x (10)15-20 (23) mm in flowering, broadening and expanding to 17- 25 (40) x 17-25 (45) mm in fruit, fruiting calyces membranous. **Corolla** violet-blue to pinkish, 25-30 (40) mm, with simple hairs on outside of upper lip; tube 21-30 mm, slightly curved and widening towards throat ± annulate. **Stamens** A, staminal connectives shorter than filaments, filaments 4-6.8 mm, fertile anthers hairless, 2.5-4.1 mm and sterile anthers 1.2-2.1 mm; upper thecae 2.2-4 mm

and lower thecae 2-3.7 mm. Style (26-) 30-40(-44) mm, exerted from corolla lips  
Nutlets brownish to blackish, suboblate to rounded trigonous, 4.3-5.4 x 3.5-4.5 mm,  
hilum diameter 1-1.4 mm. Chromosome count: 2n=14.

The **pollen** of *S. euphratica* is isopolar and prolate with  $P = 54.25 \pm 8.68 \mu\text{m}$   
and  $E = 49.59 \pm 6.60 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $45.17 \pm 8.89$   
x  $3.70 \pm 1.13 \mu\text{m}$ . The exine is  $1.47 \pm 0.22 \mu\text{m}$  thick and the intine is  $0.68 \pm 0.17$   
 $\mu\text{m}$ . Its ornamentation is bireticulate.

*Fl:* 3-5. Rocky, marly banks and river fronts. 850-1800 m.

**Syntypes.** [Turkey] B7 Malatya: in Cappadocia orientale (Aucher no. 1516  
holotypes G!)

**Type:** [Turkey] B7 Erzincan: Eğin (Kemaliye), Salihli, in siccis montium,  
25.6.1890, Sintenis 1890: 2753 p.p. (holo. W iso LD WU)

B6 Malatya: Darende to Malatya, after 1-1.5 km from the exit of Darende, 1000 m,  
A.Kahraman 1098A! Sivas: Gürün to Gökpınar, after 9 km from Gürün, 1525 m,  
A.Kahraman 1226A! B7 Malatya: Beydağı Mountain, between Gündüzbey and Kozluk,  
1400 m, A.Kahraman 1116! between Arapkir and Divriği, near Çiğnir village, 1268 m,  
25 vii 2008, A.Kahraman 1585B! Sivas:Divriği to Kangal 10 km to Kangal, 1450 m, 13  
vii 2005, SBagherpour 192! Erzincan: Kemaliye (Taş Yol), near Gümüşçeşme village,  
around Fırat river, 1120 m, FCElep 883B!

*Salvia euphratica* Montbret. & Aucher ex Bentham var. *leiocalycina* (Rech. fil.) Hedge,  
Flora of Turkey, vol 7: 431.

Synonym: *S. leiocalycina* Rech. fil. in Öst. Bot. Zeitschr. 99: 51 (1952!).

*Salvia euphratica* var. *leiocalycina* differs from the typical variety of the species by  
having glabrous inflorescence, bracts and calyx. As well as, its bracts are usually longer  
than calyx and stems sometimes glabrous. According to our field observations, its calyx  
length is larger than the typical variety in the same populations. The field notes of A.  
Kahraman 1226 B are “bracts shorter than calyx” from Sivas-Gürün.



**var. *leiocalycina*** (Rech. fil.) Hedge, Flora of Turkey, vol 7: 431. Synonym: *S. leiocalycina* Rech. fil. in Öst. Bot. Zeitschr. 99: 51 (1952!).

**Type:** [Turkey] B7 Erzincan: Eğin (Kemaliye), Salihli, in siccis montium, 25.6.1890, Sintenis 1890: 2753 p.p. (holo. W, iso LD, WU)

B6 Malatya: From Malatya to Darende, before 64 km from Darende and 2 km from Develi village, 1325 m, A.Kahraman 1216! Sivas: Gürün to Gökpınar, after 9 km from Gürün, 1525 m, A.Kahraman 1226B! B7 Malatya: From Malatya to Yeşilyurt, after 1.5 km from the exit of Beydağı, 950 m, A.Kahraman 1114A! between Arapkir and Divriği, near Çiğnir village, 1268 m, 25 vii 2008, AKahraman 1585B! Sivas: between Karasarbeli pass to Kayaburun village, 1505 m, A.Kahraman 1155B! Erzincan: Kemaliye (Taş Yol), near Gümüşçeşme village, around Fırat river, 1120 m, FCElep 883A!

**Endemic. İnan-Turan.** Treat category NT

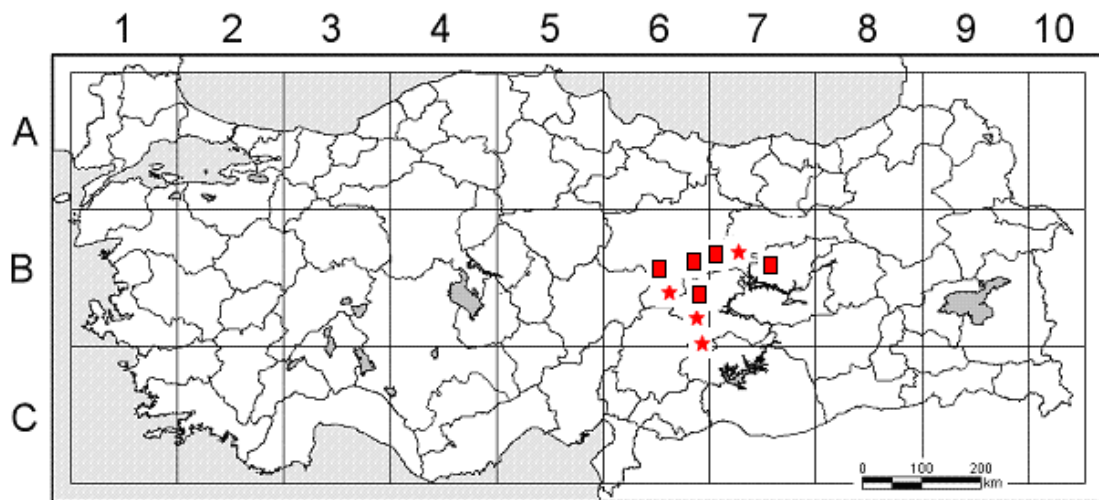


**Figure 4.16.** General appearance of *S. euphratica* Montberet & Aucher ex Bentham var. *euphratica*.





**Figure 4.17.** General appearance of *S. euphratica* Montberet & Aucher ex Bentham var. *leiocalycina* (Rech.) Hedge.



**Map 44.15.** *S. euphratica* var. *euphratica* (★), and var. *leiocalycina* (■) distribution map.

**16. *S. multicaulis*** Vahl, Enum. Pl. 1:225 (1805). Syn: *S. acetabulosa* Vahl, op. cit. 227 (1805) non L. (1767) excl. syn.; *S. szovitsiana* Bunge, Lab. Pers. 43 (1873); *Schraderia 'acetabulosa'* (Vahl) Pobed. in Fl. URSS 21:369 (1954); *Arischrada multicaulis* (Vahl) Pobed. in Novit. Syst. Pl. Vasc (Leningrad) 9:247 (1972). Ic: Fl. URSS 21: t. 18 f. 1 (1954), as *Schraderia acetabulosa*.

Perennial herb, mat-forming, with a woody rootstock. **Stems** erect, unbranched, 12-55, cm, usually glandular-pilose to -villous, especially above, rarely glabrous, rarely with dendroid hairs. **Leaves** simple, mostly with 1-2-pairs of small basal lobes, broadly ovate-elliptic to suborbicular, 2-4.5(-7) x 1-4.7 cm, rugose, crenulate, with a dense indumentum of  $\pm$  adpressed dendroid to dendroid-stellate hairs; petiole 1.5-6.5 cm. **Verticillasters** 4-10(~20)-flowered, usually -distant. Bracts broadly ovate, c. 4 x 25 mm; **bracteoles** present. **Pedicels** 1-5 mm, erecto-patent. **Calyx** campanulate, c. 8-27 mm, to C. 32 mm in fruit and broadening, sparsely to densely glandular-pilose or -villous, purplish-violet, rarely yellow-green; upper lip indistinctly 3-lobed. **Corolla** purplish-violet, rarely white, c. 10-18 mm; tube  $\pm$  straight, c. 12 mm, annulate, not squamulate ; upper lip  $\pm$  straight. **Stamens** A. **Nutlets** rounded trigonous, 3.5 x 3 mm, dark brown. Chromosome count:  $2n = 16, 18, 32$ .

The **pollen** of *S. multicaulis* is isopolar and prolate-spheroidal with  $P = 41.34 \pm 7.81 \mu\text{m}$  and  $E = 39.53 \pm 5.41 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $36.00 \pm 6.90 \times 4.58 \pm 1.15 \mu\text{m}$ . The exine is  $1.10 \pm 0.15 \mu\text{m}$  thick and the intine is  $0.68 \pm 0.13 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl. 4-7. Rocky limestone and igneous slopes, shale and sandy slopes, scree, fallow fields, in Quercus scrub, Artemisia steppe, amongst Cedrus, 550-2600 m.*

Type: 'Hab. in Oriente. Ex. Herb. Desfontainii' (holo. C-Vahl!).

**E. & adjacent C. & S. Anatolia.** A6 Sivas: Yıldızeli to Çamlıbeli , At the peak, below radio tower, 39 49 217 N 36 19 432 E, 1323 m, 12 vii 2005, SBagherpour 180! A7 Gümüşane: Gümüşane, 1400 m, Stainton 8323! A8 Erzurum: 27 km from Erzurum to Tortum, 1950 m, D. 47529! A9 Kars: W. Of Kağızman (Grossheim 7: map 449). B5 Kaysri: d. Develi, Bakırdağ to Saimbeyli, 1640 m, Hub.-Mor. 10745! B6 Sivas: Gürün

to Sivas, 17 km N. Of Gürün, 1680 m, Hub.-Mor. 11876! B6 Sivas: Ulaş, Tecer mountains, 2 km East of Tecerköy between the road and the railroad, 39 24 056 N 37 06 678 E, 1422 m, SBagherpour 432! B7 Malatya: Malatya to Pütürge, Kube Da., 1730 m, Hub.-Mor. 8975! B8 Erzincan: Tercan to Aşkale, 1600 m, D. 29341! B9 Van: 7 km from Van to Erçek, 1850 m, D. 44260! C5 Adana: d. Feke, Bakir Da., 1900 m, D. 19410! C6 Adana: d. Osmaniye, Yarpuz, 1600 m, Hub.-Mor. 14208! C7 Malatya: 74 km S.W. of Malatya, 1550 m, Sorger 71-45-25! C7 Şanlıurfa: Viranşehir, 61 km to Şanlıurfa, inside the pistation trees, 37 13 516 N 39 23 325 E, 657 m, 16 v 2008, SBagherpour 426! C8 Mardin: 10 km from Gerçüş to Hasankeyf, 750 m, D. 43011! C9 Mardin: Cudi Da. Above Hessana, 1300 m, D. 42841! C10 Hakkari: Zap river nr turning to Yüksekova, Trelawny 1307!

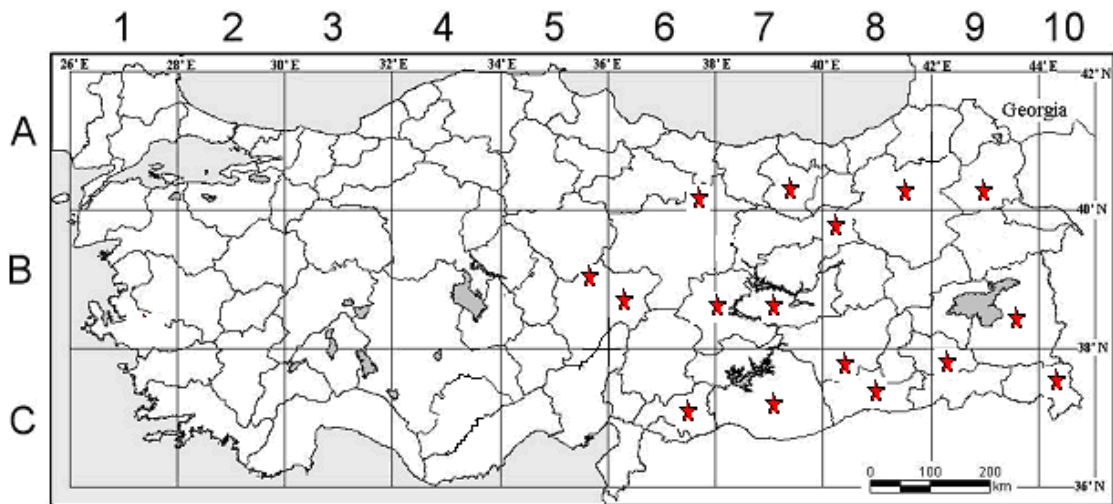
Varying considerably in leaf and stem indumentum ; specimens with the most clearly dendrois-stellate hairs are apparently from the most arid environments. A characteristic and often common steppe species of E. Anatolia. The bracts, calyces and flowers are generally violet or purple but not infrequently green and white. For note on the nomenclature of *S. multicaulis* see Notes R.B.G. Edinb. 22:427 (1958)

W. Syria, Syrian Desert, N. Iraq, Iran, Sinai. **Ir.-Tur. Element.** Treat category **LC**



**Figure 4.18.** General appearance of *S. multicaulis* Vahl.





**Map 44.16.** *S. multicaulis* distribution map.

**17.** *S. cryptantha* Montbret & Aucher ex Bentham in Ann. Sci. Nat. ser. 2, 6:40 (1836).

Perennial herb, similar in facies and general dimensions to *S. multicaulis* but usually a smaller plant; **Stems** erect, mostly unbranched, 10-30(42), cm, usually glandular-pilose to -villous, especially above, rarely glabrous, usually with dendroid hairs. **Leaves** simple, rarely with 1-2-pairs of small basal lobes, usually narrow, 1.2-6.7 x 0.5-2.5 cm, rugose, crenulate, with a dense indumentum of  $\pm$  adpressed dendroid to dendroid-stellate hairs; **petiole** 1-6.5 cm. **Verticillasters** (2- 12)~20 flowered,  $\pm$  distant. **Bracts** of median verticillasters broadly ovate, c. 0.6-2 x 0.4-1.6 cm, cordate. **Calyx** campanulate yellowish-green (rarely tinged purple), with an indumentum of sessile glands with or without some eglandular villous hairs, upper lip generally longer than lower 9-20 mm, 25 mm in fruit; **corollas** white to pinkish (to  $\pm$  purple), 12-21 mm Tube  $\pm$  straight, c. 15 mm, annulate; not squamulate, **Stamens** A. **nutlets** pale brown. Chromosome count:  $2n = 16$ .

The **pollen** of *S. cryptantha* is isopolar and oblate with  $P = 38.27 \pm 3.38 \mu\text{m}$  and  $E = 45.09 \pm 3.49 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $32.09 \pm 4.22 \times 8.06 \pm 0.86 \mu\text{m}$ . The exine is  $1.43 \pm 0.16 \mu\text{m}$  thick and the intine is  $0.68 \pm 0.12 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl. 5-7. Rocky limestone slopes, dry steppe, fallow fields, roadsides, 700-2500 m.*

Syntypes- [Turkey B5] in Cappadocia orientali, Montbret [2282] (W), Aucher [1531] (P).

**Inner (mainly C.) Anatolia.** A4 Ankara: Kizilcahamam to Celtikçi, Bozak-man & Fitz 902! ASCorum: Iskilip, Kozviran, 1050 m, Kilinc. 3723! A6 Sivas: Koyulhisar, S. of Ordu, 1000 m, Mathew & Tomlinson 4391! A6 Tokat: Artova hills above Artova Radar (Antena) Tepe 40 07 076 N 03 61 5432 E, 1410 m, 05 vi 2006, SBagherpour 290! B3 Afyon: c. 9.5 km S.W. of Isçehisar towards Afyon, 1070 m, Buttler 13196! B3 Ankara: Past Polatlı, 15 km to Sivrihisar, 39 30 535 N 31 36 734 E, 960 m, 31 v 2006, SBagherpour 224! B3 Ankara: Sivrihisar, 72 km to Eskişehir, 39 29 303 N 31 16 380 E, 1018 m, 31 v 2006, SBagherpour 227! B3 Ankara: Sivrihisar 10 km to Beylikdüzü, 39 37 053 N 31 09 018 E, 888 m, SBagherpour 232! B3 Ankara: 20 km from Keskin to Delice, 39 43 719 N 33 50 615 E, 1060 m, 01 vi 2006, SBagherpour 246! B3 Eskişehir: Seyitgazi ilçesinin üstü. 39 26 331 N 30 41 920 E, 1010 m, 10 v 2008, SBagherpour 416.! B3 Eskişehir: 20km past Alpu toward Mehiliçik eski near Osmanlı mezarı, 39 49 102 N 31 09 677 E, 849 m, SBagherpour 417.! B3 Eskişehir past Alpu 20km to Mehiliçik, 39 49 568 N 31 17 204 E, 918 m, SBagherpour 419.! B4 Ankara: ODTU fields 39 10 122 N 34 16 059 E, 1504 m, 20 v 2008, SBagherpour 438.! B4 Ankara: Beypazarı, 40 05 705 N 32 25 623 E, 1125 m, 04 vi 2005, SBagherpour 106! B4 Ankara: Beynam Orman roadside, 39 40 032 N 32 54403 E, 1487 m, SBagherpour 130! B4 Çankırı : 5km before Çankırı, 40 28 803 N 33 40 317 E, 642 m, SBagherpour 140! B4 Ankara: Ankara to Polatlı, 20 km past Ümitköy. 500m to Başkent Organize Sanaye, 39 45 699 N 32 27 646 E, 822 m, SBagherpour 219! B4 Ankara: Polatlı to Ayaş müslüm köy hills on the right side, 36 58 205 N 37 46 307 E, 490 m, SBagherpour 390.! B4 Ankara: Haymana 35km to Polatlı just few km past Haymana, 39 28 205 N 32 27 888 E, 1004 m, SBagherpour 392! B4 Ankara: 8km to Şereflikoçhisar, 39 00 901 N 32 27 122 E, 917 m, SBagherpour 394.! B4 Ankara to Kırşehir 5km after Keskin toward Kalkanlı mountain, 40 04 027 N 32 35 782 E, 1002 m. SBagherpour 464.! B4 Kırşehir :Hills N.of Kırşehir 39 08 365 N 34 13 701 E, 1246 m, SBagherpour 435.! B5 Yozgat: Saraykent to Akdağmadeni, 39 40 598 N 35 47 259 E, 1328 m, SBagherpour 173! B5 Nevşehir:

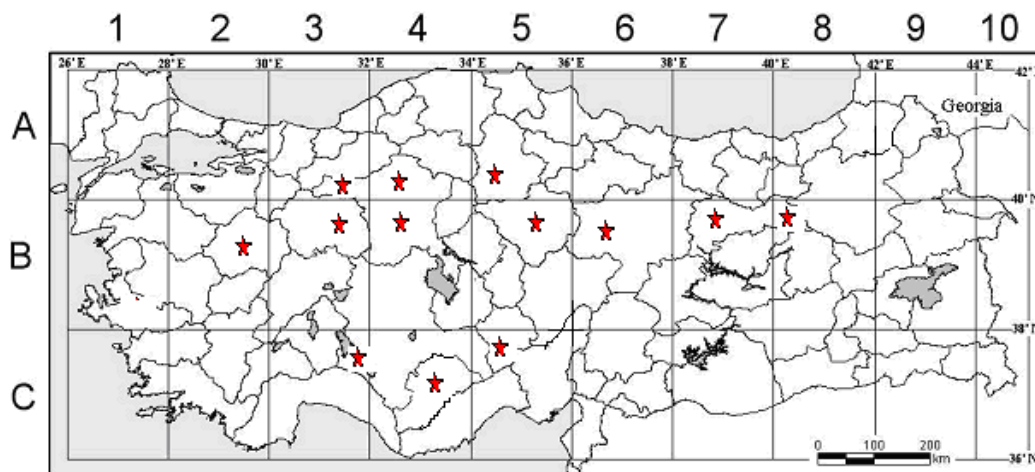
Neveşehir about 8km to Ürgüp, 38 36 555 N 34 49 573 E, 1318 m. SBagherpour 442.! B5 Kayseri: Pınarbaşı to Kayseri above Melkper village Aygörmez mountain, 38 43 837 N 36 13 021 E, 1972 m. SBagherpour 479 ! B5 Yozgot: Akçakale 15km to Akdağmadeni, 39 35 175 N 36 11 412 E, 1412 m. SBagherpour 489.! B6 Sivas: Yıldızeli 5km to Sivas, 39 43 738 N 36 53 392 E, 1284 m, SBagherpour 283.! B6 Sivas:S.of Sivas 5-7km SW.of Ulaş.Hills near sheep pens.3-4km off road, 39 25 754 N 37 00 433 E, 1539 m. SBagherpour 292.! B7 Erzincan:' nr Altbuschik, Erzincan, Sint. 1889:1061! B8 Erzincan: Tercan to Aşkale, 1600 m, D. 29344! C3 Konya: Beys,ehir to Konya, 1 100 m, Dudley (D. 35833)! C4 Konya: Konya to Beyşehir, 8 km W. of Konya, 1140 m, Hub.-Mor. 8372! C5 Nigde: Pozanti to Nigde, 1300 m, Coode & Jones 1239!

A less variable species than its close relative *S. muhicaulis* and generally more western in its distribution. In areas where they overlap, e.g. Sivas and Nigde, they appear to retain their identity and no hybrids have been seen. *S. cryptantha* is also closely related to the Lebanese and Syrian species *S. pinardii* Boiss. which is glabrous above and has pale bluish flowers. Two anomalous gatherings from A3 Ankara, Beypazari (Akman 1005, 1102!) may be hybrids (*S. aytachii*). In inflorescence, calyx and corolla characters they are atypical for *S. cryptantha* and have some features of *S. tomentosa*; the indumentum is typically that of the former species.

**Endemic. Ir.-Tur. element.** Treat category **NT**



**Figure 4.19.** General appearance of *S. cryptantha* Montbret & Aucher ex Benth.



**Map 44.17.** *S. cryptantha* distribution map.

**18.** *S. aytachii* Vural. In Tr. J. of Botany 20: 531-534 (1996)

Caespitose perennial herb with a woody rootstock. **Stems** ascending-erect, unbranched, 20-50 cm, glabrous above, sparsely simple and dendroid hairs below. **Leaves** mostly clustered at base of flowering shoots, grayish, simple, ovate-elliptic to suborbicular, rounded at base, 1-4.5 x 0.5-1.5 (-1.7) cm, rugose, crenulate, with dense



dendroid hairs; **petiole** 1-3 (-4.4) cm. with dense dendroid hairs and long ciliate on margins. **Verticillasters** 4-8 (-10) flowered, clearly distant. **Bracts** green, broadly ovate, 6-15 x 5-10 mm, sparsely simple and glandular hairy; bracteoles linear to oblong, membranous, 1-3 mm. **Pedicels** 2-7 mm, with spreading and retrorse hairs, rarely glabrous. **Calyx** purplish-violet to yellowish- green, campanulate, 6-20 mm, to 22 mm in fruit and broadening with a indumentum of sparse long simple eglandular and short glandular hairs, with sparse sessile glands; upper lip indistinctly 3-lobed or subentire. **Corolla** whitish-pink, 14-32 mm; tube straight, annulate, c. 16 m m; upper lip  $\pm$  straight. **Stamens** A; staminal connectives shorter than filaments; upper theca larger than the lower theca, 3 mm; lower theca 1.2 mm; filament 5 mm; connective c. 7 mm. Style glabrous below, sparsely soft, minute hairs towards apex, 22 m. **Nutlets** dark brown, ovoid, smooth, 4 x 3 mm. Chromosome count: unknown.

The **pollen** of *S. aytachii* is isopolar and oblate with  $P = 37.68 \pm 4.89 \mu\text{m}$  and  $E = 41.19 \pm 4.02 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $33.55 \pm 5.14 \times 5.50 \pm 1.01 \mu\text{m}$ . The exine is  $1.50 \pm 0.13 \mu\text{m}$  thick and the intine is  $0.56 \pm 0.08 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 5-7. *Steppe, marly places and gypsum soils. 650-870 m.*

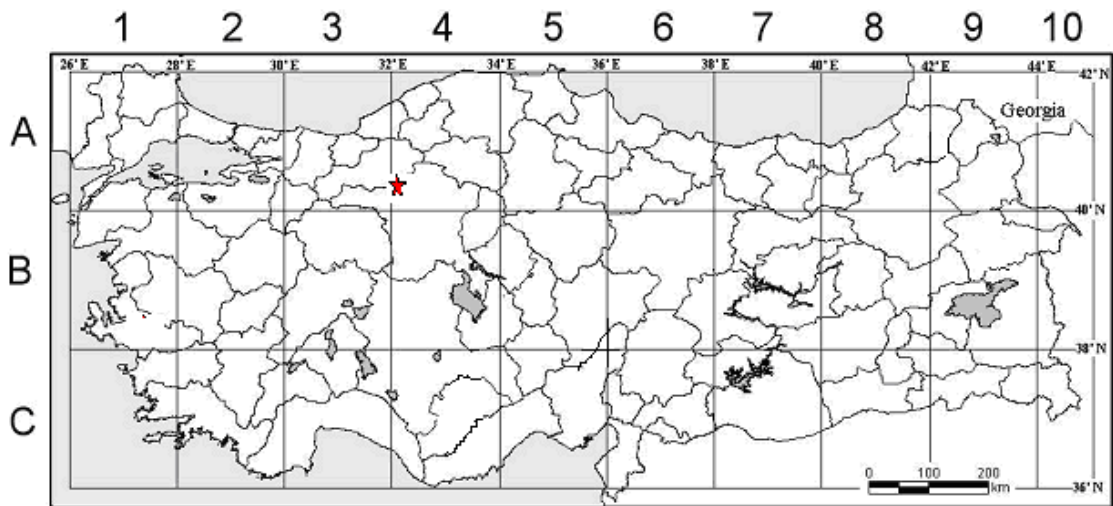
Type: [Turkey B3 Ankara] Polatli-Sivrihisar, 18. Km, open plains. 840 m. 01 vi 1990, Aytac; 3071. Duman et al.: GAZI!: iso.: ANK). A3 Ankara:~10km West of Beypazarı Çairhanede, 40 06 705 N 31 45 943 E, 623 m. 04 vi 2005, SBagherpour 109! A3 Ankara: Beypazarı: 2km from Çağırhan to Beypazarı near road on the side of the wash many weeds, 40 06 347 N 31 43 359 E, 513 m, 04 vi 2005, SBagherpour 115! A3 Ankara: Beypazarı to Nallihan, 36 58 205 N 37 46 307 E, 490 m, 14 v 2007, SBagherpour 387! A3 Ankara: Ayaş-Beypazan. 10 km to Beypazan. 650 m. 4.v.1986. Vural 4123 (GAZI)! A3 Ankara: 5 Km W of Beypazarı. 750 m, 8.v.1994. Ekim 9404 (GAZI)! A3 Ankara: Beypazan. 750 m. 18.v.1973, Akman 1102 (E)b. A3 Ankara: Beypazan. Uyku Dağı Jlu, 600 m. 30.v.1978. Akman s.n. (ANK)! A3 Ankara: Beypazan-Nallihan, 5. km. 650 m, 13.v.1995. dıguzel 2387. Duman et Aytac; (GAZI)! B3 Ankara: Polatli-Sivrihisar 18. km. open plains, 840 m. 25.v.1990. vtac; 3043 et Duman (GAZI)! bid. 16.v.1991. Aytac; 789. Ekim et Duman (GAZI)! ibid. 4.v.I.1991. Aytac; 3831 et

Duman (GAZi)! ibid. 750 m, 29.vI.1983. Guner 5069 et K. Sorkun (HUB)! ibid. 2.VI.1982. Akman, Ekim et Buyukburc; s.n. (ANK)! B3 Eskişehir: Polatlı-Sivrihisar 25. km, 870 m. 10.VII.1993. Duman 5007 (GAZI)!.B3 Ankara 21km past Polatlı towards Sivrihisar (~42km to)about 200m N.side of road, 39 34 541 N 31 55 304 E, 751 m, 10 v 2008, SBagherpour 412.

**Endemic, Ir.-Tur. element.** Treat category **VU**



**Figure 4.20.** General appearance of *S. aytachii* Vural & Adıgüzel.



**Map 44.18.** *S. aytachii* distribution map.

**19.** *S. anatolica* Hamzaoğlu. In Ann. Bot. Fennici 42: 215-220 (2005)

Perennial herb with a woody rootstock; **stems** few, erect, 25-40 cm long, unbranched, (with sterile shoots), greenish, glabrous below, with glandular and simple patent hairs above; capitates glands some branching. **Leaves** mostly basal pinnatisect, oblong-lanceolate in outline, with two pairs of lateral segments, or more rarely with only one pair on sterile shoots; terminal leaf segments ovate-elliptic lanceolate, 2.0-6.5 X 0.9-2 cm, greenish, glandular and sometimes with a few simple hairs, margin crenulated; lateral segments 4-22 x 2-7 mm; **petiole** 1-3 cm, winged, with dense glandular hairs and long ciliate margins; inflorescence 15-24 cm long, clearly exceeding leaves with 5-7 **verticillasters**, each verticillaster 4-6 flowered, internodes 2.5-4.0 cm, clearly distant; floral leaves dissimilar to stem leaves, ovate to lanceolate, widening at base, 16-30 x 10-14 mm, greenish, with dense glandular and patent simple hairs and long ciliate margins; **bracts** narrowly lanceolate to elliptic, 10-20 x 8-16 mm, greenish, indumentums similar to floral leaves; bracteoles present; pedicels 3-7 mm long, erect, with dense patent and sparse glandular hairs; **calyx** tubular-infundibular form, shortly bi-labiate, membranous-reticulate, greenish, 14-16 mm, to c. 19mm in fruit, 15-veined, with dense glandular and patent simple hairs; upper lip with tree teeth, triangular ca. 1 mm long, lower lip with

two teeth, triangular-lanceolate c. 3 mm long; **corolla** entirely yellow, 35-40 mm long, glandular and with long simple hairs on outside of upper lip; tube 20-24 mm long, not squamulate, gradually widening above, with an annulus in throat; upper lip straight equaling lower lip; stamens included within corolla lips; **stamens** A, filaments 6-8 mm, stamina connectives shorter than filaments; upper theca ca. 4 mm, longer than lower theca, with long villous hairs; style 35-40 mm, equaling corolla; immature nutlets obovoid, 2-2.6 x 1.2-1.6 mm, blackish rugose. Chromosome count: unknown.

The **pollen** of *S. anatolica* is isopolar and oblate-spheroidal with  $P = 50.86 \pm 4.35 \mu\text{m}$  and  $E = 51.08 \pm 4.00 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $43.28 \pm 4.47 \times 8.01 \pm 1.05 \mu\text{m}$ . The exine is  $1.63 \pm 0.27 \mu\text{m}$  thick and the intine is  $0.72 \pm 0.15 \mu\text{m}$ . Its ornamentation is bireticulate.

*FL. 5-6. Calcarious stony slopes and in open Quercus scrub, 1500-1600m.*

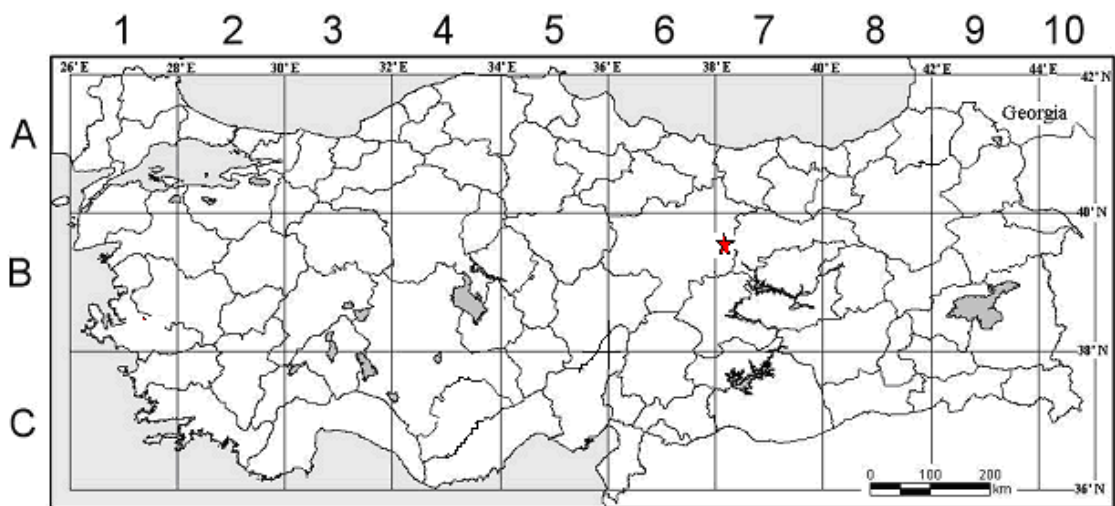
Distribution of *S. anatolica* seems to be Endemic to the area between Divriği and Kamaliye, East Anatolia, and belongs in the Irano- Turanian element. B7 Sivas: Divriği to Kemaliye 22km from Divriği to Maltepe, 39 31 210 N 38 09 370 E, 1560 m, 06 vi 2006, SB304.! B7 Sivas: Divriği to Kemaliye Maltepe to Çitme near çakır tarla 39 31 210 N 38 09 370 E, 1730 m, 09 vii 2006, SB306.

**Endemic. Ir.-Tur. element.** Treat category **CR**





**Figure 4.21.** General appearance of *S. anatolica* Hamzaoglu & Duran.



**Map 44.19.** *S. anatolica* distribution map.

#### 4.2.3 Section *Aethiopsis* Benth.:

Biennial or perennial herbs or chamaephytes. Calyx tubular or campanulate. Upper lip of corolla more or less falcate; tube not hairy-ringed. Connective longer than filaments; arms unequal, the sterile arm shorter and more or less flattened distally.

Species for Sect. *Aethiopsis*:

20. *S. syriaca* L., Systema ed. 10:854 (1759). Ic: Boul., Fl. Lib. Syr. t. 351 (1930).

Perennial herb; rhizomatous. **Stems** c. 30(-60) cm, yellowish-green, erect, branched, antrorse hairs, eglandular-pubescent below, denser above (and rarely glandular). **Leaves** simple, ovate, cordate, c.5-13 x 3.4-8 cm, rugose, serrulate, shortly eglandular or glandular-pubescent below; petiole c. 3-6 cm. **Verticillasters** 4-6-flowered, distant. **Bracts** ovate, c. 4-5 x 3- 5 mm. **Pedicels** 2-4 mm, erecto-patent. **Calyx** tubular, 5-7 mm, densely eglandular or glandular-pubescent, many sessile glands, upper lip straight, tridentate; calyx scarcely expanding in fruit. **Corolla** white, c. 10 mm; tube straight, not annulate, glabrous within; upper lip  $\pm$  straight to slightly falcate. **Stamens** B. **Nutlets** rounded-trigonous, c. 3 x 2 mm.  $2n = 22, 24$ .

The **pollen** of *S. syriaca* is isopolar and oblate with  $P = 39.23 \pm 6.48 \mu\text{m}$  and  $E = 44.88 \pm 8.48 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $32.85 \pm 5.63 \times 7.06 \pm 0.52 \mu\text{m}$ . The exine is  $1.61 \pm 0.20 \mu\text{m}$  thick and the intine is  $0.51 \pm 0.06 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 4-7. Steppe, marly banks, fallow and cultivated fields, 450-1850 m.

Type not designated (Hb. Linn. 42/15!).

**Mainly Inner Anatolia.** A3 Ankara: From Nallıhan 47km to Beypazarı, 40 08 677 N 31 28 713 E, 652 m, 31 v 2006, SBagherpour 241.! A4 Çankarı: Eldivan to Şabanözü roadside, 40 28 682 N 33 31 9714 E, 1136 m, 05 vii 2005, SBagherpour 149.! A5 forum: Iskilip, 800 m, Coode & Jones 1801! A6 Amasya: Tokat to Çengilhan, c. 450 m, Bornm. 1889:622! A8 Erzurum: Karaorgan to Horasan, 1800 m, D. 30820! A9 Kars: E. of Kizil-cakcak (Grossheim 7: map 434). B2 Uşak: Uşak, 1857, Bal. B3 Afyon: San-dikli to Dinar, A. Baytop (ISTE 9401)! B4 Konya: Cinanbeyli, D.

18722! B4 Ankara to Kırşehir 5 km to Keskin, 39 42 495 N 33 34 496 E, 1060 m, SBagherpour 244.! B5 Aksaray: Aksaray 30km to Nevşehir roadside, 38 31 686 N 34 24 826 E, 1260 m, 29 v 2008, SBagherpour 440! B5 Kayseri: Pınarbaşı to Kayseri above Melkper village Aygörmez mountain, 38 43 837 N 36 13 021 E, 1972 m, SBagherpour 481! B6 Sivas: Sivas to Hafik,soykeçerim, near fields,roadside, 39 49 800 N 37 07 658 E, 1858 m. SBagherpour 183! B7 Malatya: Malatya to Sivas, Alava 6870! B8 Erzurum: Askale şegav to Meymansur, 1500 m, Demiriz 81! B9 Van: Kurubaş,'6 km S.E. of Van, 1850 m, D. 44585! C2 Denizli: Tavas to Kale Tavas, 950 m, Hub.-Mor. 5204! C3 Antalya: Elmalı to Korkuteli, 1120 m, Dudley (D. 35216)! C4 Konya: Konya to Cumra, 980 m, Helbaek 2526! C6 Gaziantep: 40 km W. of Gaziantep, Andres 11! C7 Urfa: Urfa to Viranşehir, 500 m, D. 42285! C7 Urfa: Viranşehir 61km to Şanlıurfa inside pistachio trees, 37 13 516 N 39 23 325 E, 667 m, 14 v 2008, SBagherpour 424! C8 Mardin: Kızıltepe, 600 m, D. 28658! C9 Mardin: Cizre to Hessana, 600 m, D. 42748!

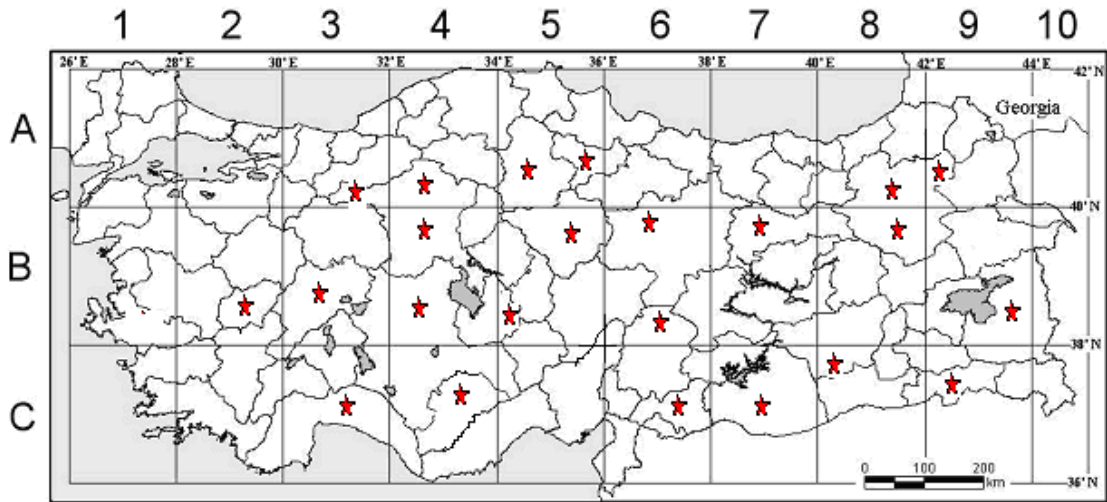
A distinctive, oligomorphic species, recognised by the tidy habit, regularly ovate leaves and the small white corollas.

W. Syria, Soviet Armenia, N. Iraq, Syrian Desert, Iran, **Ir.-Tur. element.** Treat category **LC**





Figure 4.22. General appearance of *S. syriaca* L.



Map 4.20. *S. syriaca* distribution map.



**21. *S. eriophora*** Boiss. & Kotschy in Boiss., Fl. Or. 4:611 (1879).

Perennial herb. **Stems** 10-20 cm in flower, to 40 cm in fruit, several from a woody rootstock, erect, widely branched above, eglandular lanate-arachnoid. **Leaves** simple, mostly basal, linear-oblong, (2-5) 3-6 (-6.5) x 0.6-1.3 cm, narrowing into a (10-) 15-25 mm petiole, arachnoid, rugose, crenulate. **Inflorescence** 5-25 mm, paniculate with stiffly erecto-patent branches, arachnoid-lanate, violet-blue. **Verticillasters** 2-6-flowered, approximating (slightly distant in fruit). **Bracts** usually almost equal to calyces, broadly ovate, 9-12 x 6-8 mm, arachnoid-lanate. **Pedicels** 2-3 mm, erect. **Calyx** tubular-campanulate, 8-11 mm, to 12-13 mm in fruit, violet, arachnoid-lanate, teeth long-subulate, c. 2 mm. **Corolla** violet-blue, 8-13 mm; tube 4-8 mm, straight, glabrous within; upper lip  $\pm$  straight, lower lip unspotted. **Stamens** B. **Nutlets** usually brown, c. 3 x 2 mm. Chromosome count: unknown.

The **pollen** of *S. eriophora* is isopolar and oblate-spherical with  $P = 44.53 \pm 5.17 \mu\text{m}$  and  $E = 48.78 \pm 5.92 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $39.24 \pm 5.33 \times 4.87 \pm 0.39 \mu\text{m}$ . The exine is  $1.09 \pm 0.09 \mu\text{m}$  thick and the intine is  $0.46 \pm 0.06 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl:* 6-7, volcanic rocky and stony slopes, alpine steppe and limestone slopes, 1525-1900 m.

**Type Specimen:** [Turkey C5 Adana/Niğde] ab Jool Baatch (Yol Bahçe) ad radices montis Allahdagh (Ala Da.) Ciliciae, 1525 m, [3 vi 1859], Kotschy 229 (G iso. BM! W!.K)

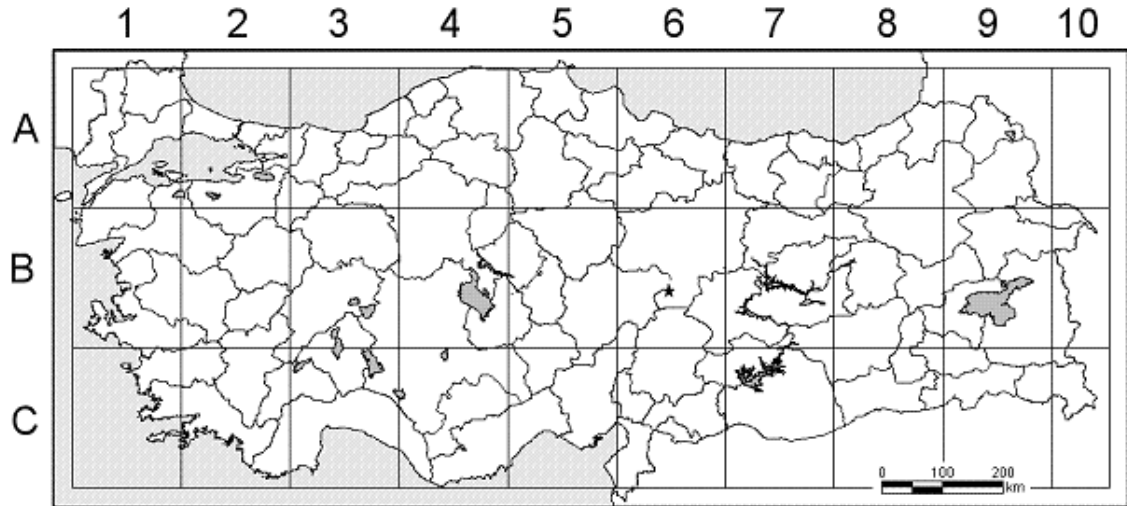
**S. Anatolia (Anti-Taurus); local. B6 Kayseri/Sivas:** Pınarbaşı to Gürün, 50 km to Gürün, near Sivas city border, 38 57 35 N 36 39 19 E, 1870 m, 18 v 2007, AKahraman 1363! near Güneşli village, 38 52 054 N 36 51 744 E, 1878 m, 17 v 2008, AKahraman 1495! c. 45 km to Gürün, 38 52 221 N 36 51 492 E, 1900 m, 23 vii 2008, AKahraman 1584B! between Pınarbaşı and Gürün, 1900 m, 18 vi 1954, D. 21971 (ANK!).

**Endemic. Ir.-Tur. element.** Threat category: EN

Distinctive on account of its small size, violet-blue paniculate inflorescence, small flowers and arachnoid linear-oblong leaves. Distantly related to *S. brachyantha*.



**Figure 4.23.** General appearance of *S. eriophora* Boiss.



**Map 44.21.** *S. eriophora* distribution map.

**22.** *S. aethiopsis* L. (Figure 8) Species plantarum, page 27, no. 25 (1753). Ic: Jav. & Csap., Ic. Fl. Hung. 432, t. 2931 (1934); F1. RPR 8: t. 42 f. 1 (1961).

Biennial or perennial, robust herb. **Stems** erect, sturdy, quadrangular, 25-180 cm, eglandular lanate, hairs denser below, with sessile glands, more or less leafless above. **Leaves** simple, mostly basal, ovate-elliptic to oblong, 10-35 x 5-9 cm, acuminate, lanate rugose, deeply and irregularly serrate to erose; petiole 4-9 cm. **Inflorescence** widely branched, candelabriform, many-flowered. **Verticillasters** 4-10-flowered, approximating above. **Bracts** broadly obovate, slightly shorter than calyx, green or violet-tinged, c. 12 x 15 mm, cuspidate, sparsely pilose. **Calyx** tubular-ovate, c. 12 mm, densely lanate, in fruit to c. 15 mm; upper lip tridentate, median tooth shorter. **Corolla** white, 10-15 mm, often with a pale yellow lip; tube abruptly ventricose, squamulate; upper lip weakly falcate with purple glandular hairs. **Stamens** B. **Nutlets** rounded trigonous, ovate, c. 3 x 2 mm. Chromosome count:  $2n = 22, 24$ .

The **pollen** of *S. aethiopsis* is isopolar and oblate-spherical with  $P = 39.29 \pm 1.42 \mu\text{m}$  and  $E = 44.10 \pm 2.31 \mu\text{m}$ . The aperture is hexacolpate and the colpi =



33.71 ±1.00 x 7.21 ±0.63 µm. The exine is 1.27 ±0.15 µm thick and the intine is 0.65 ±0.08 µm. Its ornamentation is bireticulate.

*Fl:5-8. Steppe, igneous and limestone slopes, sandy slopes, fallow fields, dry meadows, roadside banks, nr s.l.-2100 m.*

**Types:** Described from Illyria (coastal Jugoslavia), Greece & Africa (Hb. S-LINN. 42/48 photo!).

**Throughout most of Turkey except S.E. Anatolia.** A1 Kırklareli: Lüleburgaz to Pınarhisar, A.Baytop (ISTE 13308!) Kırklareli: 10 km from Babaeski to İstanbul, 16 vi 1972, A.Baytop & E.Tuzlacı! İstanbul otoban yolu Kumburgaz to Çamlıca right side of rest area, 41 04 011 N 28 30 343 E, 64 m, 06 v 2008, S.Bagherpour 460! Tekirdağ: Malkara, Tekirdağ to Malkara, 1 km before Ballı junction, roadside, 186 m, 30 v 2006, E.Karabacak 4533 ! Çanakkale: Gelibolu, Bolayır, Çimpe Castle, dry meadows, 145 m, 30 v 2006, E.Karabacak 4547 !, Çanakkale: Eceabat, Kabatepe, seaside, sandy slopes, 2 m, 26 v 2000, E.Karabacak 186! Çanakkale: Eceabat, Gelibolu peninsula, Behramlı village environs, Şarlayandere, roadside and scrubs, 63 m, 21 v 2006, E.Karabacak 4466! A1 Çanakkale: Renkoei (Erenköy), vi 1856, Kirk Çanakkale: İntepe environs, roadside, 132 m, 31 v 2006, E.Karabacak 4549!, A2 İstanbul: Yeşilköy to Safraköy, 28 vi 1904, Aznavour A2 Kocaeli: Pendik to Tuzla, 31 v 1896, Aznavour A3 Bolu: Abant G., 15 vii 1940, B.Post Bolu: Abant, stony place, 1500 m, 19 viii 1995, A.Uçar 2391 !, Bolu: Yeniçağa, Hamzabey village environs, 990 m, 7 vii 2000, M.M.Sümer 1453!, A4 Kastamonu: Daday to Eflani, c. 1100m, P.H.Davis 38617 Çankırı: Çerkeş, Gerede to Çerkeş, 5 km before Çerkeş, roadside slopes, 1120 m, 09 vii 2006, E.Karabacak 4824!, Kastamonu: 43 km E of Araç, wooded bank between road and field near wood/field edge, 980 m, 28 vi 1987, R.M.A.Nesbitt 1149!, Kastamonu: Karaçomak Dam, E of Kürteli ridge, Hasankayası stream, 1080 m, 14 vii 1982, H.Sakallıoğlu 602! Çankırı: Atkaracalar, Dumanlı mount, between Ulupınar and Taşlıdere plateau, 1300-1500 m, 6 vii 1991, A.Duran 1147 ! Ankara: Kızılcahamam, Işık mount, 1400 m, 10 vii 1976, M.Koyuncu & S.Kurucu. A5 Amasya: nr Merzifon, roadside, 1 vi 1969, A.Baytop & T.Baytop (ISTE 15244!) Amasya: Merzifon, Saraycık village environs, roadside and pathside, 872 m, 10 vii 2006, E.Karabacak 4880! Çorum: Boğazkale,

Boğazköy, Yazılıkaya ruins, 1210 m, 8 viii 1984, Ö.Seçmen 36 (EGE 17892!) A6 Tokat: Tokat to Sivas, Kızılıniş pass, slopes and scrubs, 1200 m, 10 vii 2006, E.Karabacak 4897! A7 Giresun: Suşehri to Şebinkarahisar, 4 km before Şebinkarahisar, slopes, 1335 m, 11 vii 2006, E.Karabacak 4940! Gümüşane: Erzincan to Kelkit, 2100 m, P.H.Davis 31899 Gümüşane: 6 km before Torul, 950 m, 21 vii 1972, T.Kesercioğlu & T.Gözler (EGE 19702!) A8 Artvin: N.E. of Artvin (Grossheim 7: map 439) Bayburt: Soğalnlı Mountains, 1200 m, 1 vi 1975, Y.Akman 9821 (ANK!) Bayburt: Gümüşhane to Bayburt, Nişantaşı village, Osluk (Korgan) bridge environs, steppe and rocky slopes, 1616 m, 11 vii 2006, E.Karabacak 4971! Erzurum: Tortum, Taşbaşı village to Tortum, 1600-1200 m, 24 vii 1984, N.Demirkuş 2083 (HUB 23125!) Erzurum: Tortum to Erzurum, Güzelyayla pass (2090 m), alpine pastures, limestone soil, 2132 m, 13 vii 2006, E.Karabacak 5070! Erzurum: Tortum to Narman, Kireçli (Kutumar) pass, alpine pastures, 2400 m, 14 vii 2006, E.Karabacak 5088! A9 Kars: 8 km from Akçay to Cumaçay, 1650 m, P.H.Davis 46808 B1 Manisa: Soma, Karaçam, E.Şarer 1003 B2 Bilecik: Pazaryeri, 750 m, P.H.Davis 36480 Afyon: Dazkırı, İdris village, Serenlikuyu environs, water side, 1325 m, 21 vi 1984, Z.Aytaç 1439! Kütahya: 34 km from Kütahya to Afyon, on foot of Kulaksız mountain, steppe, 1150-1200 m, 5 vii 1994, E.Akçiçek 893643! Kütahya: Dumlupınar, Çal village, Zafer hill, 1200 m, 22 vi 1996, Ö.Seçmen 4712 (EGE 19358) Denizli: between Çivril and Işıklı, roadside and fallow field, 800-850 m, 6 vi 1983, Y.Gemici 2019 (EGE 25514!) B3 Eskisehir: Sivrihisar, c. 1250 m, Dudley (P.H.Davis 36027) Afyon: 1 km S of Bayat, 1100 m, 18 vi 1980, Ö.Seçmen 2238 et al. (EGE 16983!) B4 Ankara: Çankaya, Dikmen, Çal Mountain, steppe, 900 m, 4 vi 1983, M.Vural 2263 et al. (GAZI!) Ankara to Kırşehir 5 km to Keskin, 39 42 495 N 33 34 496 E, 1060 m, 01 vi 2006, SBagherpour 243! Ankara: Beytepe, steppe, 1000 m, 31 v 1975, S.Erik 1210 (AIBU!, HUB!) Kırıkkale: Keskin, Böbrek mount, Konur village, steppe, 800 m, 23 vi 1992, Ü.Güler 1776 (GAZI!) Konya: Konya to Aksaray, 1000 m, Dudley (P.H.Davis 35900) B5 Yozgat: 8 km E. of Sorgun, 1200 m, Watson 5657 B6 Sivas: Cumhuriyet Üniversitesi Campus, steppe, 1200 m, 25 vi 1983, B.Yıldız 3712 (EGE 32607), ibid. roadside, 1275 m, 6 vii 2007, E.Karabacak 5515! Sivas: Yıldızeli, Demirözü village, 8.vii.1992, Kartal (AEF)

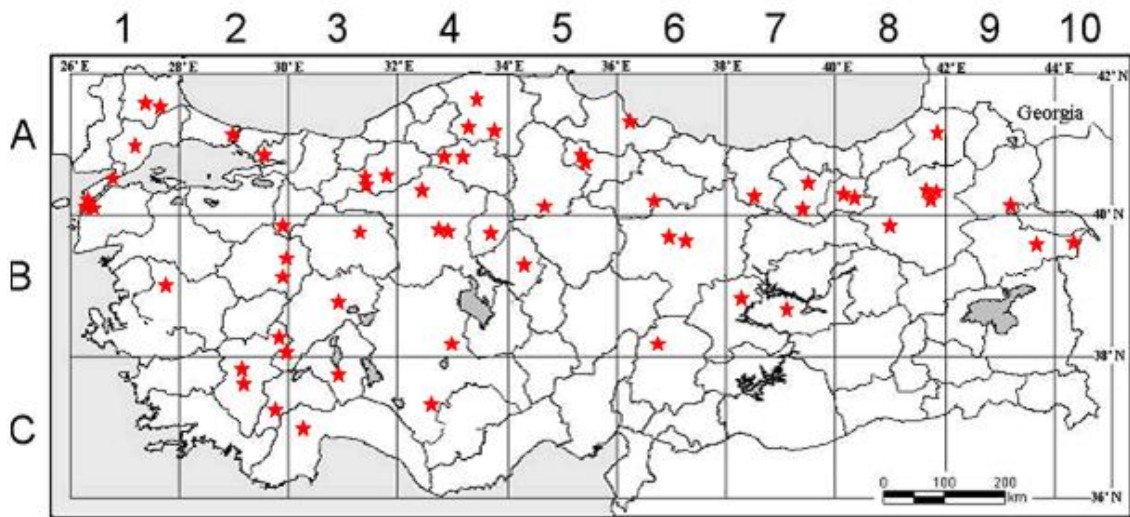
Malatya: Hekimhan, 1300 m, Stainton & Henderson 5442 Kahramanmaraş: Çardak to Göksun, 25 km before Göksun, field side, 20 vi 1979, E.Tuzlacı & M.Saraçoğlu (ISTE 42366!) B7 Elazığ: Elazığ to Hazar G., 850m, P.H.Davis 29105 B8 Erzurum: Erzurum to Aşkale, 1700m, Lamond 2595 B9 Ağrı: nr Diyadin, 1820 m, Hewitt 267 B10 Ağrı: Doğubeyazıt, Gürbulak Customs Gate road, near Telçeken village, 1600 m, 24 vi 1972, T.Gözler & T.Kesercioğlu (EGE 19701!) C2 Denizli: Cankurtaran, 1200 m, E.Şarer 1007 Denizli: between Sarayköy and Babadağ, 5 km before Babadağ, 700 m, 3 vi 1980, E.Tuzlacı & T.Çelebioğlu (ISTE 44505!) Burdur: 14 km from Dirmil to Korkuteli, fallow fields, 1220 m, 23 vi 1980, N.Özhatay, E.Özhatay & E.Tuzlacı (ISTE 44966!) C3 Isparta: between Isparta and Eğridir, 15 km before Eğridir, roadside, 23 vi 1982, Coşkun 625 & E.Şarer (AEF) Antalya: 21 km from Korkuteli to Elmalı, 1270 m, A.Huber-Morath 8375 C4 Konya: Küçük Köy, Konya to çumra, 980 m, Helbaek 2551

Distinctive on account of the sturdy stems, lanate indumentum and the candelabrifform inflorescence. A tumble-weed.

**C. & S. Europe, Caucasia, Crimea, Iran. Introduced in N. America.** Threat category: **LC**



Figure 4.24. General appearance of *S. aethiopsis* L.



Map 44.22. *S. aethiopsis* distribution map.



**23. *S. ekimiana*** F.Celep & Doğan *sp. nova*

Type: Turkey. Central Anatolia, B5 Yozgat: Above Akdağmadeni, Aktaş region, 39 35 157 N 35 50 014 E, 1793 m, open *Pinus sylvestris* forest and alpine steppe, 16 VI 2007 F.Celep 1214 (holotype ANK; isotypes E, K, GAZI).

Perennial herbs with a woody rootstock at base. Stems ascending to erect, 10-30 (-40) cm, branched or not, densely eglandular lanata. Leaves mostly basal, mainly oblong (ovate to oblong or oblanceolate) c. 2.5-7 x 1-2.5 cm, greyish-green, densely eglandular lanate, rugose, margins crenulate to serrate, petiole up to (10) 15-30 (-45) mm. Inflorescence widely branched, candelabriform, densely eglandular lanate. Verticillasters 4-12, each verticillasters with 4-10 flowered, internodes 0.5-2 cm. Bracts broadly ovate, 0.3-1.5 x 0.2-1.2 cm, densely lanate. Pedicels 2-3 mm. Calyx tubular to campanulate, 7-11 mm, up to 13 mm in fruit, scarcely expanding in fruit, densely eglandular lanate hairy, teeth shortly spinulose 0.7-0.8 mm. Corolla white with lilac hood, 7-11 mm, squamulate; tube 4-7 mm, upper lip c. 3.5-4.2 mm, scarcely falcate. Stamens 2, type B; staminal connectives clearly longer than filaments. Style glabrous, 8-12 mm, long exerted from corolla lips and divided in two part at apex. Nutlets rounded-triangular, 2.7-2.9 x 2.2-2.5 mm, greenish to brown and surface slightly tuberculate. Chromosome count: unknown.

Pollen grains are hexacolpate, oblate spheroidal to prolate-spheroidal and its ornamentation is suprareticulate. The polar axis ( $39.2 \pm 5 \mu\text{m}$ ) is bigger than the equatorial axis ( $34.4 \pm 5 \mu\text{m}$ ), P/E: 0.97-1.14 and the colpi are long  $31.7 \pm 5 \mu\text{m}$ . The exine is ( $0.95 \pm 0.12 \mu\text{m}$ ) slightly thicker than the intine ( $0.75 \pm 0.20 \mu\text{m}$ ).

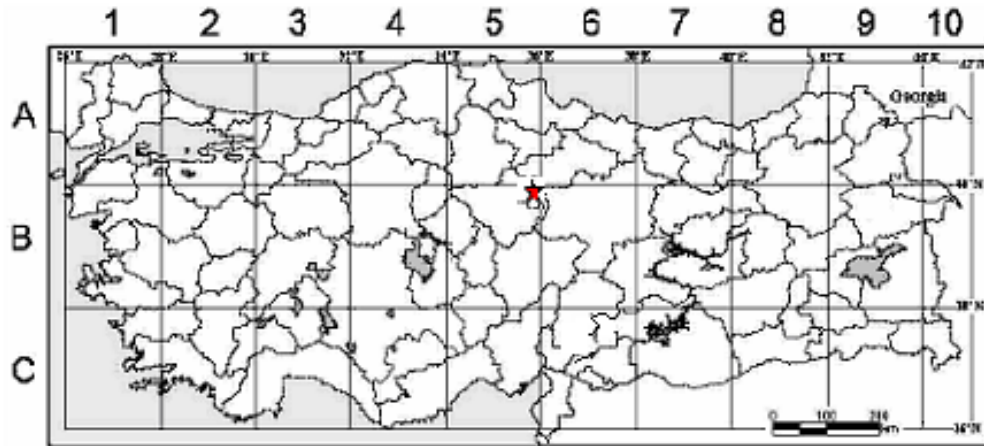
*Fl. 6. Associated with Pinus. 1700-2100 m.*

**Type:** Turkey. Central Anatolia, B5 Yozgat: Above Akdağmadeni, Aktaş region, 39 35 157 N 35 50 014 E, 1793 m, open *Pinus sylvestris* forest and alpine steppe, 16 VI 2007 F.Celep 1214 (holotype ANK; isotypes E, K, GAZI).

**Endemic. Ir.-Tur. element.** Treat category **EN**



**Figure 4.25.** General appearance of *S. ekimiana* F.Celep & Doğan.



**Map 44.23.** *S. ekimiana* distribution map.

**24.** *S. longipedicellata* Hedge in Notes R.B.G. Edinb. 23:57 (1959).

Perennial herb. **Stems** 60-90 cm, erect, solitary or 2-3, sturdy, quadrangular, eglandular lanate below, densely capitate glandular pilose hairs above. **Leaves** mostly basal, ovate-lanceolate to elliptic, 6.5-20 x 2.5-7.5 cm, lanate to pilose below, with a thinner indumentum above, irregularly lobulate serrate, truncate or attenuate. **Petiole** 3-12 cm, lanate hairs. **Inflorescence** paniculate, densely glandular pilose. **Verticillasters** 4-6-flowered, clearly distant. **Bracts** clearly shorter than calyces, broadly ovate-acuminate, 7-18 x 6-15 mm. **Pedicels** (5-) 6-10 mm. **Calyx** tubular-campanulate, 9-11 mm, to 11-14 mm in fruit, densely glandular pilose. **Corolla** white, 15-30 mm; tube ventricose, squamulate; upper lip falcate. **Stamens** B. apex. **Nutlets** ovoid, c. 3 x 2 mm. Chromosome count:  $2n=20$ .

The **pollen** of *S. longipedicellata* is isopolar and oblate with  $P = 40.27 \pm 4.26 \mu\text{m}$  and  $E = 44.08 \pm 2.82 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $32.61 \pm 4.84$  x  $4.53 \pm 1.27 \mu\text{m}$ . The exine is  $1.38 \pm 0.10 \mu\text{m}$  thick and the intine is  $0.73 \pm 0.12 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl:* 7-8, fields, roadsides, slopes, disturbed steppe and meadows, 1484-2110 m.

**Type Specimen:** Turkey B8 Erzurum: between Ilıca and Tercan, near the turning to Aşkale, 1850 m, 10 vii 1957, Davis & Hedge, D. 30875 (holo. E! iso. BM K).

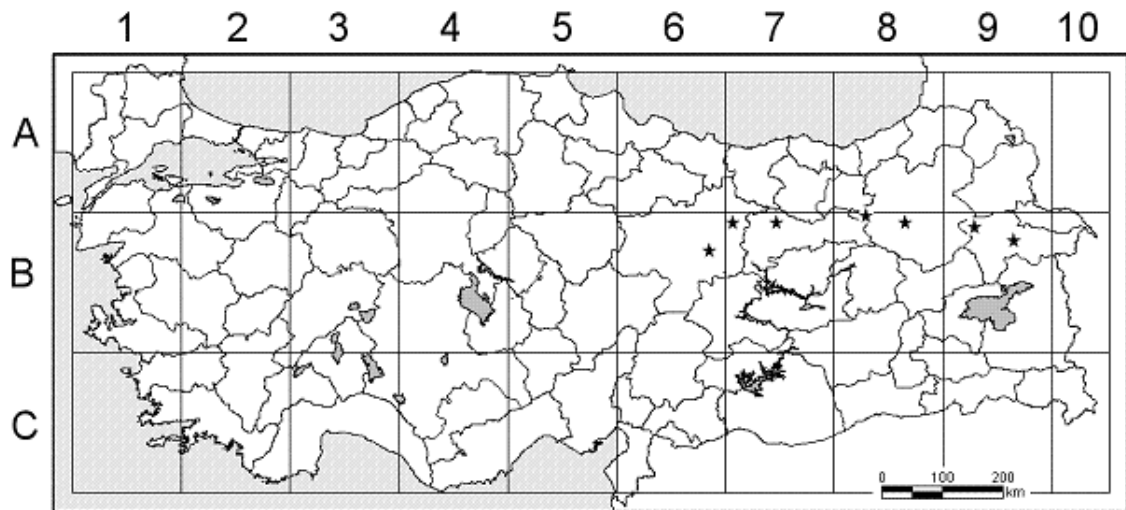
Doğu Anadolu. A/B8 Erzurum: Aşkale, 39 58 729 N 40 33 729 E, 1742 m, 29 vii 2008, AKahraman 1609! B6 Sivas: Zara-Kangal to Külekli c. 3 km, 39 21 624 N 37 39 978 E, 1484 m, 20 vii 2008, SBagherpour 528! Sivas 60 km southwest, 1620 m, M.& D. Zohary 209/4. B7 Sivas: İmranlı to Zara 16 km, Adamfakı köyü, 39 52 280 N 37 56 995 E, 1650 m, 20 vii 2008, SBagherpour 519! Erzincan: Refahiye 2 km to Erzincan, 1540 m, 9 vii 1979, B. Çubukçu, E. Tuzlacı and M. Saraçoğlu 42564 (ISTE!), İmranlı 13 km to Zara, 1680 m, 22 vii 1978, E. Tuzlaci 41056 (ISTE!). B8 Erzurum: Erzurum , 40 04 487 N 42 07 471 E, 1779 m, 29 vii 2008, AKahraman 1608! Aşkale-Tercan , 1800 m, 25 vii 1957, Davis & Hedge 32671 (ANK!). B9 Ağrı: Ağrı-Horasan c. 60 km to Ağrı, 2081 m, 12 vii 2007, AKahraman 1459! Ağrı 15 km to Taşlıçay, 1680 m, 12 vii 1979, A. Baytop, B. Çubukçu, E. Tuzlacı and M. Saraçoğlu 42686 (ISTE!), Eleşkirt Aras'a 25 km, 2040 m, 11 vii 1979, A. Baytop, B. Çubukçu, E. Tuzlacı and M. Saraçoğlu 42686 (ISTE!).

Related to the S.W. Anatolian *S. chionantha* but with broader leaves, longer pedicels and smaller calyces and corollas.

**Endemic. Ir.-Tur. element.** Threat category: **VU**



**Figure 4.26.** .General appearance of *S. longipedicellata* Hedge.



**Map 44.24.** *S. longipedicellata* distribution map.

**25. *S. candidissima*** Vahl, Enum. Pl. 1:278 (1804).

Perennial herb. **Stems** 30-60(-90) cm, erect, branched above, pilose to lanate below with few sessile glands, densely pilose to glandular-papillose above. **Leaves** simple, oblong to broadly ovate, 2.5-10(-14) x 1-9 cm, pubescent to densely pannose, subentire to erose, cordate to rounded; **petiole** 3-11 cm. Inflorescence paniculate, often yellowish-green; **Verticillasters** 2-6-flowered, distant. **Bracts** ovate-acuminate, 4-10 x 3-6 mm. **Pedicels** 2-4 mm. **Calyx** tubular-campanulate, 12-15 mm, to 18 mm and widening in fruit, densely pilose to glandular-papillose; upper lip with 3 closely connivent mucronate teeth. **Corolla** white or white with yellow lip, 22-27 mm; tube c. 12 mm, ventricose, squamulate; upper lip strongly falcate. **Stamens** B. **Nutlets** rounded trigonous, ovoid, c. 3 x 2.5 mm. Chromosome count:  $2n = 22, 24$ .

*Fl.* 5-9.

1. Leaves ovate to broadly ovate, 5-10(-14) x 3-9 cm, often discoloured with a thin (to thick) indumentum, serrulate to erose, cordate; flowers white with a yellow lip *subsp.*

***Candidissima***

The **pollen** of *S. Candidissima subsp. candidissima* is isopolar and spheroidal with  $P = 46.73 \pm 1.49 \mu\text{m}$  and  $E = 46.81 \pm 2.07 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $41.55 \pm 1.52 \times 7.57 \pm 0.74 \mu\text{m}$ . The exine is  $1.45 \pm 0.24 \mu\text{m}$  thick and the intine is  $0.72 \pm 0.08 \mu\text{m}$ . Its ornamentation is bireticulate.

*Rocky limestone and shale slopes, bushy places, amongst Pinus, Quercus, Abies and Cedrus, fallow fields, 700-2000 m.*

**Type specimen:** Type: 'Hab. in Armenia;ex Otsular. Vaillantii [Sclarea armena, foliis rotundioribus, candidiss., iso. P-Tourn. 1103, photo!].

A3 Eskişehir: Beylikova 7-8 km to Miheliçik off the main road to east riverside road into farmlands, 39 50 562 N 31 24 094 E, 1070 m, 31 v 2006, SBagherpour 234! A4 Çankırı: Eldivan toward tv tower station on the mountain, 40 31 260 N 33 29 600 E, 673 m, 05 vii 2005, SBagherpour 141! A5 Amasya: Suluova-Amasya road, 2 km past Boğazköy (Kanlıdere) köy, in the rocks next to railroad, 425 m, 10 vii 2006, K.4881. A6 Tokat: Tokat-Sivas road, 1060 m, 10 vii 2006, K.488 A7 Giresun: Şebinkarahisar-

Kelkit, 5-6 km past Karaçayır köy, 1335 m, 11 vii 2006, K.4943. A7 Gümüşhane: Torul-Hamsiköy road (old road), rocky areas, 1281 m, 12 vii 2006, K.4997. A8 Erzurum: Yusufeli-Tortum, 15 km to Tortum, rocky areas, 1351 m, 13 vii 2006, K.5049. B3 Konya: Beyşehir to Ilgın, 5-6 km before Aşağıçiğil village, 1100-1300 m, 27.7.2005, FÇelep 1008! B4 Ankara: Beynam orman road, 39 40 032 N 32 54 403 E, 1487 m, 04 vii 2005, SBagherpour 131! Ankara Hills above Kalecik 4km to Gülkoy, 40 05 067 N 33 22 060 E, 18 vii 2008, SBagherpour 508! B6 Sivas: Zara to Divriği Çulhali Village, 37 50 397 N 43 86 828 E, 1541 m, 13 vii 2005, SBagherpour 188 Sivas: Gürün, Gökpinar, 1520 m, 7 vi 2006, AKahraman 1227! Maraş: Göksun Elbistan, 27 km E. of Göksun, 1320m, Hub.-Mor. 11864 Adana-Kayseri: Sarız, Yeşilkent (Yalak), around Doğankonak village, 1562 m, 10.6.2006, 38 14 757 N 36 25 724 E, FÇelep 1074! B7 Erzincan: Kemaliye, 39 14 35 N 38 29 36 E, 977 m, 6 vi 2006, AKahraman 1390! Malatya: Beydağı, 1300 m, 7 vi 2006, AKahraman 1213! B9 Van: Van-Gürpınar arası, 1798 m, AKahraman 1327! C3 Konya: 6-8km west of Konya near Altınkaya barajı, 37 53 221 N 32 15 267E, 1350 m, 26 vii 2005, SBagherpour 209! C5 Niğde: Ulukişla to Niğde, 1420 m, Tuzlaci (ISTE 37506)! C9 Şırnak: Şırnak-Hakkari , Taşdelen, 997 m, 6 vi 2008, AKahraman 1547!

N. Iraq. **Ir.-Tur. element.** Threat category: **LC**





**Figure 4.27.** General appearance of *S. candidissima* Vahl subsp. *Candidissima*.

2. Leaves oblong to ovate, 2.5-1 1.5 x 1-6 cm, concolorous with a thick indumentum, serrulate to subentire, rounded to subcordate; flowers white throughout *subsp. Occidentalis*.

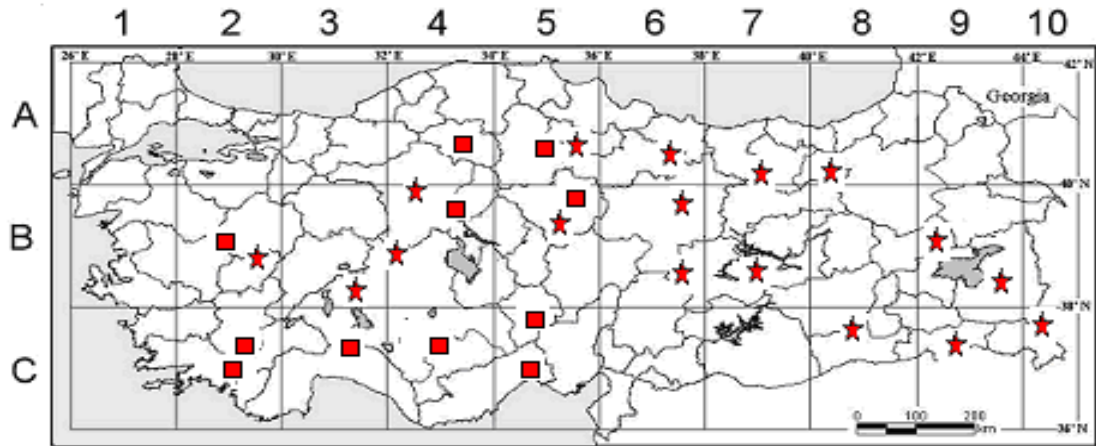
The **pollen** of *S. candidissima subsp. Occidentalis* is isopolar and spheroidal with  $P = 54,56 \pm 3,9 \mu\text{m}$  and  $E = 50,69 \pm 4,12 \mu\text{m}$ . The aperture is often hexacolpate (rarely octacolpate) and the colpi =  $43,58 \pm 4,36 \times 4,91 \pm 0,75 \mu\text{m}$ . The exine is  $1,04 \pm 0,1 \mu\text{m}$  thick and the intine is  $0,72 \pm 0,12 \mu\text{m}$ . Its ornamentation is bireticulate. Greece, Albania. **Ir.-Tur. Element.**



**Figure 4.28.** General appearance of *S. candidissima* Vahl subsp. *occidentalis* Hedge.

**Inner, mainly W. Anatolia.** B2 Kütahya: Domanis to Tavşanlı, 800 m, D. 36421! B3 Kütahya: Kütahya, 28 km from Kütahya to Eskişehir, 800 m, Dudley (D. 36075)! Afyon: Dazkırı to Dinar, 18 km before Dinar, 38 00 779 N 29 58 205 E, 991 m, 5 vii 2006, FCelep 1169! B5 Nevşehir: 5km to Karalık-Yeşilöz turn off, 38 37 435 N 34 57 575 N, 1304 m, 22 vii 2008, SBagherpour 532! C2 Muğla: 3 km N.E. of Muğla, 880 m, Nydegger 10189. C2 Antalya: Elmalı, Cedar Research Forest, 36 35 800 N 30 02 077 E, 1690 m, 7 vii 2007, FCelep 1326! C3 Isparta: Aksu, above Yaka village, 37 44 169 N 31 15 462 E, 1558 m, 7 vi 2008, FCelep 1444! C4 İçel: Gülnar to Ermenek, around Bereket village, 36 21 625 N 33 13 862 E, 1300-1400 m, 25 vii 2005 FCelep 993! C5 Nigde: Ala Da., Çukurbağ village, Emli Boğazı, 37 45 355 N 35 06 460 E, 1835-2000 m, 24 vii 2005, FCelep 975!

Distribution of species: Greece, Albania. Ir.-Tur. element? A widespread and common species throughout most of Inner Anatolia. The two subspecies — one eastern, one western - recognised here are based largely on leaf shape and indumentum; their extremes are quite distinct but there are many intermediates. Within them there are also numerous rather distinctive local populations, but these do not merit formal status.



**Map 4.25.** *S. candidissima* subsp. *candidissima* (★), and *S. candidissima* subsp. *occidentalis* (■) distribution map.

**26. *S. microstegia*** Boiss. & Bal. (Figure 10) Boiss., *Diagn. ser.* 2(4):17 (1859). = *S. verbascifolia* Bieb. var. *cana* Boiss., *Fl. Or.* 4:619 (1879)! = *S. chnoodes* Stapf in *Denkschr. Akad. Wiss. Wien, Math.-Nat. Kl.* 50:98(1885)! Ic: *J. Roy. Hort. Soc.* 85(10): t. 140(1960).

Perennial herb with a woody rootstock, **Stems** few or several, erect, 20-100 cm, densely pilose-villous glandular, often eglandular lanate below. **Leaves** mostly basal, variable in size and shape, ovate to oblong, (5-)7-17(-20) x 3-8(-14) cm, white or grey lanate, obtusely lobed or irregularly serrate, sub-cordate; petiole 3-16(-20) cm. **Inflorescence** usually a widely spreading panicle, often yellowish-green. **Verticillasters** 4-6-flowered, usually distant. **Bracts** variable, broadly ovate, 9-17 x 8-14 mm. **Pedicels** 2-5 mm. **Calyx** ± campanulate, 9-12 mm, to c. 11-14 mm in fruit, densely glandular with capitate glandular hairs and sessile glands; upper lip shortly tridentate, median tooth much shorter; lips ± equal. **Corolla** white, lip fading yellow, 17-30 mm, tube 5-8 mm, ventricose, squamulate; upper lip compressed, strongly falcate. **Stamens** B. **Nutlets** ovoid, c. 3 x 2.5 mm. Chromosome count: 2n = 16.

The **pollen** of *S. microstegia* is isopolar and oblate with P = 46,96±1,34 μm and E = 52,49±2,88 μm. The aperture is hexacolpate and the colpi = 37,05±1,76 x 4,56±0,8 μm. The exine is 0,69±0,07 μm thick and the intine is 0. 0,63±0,13 μm. Its ornamentation is bireticulate.

*Fl: 6-8. Rocky limestone and igneous slopes, alpine pastures, scree, in Quercetum, Pinus woodland, feldside, 970-3350 m (nr permanent snowbeds).*

**Types:** [Turkey B5 Kayseri] in monte Alidagh prope Caesaream (Kayseri) Cappadociae sito, 1400m, [9 viii 1856], Balansa [1083] (iso G!).

A6 Sivas: Suşehri to Şerefiye, Karabayır pass, 1700-1900 m, 25 vii 1985, B.Yıldız 6656! A7 Giresun: Suşehri to Şebinkarahisar, 4 km before Şebinkarahisar, slopes, 1335 m, 11 vii 2006, E.Karabacak 4941! Sivas: 10 km E. of Suşehri, 1400 m, Spitzenberger 83 Sivas: Gölova, Aşağıtepecik village, limestone soil slopes, 1290 m, 7 vii 2007, E.Karabacak 5532! A8 Erzurum: Tortum to Erzurum, Güzelyayla pass alpine pastures, limestone soils, 2090 - 2132 m, 13 vii 2006, E.Karabacak 5071! Bayburt: Aşkale to Bayburt, Kop pass environs, alpine pastures, 2408 m, 14 vii 2006, E.Karabacak 5121! A9 Kars: Kağızman, Turkewicz 627 B5 Niğde: melendiz dağı to tepeköy, 38 06 298 N 34 36 624 E, 2228 m, 23 vii 2005, S.Bagherpour 205! Niğde: above Fesleğen village, on rocks, 2000 m, 21 vii 1981, N.Özhatay & M.Saraçoğlu (ISTE 47125!) Kayseri: Bünyan, Korunmaz mount, Kazlar peak, stony steppe, 1800 m, 23 vi 2001, M.E.Uzunhisarcıklı 1705 (GAZI!) B6 Sivas: S slopes of Çeltek mount, near Karaçayır village, scrubs, 1670 m, 15 vii 2006, E.Karabacak 5150! Malatya: Doğanşehir, Dedeyazı village, Koru yaylası, 2000 m, 14 viii 1968, H.Peşmen 1045 (EGE 19628!) Malatya: Koru yaylası, Dedeyazı mount, steppe, 14 viii 1966, H.Pşmen 1049 (EGE 5569!) Kayseri: Pınarbaşı Şirvan Dağı batısı near TRT radar station old US military road, 38 39 694 N 36 23 765 E, 2127 m, 20 vii 2008, S.Bagherpour 324! Kayseri: Sarız, Yalak, Binboğa mount, between Yalak and Korkuyu, stony places, 1750-2200 m, 20 vii 1992, Z.Aytaç 5394 et al. (GAZI!) Adana: Saimbeyli, Obruk yaylası, near Avcıpınar village, arid and rocks, 1420 m, 30 vii 1979, E.Tuzlacı & M.Saraçoğlu (ISTE 43358!) Kahramanmaraş: Göksun, Dibek mount, forest clearings, 1750 m, 19 vi 1979, E.Tuzlacı & M.Saraçoğlu (ISTE 42331!) Kahramanmaraş: Göksu, Binboğa mount, 1800 m, 17 vii 1992, M.Koyuncu 9702 Z.Aytaç (AEF) Kahramanmaraş: Çardak, Berit dağı, above Arpa Çukuru yaylası, 2800 m, 26 vii 1952, P.H.Davis 20332, Dodds & R.Çetik (EGE 27345!) B7 Erzincan: Keşiş Da. above Cimin, 2700 m, P.H.Davis 31743 Erzincan: Keşiş (Spikör) mount, 1 km before Kolçekmez mount pass, calcareous slopes, 2099 m, 7 vii

2007, E.Karabacak 5543! B8 Erzurum: 14 km from Erzurum to Pasinler, 2000 m, P.H.Davis 47452 Muş: Cingilli church, oakland, 17 vii 1956, H.Birand & K.Karamanoğlu (AEF) B9 Ağrı: Ağrı to Horasan, 1900 m, Lamond 2556 Van: Çavuştepe village, Çavuştepe ruins, 1900 m, 21 vi 1986, Ö.Seçmen 3711 (EGE 17945!) C4 Konya: Hadim, 3 km from Hadim to Taşkent, damaged oakland, 1450 m, 9 vi 1999, H.Duman 6939 et al. (GAZI!) Karaman: Ermenek to Hadim, above Başyayla, 1700 m, 29 vi 1980, E.Tuzlacı (ISTE 45226!) Karaman: 35 km from Karaman to Mut, rocky slopes, 1600-1610 m, 19 vi 1989, Z.Aytaç 2717 (GAZI!) Mersin: 23 km from Gülnar to Silifke, 970 m, A.Huber-Morath 9597 C5 Niğde: S. of Maden village, 2130 m, Darrah 413 Niğde: NW part of Aladağ, c 5 km SSE of the village of Demikazık village, limestone rocks and screes, 2000-2100 m, 22 vii 1984, G.Görk, P.Hartvig & A.Strid 23812 (EGE 31187!) Mersin: between Mut and Karaman, steppe, 1590-1610 m, 30 vi 1993, Z.Aytaç 6074 (GAZI!) C6 Adana: Pozantı, Armutluk Mvk., 1600 m, 12 vi 1995, N.Tan (ISTE 68299!) Adana: Karsantı, Tırak area, E of Kaldı mount, Ziyaret hill, forest clearings, 1900 m, 27 vii 1979, E.Tuzlacı & M.Saraçoğlu (ISTE 43342!) Osmaniye: Yağlıpınar, S. of Yarpuz, 1500 m, A.Huber-Morath 15310 Kahramanmaraş: Andırın, Elma mount, Cedrus-Abies forest open, 1300 m, 22 vi 1979, E.Tuzlacı & M.Saraçoğlu (ISTE 42402!) Kahramanmaraş: Engizek mount, Sinkört yaylası, rocky places, 2150 m, 13 vii 1988, H.Duman 4222 (GAZI!) C7 Adıyaman: Nemrut dağı, 200-2100 m, 20 vi 1987, N.Tanker & M.Koyuncu 8167 (AEF) C9 Hakkari: Hakkari to Kaval (Piyannis), 2500m, P.H.Davis 45395 Hakkari: Berçelan yaylası, 3000 m, 21 vii 1974, M.Koyuncu (AEF) C10 Hakkari: Sat Da., 2950 m, P.H.Davis 45702.

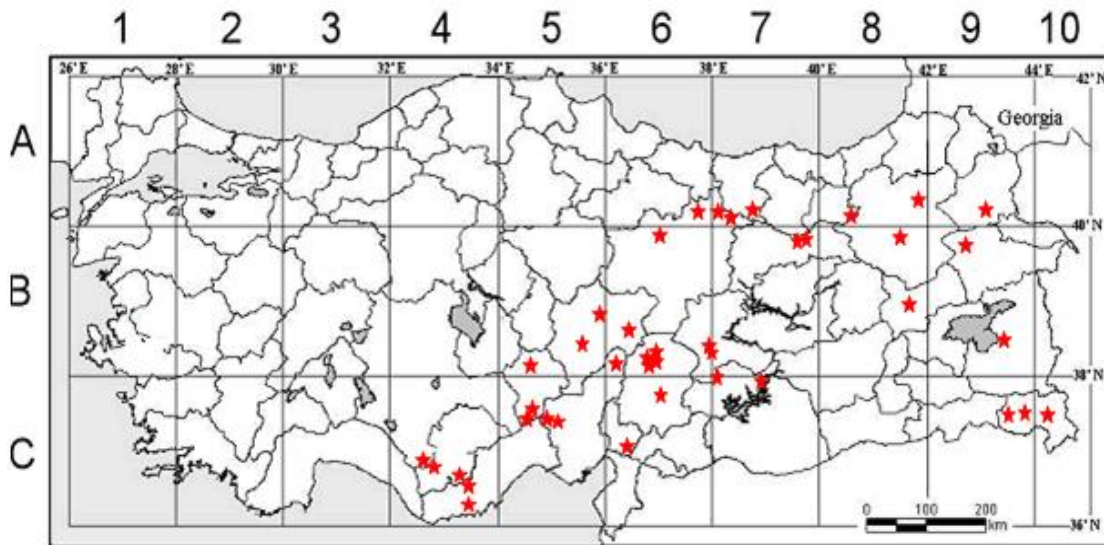
Related to *S. xanthocheila*, *S. atropatana* and *S. argentea* (q.v.); also close to the Caucasian *S. verbascifolia* M.Bieb. which apparently always differs by its much thinner indumentum on all parts. *S. microstegia* varies considerably in the density of the leaf indumentum; the . most lanate specimens are usually from the higher altitudes. Although in most cases there is little likelihood of confusion with *S. argentea*, despite the narrow morphological differences, some specimens from S. Anatolia (e.g. C4, C5) are close to the latter.

Latakia, Lebanon. **Irano-Turanian element.** Threat category: **LC**





**Figure 4.29.** General appearance of *S. microstegia* Boiss. & Bal.



**Map 44.26.** *S. microstegia* distribution map.

27. *S. frigida* Boiss., Diagn. ser. 1(5): 10 (1844). Syn: *S. spinulosa* Montbret & Aucher ex Benth in DC., Pro dr. 12:283 (1848)! *S. frigida* Boiss. var. *oblongifolia* Boiss., Fl. Or. 4:621 (1879)! *S. frigida* Boiss. var. *albiflora* Bornm. in Belli. Bot. Centro 24(2):487 (1909)!

Perennial herb with a thick woody rootstock. Stems solitary or several, erect, 10-30(-50) cm, below pilose to villous with sessile glands, densely glandular above with capitate glands. Leaves mostly basal, variable, ovate to narrowly oblong, 2-12 x 1.2-5 cm, crenulate to erose, rugulose, arachnoid to lanate with many sessile glands; petiole 1.5-8 cm. Inflorescence little branched to widely paniculate. Verticillasters 2-6-flowered, usually distant. Bracts ovate to orbicular, C. 6-13 x 4-11 mm. Pedicels 1-3 mm. Calyx campanulate to infundibular, 5-10 mm, c. up to 12 mm in fruit and widening, densely capitate glandular and sessile glands; teeth usually prominently spinulose; upper lip tridentate, median tooth much shorter, truncate or not. Corolla white to lilac, 7-10 mm; tube C. 8 mm, ventricose, squamulate; upper lip narrow, somewhat falcate, scarcely bifid. Stamens B. Nutlets ovoid, C. 3.5 x 2.5 mm. Chromosome count:  $2n = 20, 21, 22$ .

The **pollen** of *S. frigida* is isopolar and oblate with  $P = 37.86 \pm 4.10 \mu\text{m}$  and  $E = 40.59 \pm 3.65 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $33.10 \pm 3.93 \times 5.06 \pm 0.50 \mu\text{m}$ . The exine is  $1.15 \pm 0.13 \mu\text{m}$  thick and the intine is  $0.70 \pm 0.11 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 5-7. *Pinus nigra*, *Juniperus*, *Abies* and *Pyrus* woodland, limestone slopes and crevices, meadows, 1000-2450 m.

Type: [Turkey C2 Denizli] in regione alpina excelsiori montium Cariae, Cadmi orientalis (Honaz Da.) supra Colossam (Honaz) et occidentalis (Baba Da.) supra Gheyra (Goyre), vi 1842, Boissier (holo. G!). :

**Inner & S.W. Anatolia.** A4 Ankara: Çamkoru, N.W. of Kizilcahamam, 1350 m, Bozakman & Fitz 807! A4 Çankarı: Eldivan dağ top, 40 27 416 N 33 26 .874 E, 1777 m, 05 vii 2005, SBagherpour143.! A6 Sivas: Yıldızeli to Tokat 5km N. Of Yıldızeli, 39 54 478 N 36 32 961 E, 1403 m. SBagherpour 284.! B2 Kütahya: Murat



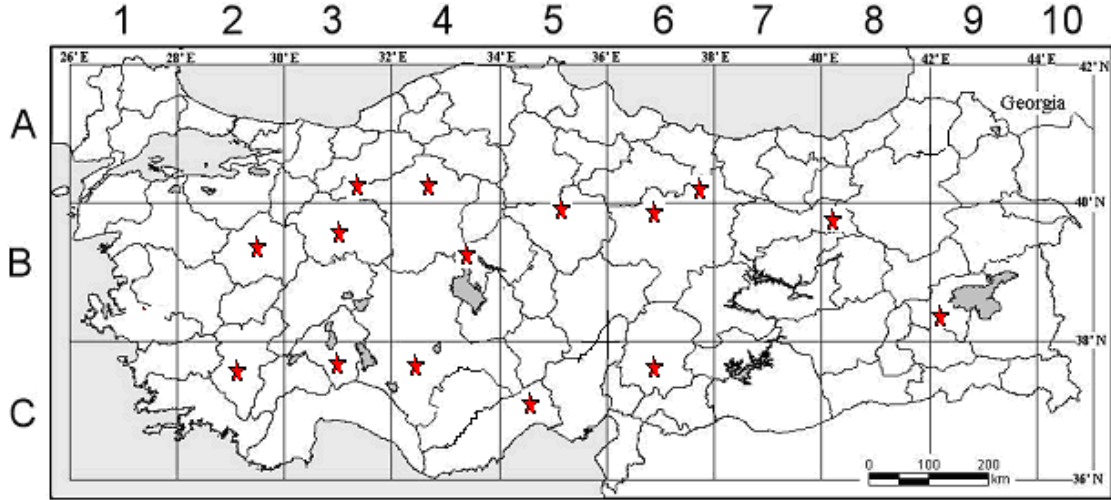
Da. above Banaz, 2000 m., Coode & Jones 2499! B3 Ankara:Polatlı 31km to Sivrihisar, 39 33 599 N 31 47 914 E, 853 m, 10 v 2008, SBagherpour 415.! B3 Eskişehir: past alpu 20km to Mehiliçik, 39 49 568 N 31 17 204 E, 918 m, 11 v 2008, SBagherpour 420.! B4 Ankara: Ankara to Konya 4km to Bezirhane, 39 31 218 N 32 51 965 E, 1125 m, 14 v 2007, SBagherpour 396.! B4 Konya: 90 km N. of Konya, M. Zohary & Orshan 281211. B5 Kayseri: Pınarbaşı west side ofŞirvan Dağ, 38 41 131 N 36 23 087 E, 1760 m, 08 vi 2006, SBagherpour 326.! B6 Sivas: Sivas 10km to Kangal, 39 12 111 N 37 14 537 E, 1534 m. SBagherpour 524. B7 Malatya: 5 km E. of Malatya, 1300 m, Hub.-Mor. 8988! B8 Erzincan: 17 km from Tercan to Aşkale, 1680 m, Hub.-Mor. 10768! B9 Bitlis: Bitlis to Tatvan, 1900 m, D. 22354! C2 Denizli: Honaz Da., 1300 m, Sorger 62-32a-29! C3 Isparta: Davras Da., A. Baytop (ISTE 9620)! C4 Konya: Bozkir to Çamli, 1400 m, Çetik et al. 1017! C5 İçel: Tekir Tepesi, 1270 m, Sorger 62-68-37!

Close to *S. modesta* and *S. yosgadensis*. With some affinities to *S. argentea* and *S. microstegia* but with much smaller corollas. A most variable species in all respects. Although there is a core of specimens which is fairly typical for the species, there are many individuals which because of characters of habit, indumentum, leaf shape, bract size and calyx shape are anomalous. Mostly they occur in the northern peripheral parts of the range (e.g. A4, B2, B3). Male sterile sex-forms are very common and these plants tend to be aberrant in other respects. No definite hybrids have been reported but D. 19915 (B6 Maraş; d. Goksun, Yalak, 1400 m) combines features of *S. frigida* (calyx and corolla) and *S. microstegia* (height and indumentum) and is not readily assignable to either.

N.W. Iran. **Ir.-Tur. element.** Threat category: **LC**



**Figure 4.30.** General appearance of *S. frigida* Boiss.



**Map 44.27.** *S. frigida* distribution map.

28. *S. modesta* Boiss., Fl. Or. 4:621 (1879) p.p. Notes R.B.G. Edinb. 22:181 (1957).

Perennial herb with a thick woody rootstock. **Stems** solitary or several, erect, 10-30(-50) cm, below pilose to villous with sessile glands, densely pilose to villous glandular above with capitate glands. **Leaves** mostly basal, variable, ovate to narrowly oblong, 2-12 x 0.8-5 cm, crenulate to subentire, arachnoid to  $\pm$  lanate with many sessile glands; **petiole** 1.5-8 cm. **Inflorescence** little branched to widely paniculate. **Verticillasters** 2-8-flowered, usually distant. Bracts broadly ovate, c. 4-8x5-8 mm. Pedicels 2-3 mm. **Calyx** tubular to campanulate, 5-9 mm, to 10-12 mm in fruit and widening, purplish, densely multicellular pilose to villous glandular or eglandular pilose capitate-glandular; teeth usually prominently spinulose; upper lip tridentate, median tooth much shorter, truncate or not. **Corolla** lilac, 8-11 mm; tube c. 6-8 mm, ventricose, squamulate; upper lip narrow, somewhat falcate, scarcely bifid. **Stamens** B. Anther ca. 2 mm, upper theca ca. 3-4 mm, lower theca ca. 1 mm, filaments ca. 2-3 mm. Chromosome count: unknown.

The **pollen** of *S. modesta* is isopolar and oblate with  $P = 43,47 \pm 2,24 \mu\text{m}$  and  $E = 47,81 \pm 2,8 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $36,43 \pm 2,76 \times 5,42 \pm 0,31 \mu\text{m}$ . The exine is  $1,24 \pm 0,33 \mu\text{m}$  thick and the intine is  $1,06 \pm 0,18 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl. 6. Rocky slopes, 1700-2000 m.*

Type: [Turkey B5 Kayseri] in Cappadociae regione subalpina montis Argaei (Erciyas Da.) in valle Kamechly Tchai (Çomakli çay), [1700 m, 16 vi 1856], Balansa [242] (holo. G!).

C. & S. Anatolia (Anti-Taurus). B5 Kayseri: Bakırdağ to Saimbeyli, 2000 m, Hub.-Mor. 10763! Erciyas Da., 1800 m, M. Zohary & Plitm. 17600-7!

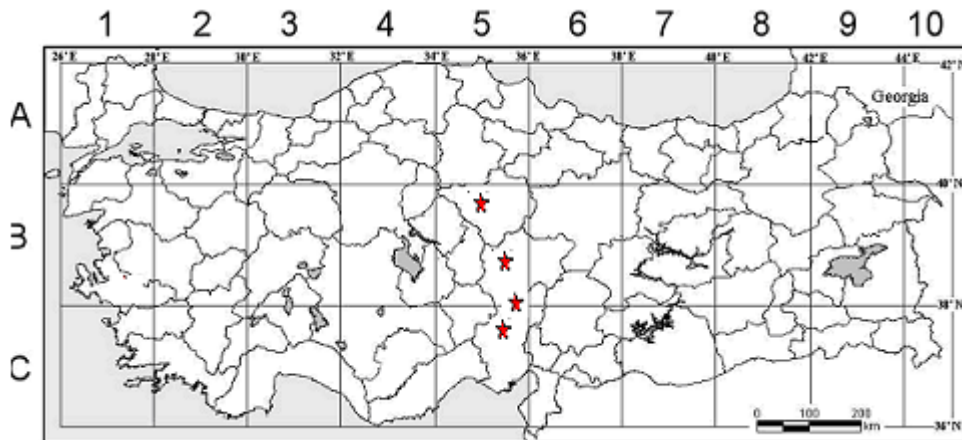
Little-known and possibly not specifically different from *S. frigida*. All the gatherings examined were male sterile sex-forms. Boissier's original description and discussion of this species covered both it and the clearly distinct E. Anatolian *S.*

*brachyantha*. A specimen from B4 Kirşehir (Bozcalıdağ, 1500 m, Sorger 64-20-12!) may also belong here.

**Endemic. Ir.-Tur. element.** Treat category **VU**



**Figure 4.31.** General appearance of *S. modesta* Boiss.



**Map 44.28.** *S. modesta* distribution map.

29. *S. tobeyi* Hedge in Notes R.B.G. Edinb. 38:49 (1980).

Perennial herb, clump-forming. **Stems** erect, 15-60 cm, villous to lanate, usually eglandular below, densely glandular above with villous eglandular hairs. **Leaves** mostly basal, ovate to ovate-elliptic, 3-9 x 2.5-4.5 cm, ± lanate with numerous sessile glands, subentire to ± serrate; **petiole** 1.3-4.0 cm. **Inflorescence** ± narrowly paniculate. **Verticillasters** 4-6-flowered, ± crowded. **Bracts** broadly ovate, acuminate, c. 12-17 x 10-14 mm. Pedicels 2-4 mm. **Calyx** campanulate, 8-11 mm, to 11-14 mm in fruit, densely glandular and with eglandular villous hairs; upper lip shortly , tridentate. **Corolla** white with yellow lower lip, c. 11-16 mm; tube c. 8 mm, ± ventricose, not squamulate; upper lip somewhat falcate. **Stamens** B. **Nutlets** ovoid, c. 3 x 2.5 mm.

*Fl. 6. Subalpine meadows, grassy slopes, 1400-2100 m.*

Type: Turkey A4 Kastamonu: Guiardagh (Gavur Da., c. 7 km N.W. of Tosya), in pascuis subalpinis, 13 vi 1892, Sintenis 3913 (holo. LD! iso. B! W! Z!).

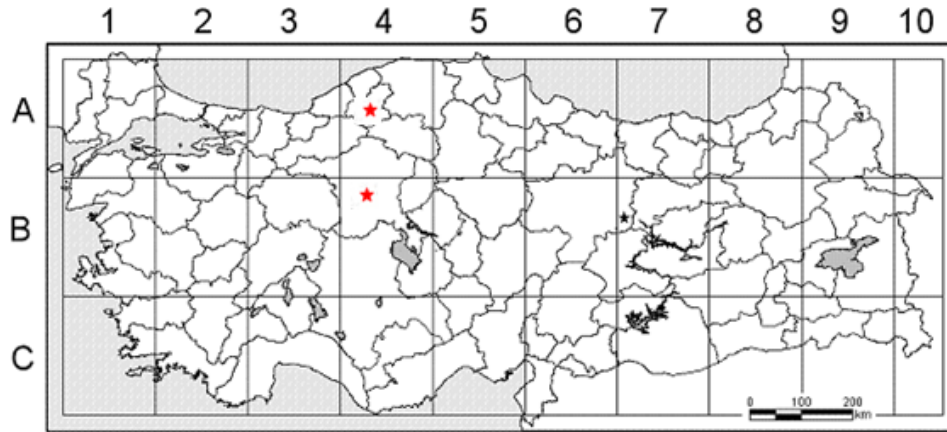
N. Anatolia (central part). A4 Kastamonu: Ilgaz Da., 35 km S. of Kastamono, 2100 m, Edmondson 520! Zonguldak: Kel Tepe, Tobey 1860! B4 Ankara: elma daga above yesildere, 40 01 537 N 33 16 944 E, 1400-1700 m, 20 v 2010, SBagherpour 539!

**Endemic.** With features of *S. xanthocheila* (inflorescence structure and bract size) and *S. frigida* (floral characters). Closer to the latter but differing by its broader lanate leaves, villous eglandular hairs, larger bracts and slightly larger calyces and corollas.





**Figure 4.32.** General appearance of *S. tobeyi* Hedge.



**Map 44.29.** *S. tobeyi* distribution map.

**30.** *S. yosgadensis* Freyn & Bornm. in Ost. Bot. Zeitschr. 42:348 (1892). Map 54.

Perennial herb. Stems 13-40 cm, usually stiffly erect, quadrangular, densely eglandular-pilose above with some sessile glands (rarely with some capitate glandular hairs). Leaves mostly basal, ovate to oblong, 2.7-13 x 1-6 cm, rugulose, pubescent with many sessile glands, irregularly serrate to erose; petiole 1-5 cm. Inflorescence widely paniculate. Verticillasters 4-6-flowered,  $\pm$  distant. Bracts ovate, 5-15 x 4-14 mm. Pedicels 2-3 mm. Calyx infundibular, 7-11 mm, c. up to 15 mm in fruit and widening, eglandular pubescent with many sessile glands, teeth clearly spinulose. Corolla white or tinged lilac, 7-14 mm; tube c. 7 mm, ventricose, squamulate; upper lip narrow, scarcely falcate, scarcely bifid. Stamens B. Nutlet, rounded-trigonous c. 2.95 x 2.3. Chromosome count:  $2n=20$

The **pollen** of *S. yosgadensis* is isopolar and oblate with  $P = 35.61 \pm 1.71 \mu\text{m}$  and  $E = 39.13 \pm 1.77 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $29.60 \pm 1.38 \times 5.57 \pm 0.36 \mu\text{m}$ . The exine is  $1.29 \pm 0.07 \mu\text{m}$  thick and the intine is  $0.70 \pm 0.07 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 5-6. In *Quercus scrub*, disturbed steppe, fields, 800-1400 m.



Type: [Turkey B5 Kayseri/Yozgat] inter Caesaream (Kayseri) et Yosgad (Yozgat), 1400 m, 23 vi 1890, BornmuUer 2175 (holo. B!).

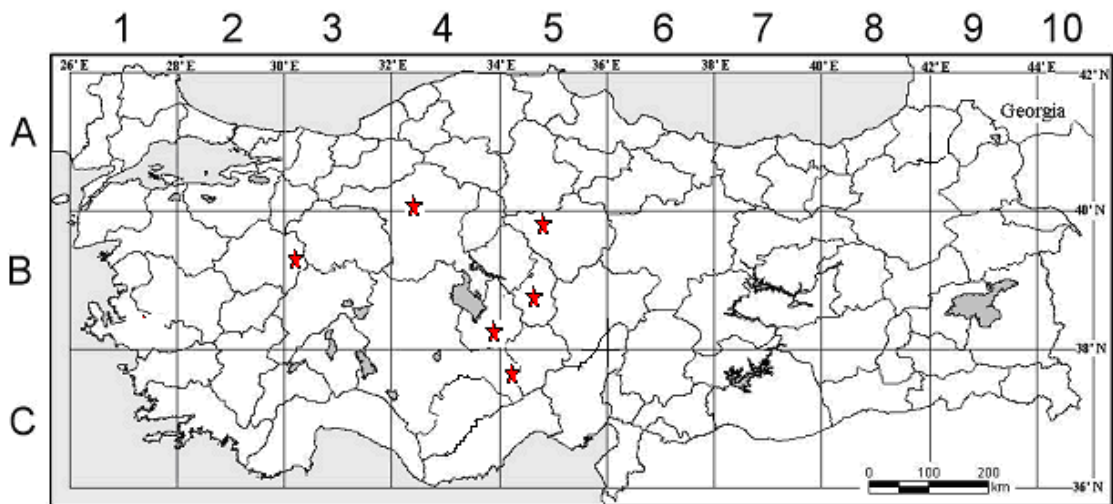
**C. (western) Anatolia.** A4 Ankara:29km past Polatlı to Sivrihisar 39 33 845 N 31 48 664 E, 880 m, 30 v 2008, SBagherpour 449! B3 Eskişehir: 11 km E. of Eskişehir, 800 m, Sorger 64-11-22! B4 Aksaray,Taşlıpınar Dikmen köyü altı, 38 09 456 N 34 05 312 E, 1285 m, 02 vi 2006, SBagherpour 262.! B4 Aksaray Helvadere Köşebaşı road to Hasan Dağı, 38 10 259 N 34 10 742 E, 1635 m, 03 vi 2006, SBagherpour 265.! B4 Ankara: Ankara to Konyaş, 1100 m, Tuzlaci (ISTE 39873)! Konya: Sarayönü to Cihanbeyli, 870 m, Hub.-Mor. 14215! B5 Yozgat: Roadside to Yozgat Büyükyaptı Köyü. 39 56 67 N 33 54 914 E, 884 m, 04 vi 2006, SBagherpour 266.! B5 Yozgat: 50km s.of Yozgat toward Kayseri at Karkışla above symmetry, 39 30 537 N 39 06 974 E, 1087 m, 04 vi 2006, SBagherpour 279.! B5 Nevşehir 12km to Gölşehir on the historic location 38 44 155 N 34 40 299 E, 938 m, 29 v 2008, SBagherpour 441.! B5 Nevşehir: Nevşehir to Gülşehir, 950 m, Tuzlaci (ISTE 40172)! Yozgat: Yozgat, Curtis 104! C5 Konya: Ereğli to Ulukışla, 1200 m, It. Leyd. 1959:1018!

Endemic. Ir.-Tur. element. Close to *S. frigida* but with an essentially eglan-dular indumentum on all parts; mostly from lower altitudes and less natural habitats.

**Endemic. Ir.-Tur. element.** Treat category **VU**



**Figure 4.333.** General appearance of *S. yosgadensis* Freyn & Bornm.



**Map 44.30.** *S. yosgadensis* distribution map.

**31. *S. cyanescens*** Boiss. & Balansa Diagn. Pl. Orient. Ser. 2(4): 19 (1859).

Perennial herb. **Stems** erect, quadrangular, 25-70 cm, branched above, pilose to lanate below, pilose with sessile glands to  $\pm$  densely papillose glandular above. **Leaves** simple, oblong to broadly ovate to suborbicular, 2-10 x 1.5-6.5 cm, pinnose, serrulate to subentire, keeled to cordate; petiole 1-7 cm. **Inflorescence** paniculate with slender branches; verticillasters (1-)2-6-flowered, distant. **Bracts** broadly ovate-acuminate, 2-6 x 2-4.5 mm. **Pedicels** 1.5-3 mm. **Calyx** tubular-campanulate, usually purple tinted, usually upper lip blue-purple, 7-10 mm, to 9-12 mm in fruit, shortly pilose or papillose glandular; upper lip tridentate, median tooth longer or shorter than, laterals, scarcely mucronate. **Corolla** lilac to violet, 16-30 mm; tube 7-8 mm, ventricose, squamulate (rarely not); upper lip strongly falcate. **Stamens** 5. **Nutlets** rounded trigonous, ovoid, 2.5 x 1.7 mm. Chromosome count: Unknown.

The **pollen** of *S. cyanescens* is isopolar and oblate with  $P = 49.45 \pm 2.36 \mu\text{m}$  and  $E = 55.67 \pm 3.39 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $42.18 \pm 1.85 \times 8.51 \pm 0.54 \mu\text{m}$ . The exine is  $1.80 \pm 0.10 \mu\text{m}$  thick and the intine is  $0.62 \pm 0.11 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl:* 6-10. Limestone, serpentine and igneous slopes, shale banks, *Pinus nigra* forest, gravel river beds, fallow fields, vineyards, 400-2300 m.

**Type:** [Turkey C5 Nigde] in collibus secus fluvium Kamechly Tchai (Kameçli Çay) ad basin fluvii Masmeneu Dagħ Cappadociae inter Tarsous et Caesaream, [14 vi 1856], Balansa [233] (holo. G! Iso G!).

A2 Bursa: bei Bursa, 7 vi 1929, H.Wolff! A3 Bolu: Mudurnu, 1000 m, P.H.Davis 37016 Bolu: Seben Karakiriş mount, Çeltik stream, Kaşbıyıklar Mvk, 790 m, 19 vi 1999, N.Aksoy 2037! Bolu: above Göynük, serpentine slopes of roadside, 912 m, 9 vii 2006, E.Karabacak 4807! Bolu: Mudurnu, Ankara-Bolu junction, roadside, serpentine slopes, 802 m, 9 vii 2006, E.Karabacak 4818! A4 Çankırı: W. of Çankırı, 800 m, A.Huber-Morath 13041 Çankırı: N of Yapraklı, mixed forest, 1440-1460 m, 26 ix 1992, H.Duman 4628 et al. Kırıkkale: Koçubaba town, Bağlar Mvk., steppe, scree, 1200 m, 14 vii 1990, A.A.Dönmez 2693! A5 Kastamonu: Taşköprü to Gökçeğaç, 500 m, P.H.Davis 38057

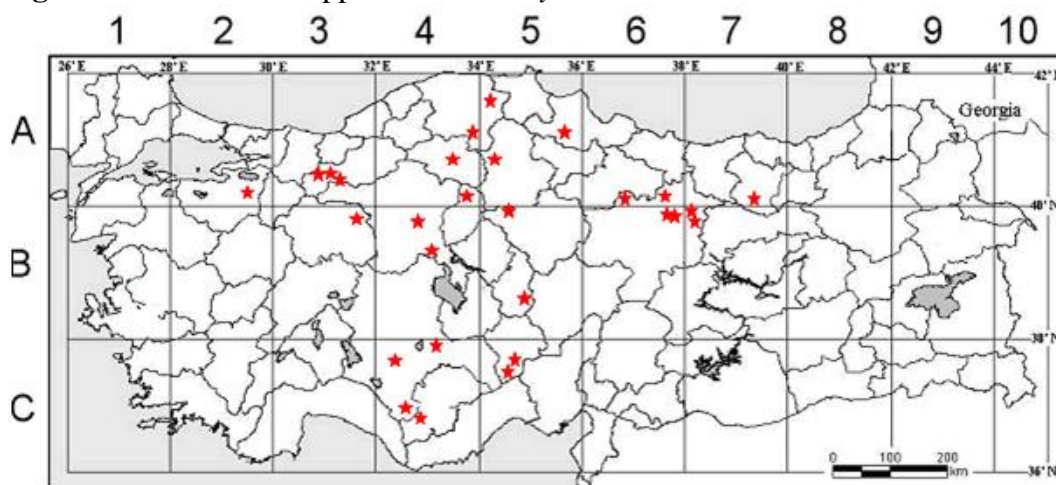
Kastamonu: Tosya, Gavur mount, serpentine slopes, 1175 m, 14 vii 2007, E.Karabacak 5448! Çorum: Bayat, Aşağılapa village, 1200 m, 16 vii 1977, M.Kılınç 6524! A6 Samsun: Ladik, Sultan mount, 28 vi 1953, H.Birand 2290! Sivas: Yıldız Da., Çırçır, 1400 m, Tobey 2335 Sivas: Şerefiye to Suşehri, Karabayır pass limestone slopes, (1925 m), 1348 m, 11 vii 2006, E.Karabacak 4937! A7 Gümüşane: Erzincan to Kelkit, dry shaley slopes and fallow fields, 1750 m, 1 viii 1957, P.H.Davis 31923 & I.C.Hedge! B3 Eskişehir: Ankara to Sivrihisar, c. 40 km from Polatlı, 1000 m, Dudley (P.H.Davis 36014) B4 Ankara to Aksaray before Şereflikoçhisar hills, 39 00 927 N 33 27 092 E, 1192 m, 03 vi 2006, SBagherpour 263! Ankara: d. Bala, Ankara to Şerefli Koçhisar, 50 km S. of Ankara, 1020 m, A.Huber-Morath 15314 Ankara: Beştepe, steppe, 850 m, 3 vii 1992, M.Vural 6028! B5 Yozgat: Yozgat to Boğazkale, 2 km N. of Derbet, 1200 m, Buttler 12845 Nevşehir: Zelve, volcanic turf, 1050 m, 22 vi 1989, M.Vural 5396 et al.! B6 Sivas: Zara to Suşehri, P.H.Davis 20451 B6 Sivas: 2 km S of Şerefiye, forest opening, 1600 m, 10 viii 1984, B.Yıldız 4791! B7 Sivas: Refahiye to Zara, Kızıl Da., 1710 m, Bothmer 1581! Sivas: Suşehri to Zara, above Suşehri, dry slopes, 2000 m, 26 viii 1957, P.H.Davis 32700 & I.C.Hedge! C4 Konya: N. of Sille, A.Huber-Morath 8020 Konya: 25 NW of Kocavaş, 1200 m, 22 vi 1953, H.Birand ! Konya: 2 km from Hadim to Korualan, 1680 m, 14 vii 1998, K.H.C.Başer 1417! Karaman: 5 km from Ermenek to Tekeçatı, 1650 m, 28 vi 1995, G.Kökdil et al.! C5 Niğde: Ala Da., Ulupınar Y. to Kara G., c. 2300 m, Spitzenberger 64.

Close to *S. candidissima* but with smaller lilac-tinted calyces and corollas, a more slender habit and smaller nutlets. Specimens from the type locality, Niğde, appear to be smaller plants with more condensed inflorescences and darker flowers; they grow at higher altitudes than those from northern Anatolia.

**Endemic. Irano-Turanian element.** Treat category: **NT**



**Figure 4.344.** General appearance of *S. cyanescens* Boiss. & Balansa



**Map 44.301.** *S. cyanescens* distribution map.

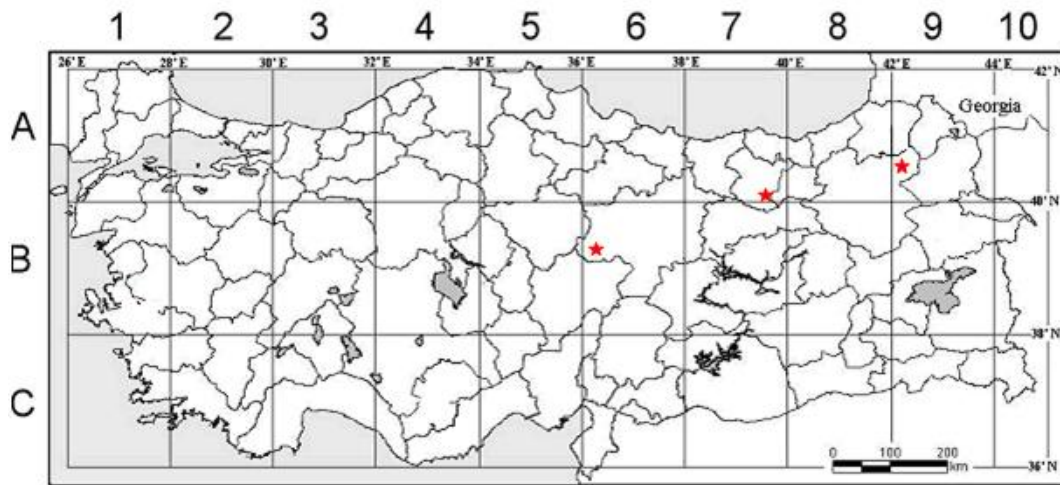
*Salvia candidissima* Vahl X *Salvia cyanescens* Boiss. & Balansa

A7 Gümüşhane: Kelkit-Köse, 1550 m., dry gravelly banks, perennial, flowers varying from small with pale lilac blue hood to larger and white. A hybrid swam between *S.*



*cyanescens* and *S. candidissima*, 2 Aug. 1957, P.H.Davis & I.C.Hedge (D.31970) (ANK!) A9 Erzurum: Oltu, Çamlıdere picnic area, 1443 m, slopes, 22 vi 2008, E.Karabacak 6162! (leaves similar to *S. cyanescens* but corollas white) B6 Sivas: Şarkışla to Kayadibi, 1400 m, dry gravel hills. Upper lip lavender-blue (pale), lower lip cream. 28 viii 1957, P.H.Davis 32728 I.C.Hedge (ANK!)

Hybridisation and introgression between the two species is probably frequent although only a few definite instances of hybrids are known.



**Map 4.312.** *S. candidissima* X *cyanescens* distribution map.

**32.** *S. hypargeia* Fisch. & Mey. Ann. Sci. Nat. Bot. sér. 4(1):34 (1854). = *S. montbretii* sensu Boiss. -- Flora Orientalis 4:611 p.p. non Bentham (1836). Ic. Tchihat., Asie Min. Bot. Atlas t.22 (1860).

Perennial herb forming tufts to 60 cm diam. **Stems** erect, sturdy, 25-60 cm, usually unbranched, eglandular arachnoid to lanate below, glandular pilose above. **Leaves** simple, linear to linear-oblong or spatulate, mostly basal, greenish above, white lanate below, margins subentire, 4-8 x 0.5-1 cm, incl. indistinct petiole. **Verticillasters** 4-8-flowered, clearly distant. **Bracts** broadly ovate, c. 15x12 mm, lower surface lanate. **Pedicels** 2-3 mm, ± erect. **Calyx** tubular-ovate, c. 10 mm, to c. 12 mm in fruit, lanate and glandular; upper lip truncate. **Corolla** lavender to purplish-blue, c. 25 mm; tube straight, slightly ventricose above; upper lip falcate. **Stamens** B. **Nutlets** rounded trigonous, 3.5 x 2.5 mm, Chromosome count: 2n = 22.

The **pollen** of *S. hypargeia* is isopolar and oblate-spherical with  $P = 51.50 \pm 4.05 \mu\text{m}$  and  $E = 52.42 \pm 4.47 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $43.64 \pm 3.91 \times 3.57 \pm 0.96 \mu\text{m}$ . The exine is  $1.16 \pm 0.15 \mu\text{m}$  thick and the intine is  $0.54 \pm 0.06 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl. 6-7. Limestone slopes and banks, with Pinus brutia, fallow fields, 800-2000 m.*

**Type:** [Turkey B4 Kırşehir] inter Karadjeli (İsahocalı) et Gaman (Kaman), [900 m, 1849], Tchihatcheff (holo. P).

**Central Anatolia, extending South & East** A3 Zonguldak: Ereğli, N slopes of Bulgar mount, 25.vi.1953, H.Birand 2721! A4 Karabük: Keltepe, kayabaşı, 1200 m, 12 vii 1984, M.Demirörs 155! Kastamonu: Kastamonu, 850m, Edmondson 541 Kastamonu: Vocational Collage garden, 500 m, 13 vii 1986, N.Tanker (AEF) Kastamonu: S part of Ilgaz Dağları, calcareous slopes near Yeşildumlupınar, SW of Kastamonu, 27 vi 1989, J.Zielinski 853a! Kastamonu: Araç, Gemi village, under Pinus nigra, 750 m, 14 vi 1977, Y.Akman 6920! Kastamonu: Daday to Devrant, black-pine forest, 800 m, 11 vi 1979, O.Ketenoğlu 1191! Kastamonu: İhsangazi, Dağyolu to Akkirpi village, calcareous steppe, 41 17 28.8 N 33 33 08.6 E, 1139 m, 13 vi 2007, E.Karabacak 5425! Kastamonu: Kastamonu to Tosya, Sapaca environs, limestone slopes, 848 m, 14 vi 2007, E.Karabacak 5438! Çankırı: Ilgaz, 1000 m, Bornmueller 1929:13503 Zonguldak: Safranbolu, Wiedemann 332 Ankara: Ayaş, 1000 m, Markgraf 11072 A5 Kastamonu: Tosya, Sintenis 1892:4233 Kastamonu: Tosya, between Sofular and Dedem villages, oakland, 1000 m, 17 vi 1975, M.Kılınç 3679! Kastamonu: Tosya, between Yukarı Dikmen and Kilkuyu village, Pinus nigra forest, 1400-1600 m, 12 vi 1975, M.Kılınç 3681! Kastamonu: Tosya, Gavur mount, Pinus forest, limestone slopes, 1117 m, 14 vi 2007, E.Karabacak 5441! B4 Ankara: 8 km S. of Ankara, M.Zohary & Orshan 28112 Ankara: Ayaş:Ankara yolu Ayaş Beli, 40 05 125 N 32 26 470 E, 1189 m, 04 vi 2005, SBagherpour 119! Ankara: Çankaya, Dikmen, Çal mount, protected steppe, 1100-1200 m, 5 vi 1984, M.Vural 2851! Ankara: Ayaşbeli, Akkaya hill, steppe, 1250-1400 m, 27 vi 1986, M.Vural 4171! B5 Aksaray: Kızılkaya village, 1150 m, 12 vi 1995, F.Ertuğ 489! Aksaray: Kızılkaya village, Lalelik Mvk., 1200 m, 23 v 1994, F.Ertuğ 40! Kayseri: Bakır Da. above Kısge, P.H.Davis 19277 Kayseri: Alidağ, S slopes, oakland, 1200-1300 m, 22 vi 1983, M.Koyuncu 6055 & İzgü! Kayseri: Alidağ, city environs,



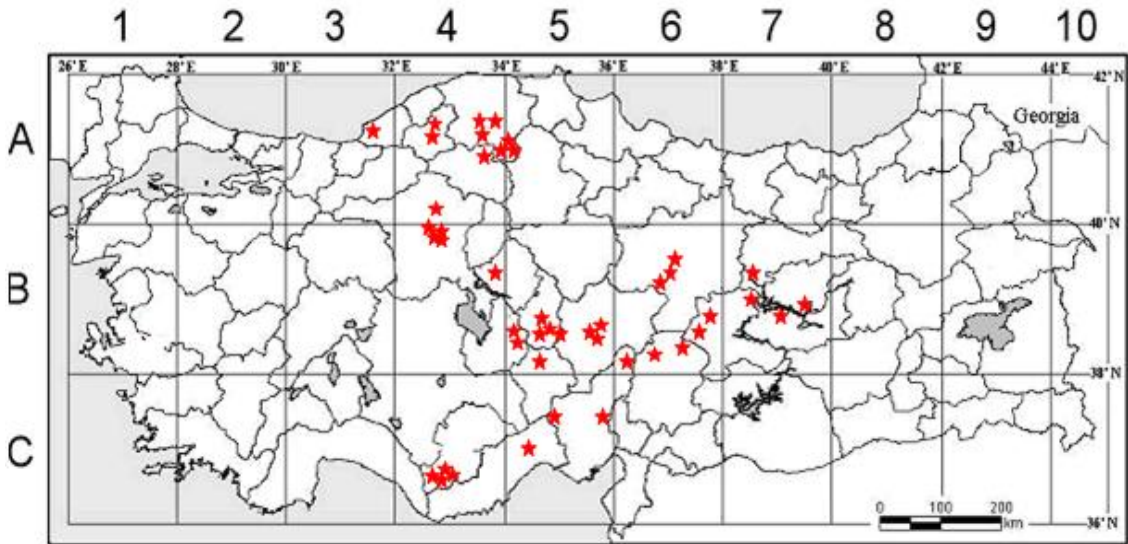
rocks, 1400 m, 17 vi 1995, A.A.Dönmez 4609 ! Kayseri: Talas, Ali mountain, Endürlük village, in fields, 1250-1550 m, 05 v 1996, S.Çelik 1247! Niğde: Ortakayaardı valley, 1200 m, P.H.Davis 19074 Nevşehir: Mucur, P.H.Davis 21824 Nevşehir: between Ürgüp and Ortahisar, volcanic turf, field side, 1120 m, 20 vii 1989, M.Vural 5278 et al.! Nevşehir: Zelve, Akdağ, volcanic turf, erosion slopes, 1200-1350 m, 21 v 1989, M.Vural 4893 et al.! Nevşehir: Ürgüp to Kayseri, pass Karacaviran, 11.vi.1971, A.Baytop! B6 Sivas: Gürün to Sivas, 1400 m, Stainton & Henderson 5729 Sivas: 15 km from Taşlıdere to Kayseri, W slopes, gypseous land, 1400-1500 m, 10 vii 1985, Ş.Civelek 1997! Sivas: 18 km from Kangal to Gürün, open slopes of sandy calcareous soil hills, 1564 m, 16 vi 2007, E.Karabacak 5503! Malatya: Gürün to Darende, 1300 m, M.Zohary & Plitm. 1767-27 Malatya: between Malatya and Darende, above Kürecik, 1700 m, 9 vi 1989, M.Koyuncu & Soner! Kahramanmaraş: Elbistan to Gürün, 1200 m, Stainton & Henderson 5665 Adana: Saimbeyli to Obruk Y., 950 m, E.Tuzlacı! Kahramanmaraş: Göksun, Binboğa mount, Keklikoluk village environs, steppe, 1600-1650 m, 30 vi 1992, Z.Aytaç 5063 et al.! Adana: Saimbeyli to Obruk yaylası, 950 m, 29 vii 1977, E.Tuzlacı! B7 Tunceli: 10 km N. of Pertek, 1800 m, It.Leyd. 1959:1572 Malatya: Arapkir, Sintenis 1889:858 Erzincan: Kemaliye, Sintenis 1890:2819 Elazığ: Keban, Maden, Sintenis 1889:844 C4 Konya: Ermenek to Balkusan De., 1500 m, P.H.Davis 16197 Karaman: Karaman to Mut, 1430 m, M.Zohary 290113 Karaman: 5 km from Ermenek to Tekeçatı, 1650 m, 28 vi 1995, G.Köktil et al. (GAZI!) Karaman: Değirmenbaşı village environs, Pinus nigra forest clearings, 1500 m, 22 vi 1979, M.Vural 1578 et al.! Karaman: 22 km from Ermenek to Karaman, Aktepe place, Pinus nigra openings, 1600 m, 28 vi 1980, E.Tuzlacı! Karaman: 10 km from Ermenek to Tekçatı, dry slopes, 1700 m, 20 vii 1983, M.Koyuncu 6577 & Coşkun! C5 Konya: d. Ereğli, Aydos Da., 1400m, S.Erik 2948! Mersin: Tarsus, Namrun road, Sarıkavak village environs, 900 m, 6 vi 1981, M.Koyuncu 4398 & S.Erik! Adana: Gülek gorge environs, slopes, 1200-1300 m, 10 vi 1992, M.Koyuncu 9918! Adana: Burujik (Bürücek), 1100m, Balls 1233.

*S. hypargeia* is closely related to *S. montbretii*; calyx and bracts of *S. hypargeia* smaller than *S. montbretii*'s.

**Endemic. Irano-Turanian element.** Treat category: **NT**



Figure 4.355. General habitus of *S. hypargeia* Fisch. & Mey.



Map 4.323. *S. hypargeia* distribution map.

**33. *S. ceratophylla* L.** (Fig. 9) Species plantarum, page 27, no. 24 (1753). = *S. semilanata* Czernjak., Feddes Repert. 27: 278 (1930).

Biennial very sticky herbs, lemon-scented. **Stems** sturdy, 25-70 cm, glandular-villous, densely so above. **Leaves** mostly basal, pinnatifid, oblong in outline, with spreading linear segments, white-lanate when young, 10-29 x 3-10 cm, rachis winged; petiole subabsent. **Inflorescence** spreading paniculate, yellowish-green. **Verticillasters** 2-8-flowered, distant. **Bracts** ovate, cuspidate, c. 1.5 x 1.2 mm. **Pedicels** erecto-patent, 2-4 mm. **Calyx** ovate-campanulate, c. 12 mm, to c. 18 mm in fruit with diverging lips, glandular-villous; upper lip tridentate with cuspidate teeth. **Corolla** cream or sulphur, rarely with lilac upper lip, 15-20 mm; tube 4-5 mm, abruptly ventricose, squamulate; upper lip falcate. **Stamens** B. **Nutlets** spherical, black, c. 3.5 x 2.5-3 mm. Chromosome count:  $2n = 44$ .

The **pollen** of *S. ceratophylla* is isopolar and oblate with  $P = 40.33 \pm 3.17 \mu\text{m}$  and  $E = 45.77 \pm 4.38 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $34.65 \pm 3.35 \times 4.00 \pm 0.58 \mu\text{m}$ . The exine is  $1.25 \pm 0.14 \mu\text{m}$  thick and the intine is  $0.76 \pm 0.08 \mu\text{m}$ . Its ornamentation is reticulate.

*Fl: 4-6. Limestone, igneous and gypsum slopes, corn and fallow fields, waste ground, steppe, 300-2150 m.*

**Type:** Described from 'Persia' (Hb. S-LINN 42/47 photo!).

**Widespread in Inner Anatolia.** A4 Ankara: Keçiören, 1000 m, Markgraf 10509 A5 Kastamonu: Tosya, Sintenis 1892:4287 A8 Erzurum: N.E. of Tortum (Grossheim 7: map 440) A9 Kars: 23 km from Kağızman to Karakurt, 1350 m, Rechinger 57430 B3 Eskişehir: Sündiken Da., T.Ekim 645 Eskişehir: Eskişehir to Ankara, 35 km before Sivrihisar, roadside, 930 m, 19 vi 2004, E.Karabacak 3308! Ankara: between Polatlı and Sivrihisar, 840-850 m, 11 vi 1991, steppe, H.Duman 3869 et al.! Nevşehir: Zelve to Göreme, volcanic turf, roadside, 1100 m, 20 v 1989, M.Vural 4850 et al.! B4 Ankara: Haymana to Sivrihisar, mountain steppe, 800 m, 30 v 1956, H.Demiriz 2952! Ankara 15 km to Kırıkkale, 39 56 093 N 33 24 808 E, 1060 m, 01 vi 2006, SBagherpour 242! Ankara: Beştepe, steppe, 850 m, 3 vi 1992, M.Vural 6022 ! Aksaray: between Aksaray to Ulukışla, field edge, 1060 m, 18 v

1993, M.Vural 6273 et al.! B5 Yozgat: Akdağmadeni, Fındıcak stream, 1750 m, 4 vi 1980, T.Ekim 5265! Kayseri: İncesu to Develi, 1050m, A.Huber-Morath 10742 B6 Malatya: E. of Darende, 1500m, Watson 5563 Kayseri: between Kayseri and Sivas, 20 vi 1934, Balls 1439! Kahramanmaraş: Çardak to Göksun, 5 km before Göksun, roadside, 1350 m, 20 vi 1979, E.Tuzlacı & M.Saraçoğlu 42369! B7 Sivas: Divrik, Dumlucadağ, 30 v 1968, T.Baytop 12925! Erzincan: 3 km from Erzincan to Spikör mount, calcareous slopes, 1567 m, 7 vii 2007, E.Karabacak 5543! Diyarbakir: Ergani to Maden, 900 m, P.H.Davis 28878 B8 Erzincan: Tercan to Aşkale, 1600 m, P.H.Davis 29343 B9 Van: 20 km from Timar to Van, 1800m, P.H.Davis 44219 C2 Burdur: Tefenni to Burdur, 1100 m, A.Huber-Morath 5209 Burdur: 12 km from Karamanlı to Burdur, slopes of Karataş lake hills, 1150 m, 6 vii 1993, L.Bekat 3101 18912! C3 Burdur: Burdur to Antalya, A.Huber-Morath 5210 Antalya: between Kızılcadağ and Korkuteli, 2 km before Korkuteli, Quercus scrub, 1150 m, 23 vi 1980, N.Özhatay, E.Özhatay & E.Tuzlacı! C4 Mersin: Mut to Büyük Egri Da., 800 m, Coode & Jones 913 C5 Niğde: Niğde, 100 m, Siehe 1898:38 Niğde: Ulukışla-Darboğaz junction, Artemisia steppe, 13 vi 1991, Y.Gemici 6072! C6 Adıyaman: Malatya to Besni, 1000 m, Balls 2262! C7 Urfa: Urfa to Hilvan, 700 m, P.H.Davis 28241 C8 Siirt: 5 km S. of Siirt, 700 m, P.H.Davis 43214 C10 Hakkari: Zap river valley, Trelawny 1319.

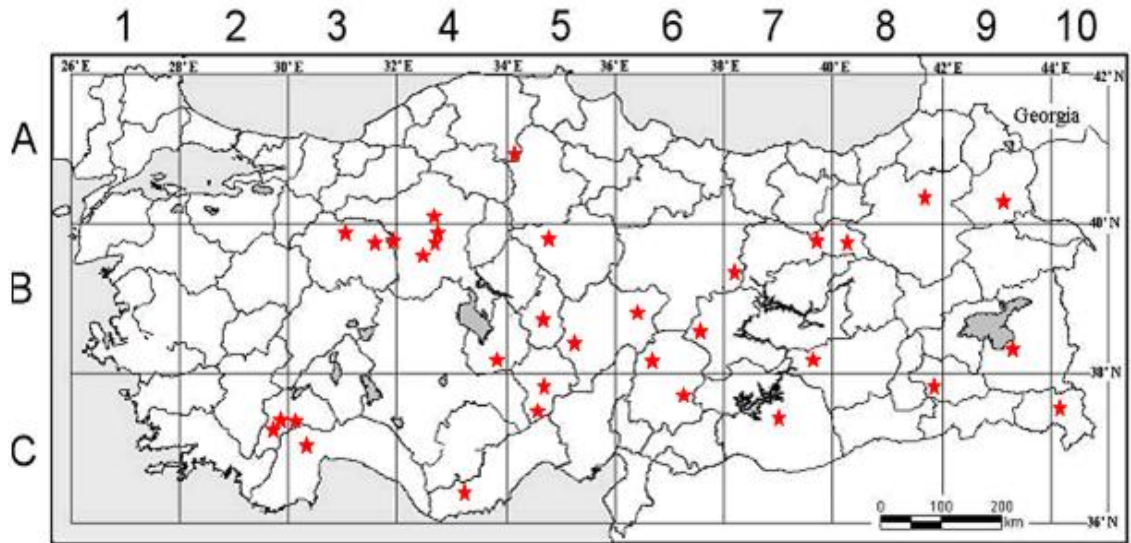
Very distinct and unmistakable on account of the pinnatifid leaves, white-lanate when young, and yellow or cream corollas.

Palestine, Syrian Desert, Soviet Armenia, N. Iraq, Iran, Afghanistan. **Irano-Turanian element.** Threat category: **LC**





**Figure 4.366.** General appearance of *S. ceratophylla* L.



**Map 44.334.** *S. ceratophylla* distribution map.

**34.** *S. vermifolia* Hedge & Hub.-Mor. in Notes R.B.G. Edinb. 22: 185 (1957).

Perennial herb. **Stems** 25-40(60) cm, simple, erect, eglandular pubescent floccose, retrorse, and deep purple below, densely glandular and yellowish-green above. **Leaves** simple, narrowly linear to linear-oblong, 20-47 x 6-10 mm, margins crenulate, revolute, floccose-tomentose below, narrowed into **petiole**; cauline leaves sessile, 2-3 paired. **Verticillasters** 2-3 flowered, distant. **Bracts** c. 4-7 x 4-5 mm. **Pedicels** 2-4 mm, erect. **Calyx** tubular-campanulate, 10-11, c. up to 12 mm at fruit, yellowishgreen, glandular-pubescent, many sessile glands; upper lip recurved, teeth mucronate. **Corolla** white with yellowish lower lip, many sessile glands, 15-24 mm; tube abruptly broadened above, squamulate; upper lip strongly falcate-compressed. **Stamens** B. Chromosome count:  $2n=20$ .

The **pollen** of *S. vermifolia* is isopolar and prolate with  $P = 33.57 \pm 4.80 \mu\text{m}$  and  $E = 30.79 \pm 3.20 \mu\text{m}$ . The aperture is mostly hexacolpate (rarely heptacolpate to octacolpate) and the colpi =  $29.01 \pm 4.31 \times 4.47 \pm 0.65 \mu\text{m}$ . The exine is  $1.21 \pm 0.19 \mu\text{m}$  thick and the intine is  $0.64 \pm 0.14 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 6-7. Igneous and serpentine slopes, c. 1450 m.

Type: [Turkey B6] Sivas: Sivas - Ulaş, Hiigel, Eruptivgestein 27 km siid-lich Sivas, 1450 m, 27 vi 1955, A. Huber-Morath & Ch. Simon, Hub.-Mor. 13040 (holo. E! iso. Hb. Hub.-Mor.!).

**C. Anatolia.** B6 Sivas: Ulaş Kurtlukaya to Boğazdere:left side of road. 39 23 142 N 36 55 898 E, 1495 m, 20 vii 2008, SBagherpour 521! B6 Sivas to Tecer, 26 km S. of Sivas, c. 1450 m, Hub.-Mor. 15311!

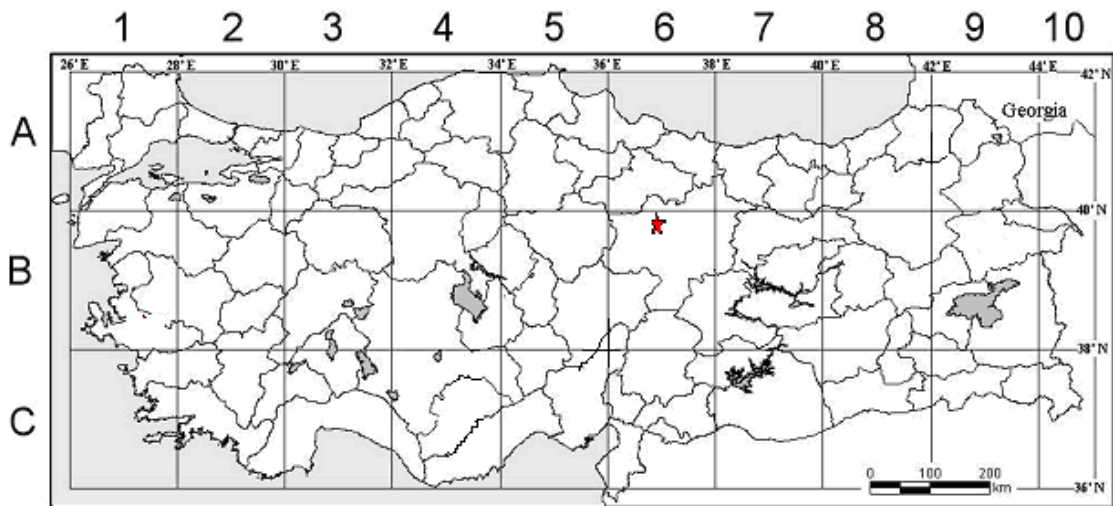
Very distinctive on account of the linear leaves, but within the *S. candidissima* complex.

**Endemic. Ir.-Tur. element.** Treat category: **EN**



**Figure 4.377.** General appearance of *S. vermifolia* Hedge & Hub.-Mor.





**Map 44.345.** *S. vermifolia* distribution map.

**35.** *S. sclarea* L. (Figure 7) Species plantarum, page 27, no. 23 (1753). Ic: Reichb., Ic. Fl. Germ. 18: t. 1249 (1856) Fl. RPR 8: t. 41 f. 2 (1961) Huxley & Taylor, Fls. Greece t. 239 (1977). = *S. pamirica* Gand., Bull. Soc. Bot. Fr. 60: 26 (1913) = *S. atilabrosa* Pau, Trab. Mus. Nac. Scienc. Nat. Ser. Bot. Madrid 14: 33 (1918)

Biennial or short-lived perennial with erect rather coarse quadrangular, **stems** to 100 cm, much branched above, pubescent to hirsute below, glandular above. **Leaves** simple, broadly ovate to ovate-oblong, c. 8-14 x 5-10 cm, cordate, pubescent, crenate-erose; petiole 3-9 cm. **Inflorescence** paniculate, many-flowered; **Verticillasters** 2-6-flowered, distant. **Bracts** ± exceeding flowers, pink to mauve or white, membranous, ovate, acuminate, 15-35 x 10-25 mm. **Pedicels** 2-3 mm, erecto-patent. **Calyx** ovate-campanulate, c. 10 mm, to 13 mm in fruit, scabrid, with sessile glands; upper lip tridentate, mucronate. **Corolla** with a lilac or pale blue upper lip and cream lower lip 20-30 mm; tube abruptly ventricose, strongly squamulate; upper lip falcate. **Stamens** B. **Nutlets** rounded trigonous, 3 x 2 mm. Chromosome count: 2n=22.

The **pollen** of *S. sclarea* is isopolar and oblate-spherical with  $P = 32,64 \pm 1,22 \mu\text{m}$  and  $E = 34,58 \pm 1,87 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $26,8 \pm 1,84 \times 5,37 \pm 0,56 \mu\text{m}$ . The exine is  $1,12 \pm 0,17 \mu\text{m}$  thick and the intine is  $0,67 \pm 0,13 \mu\text{m}$ . Its ornamentation is reticulate.

*Fl: 5-8. Rocky igneous slopes, mixed deciduous and coniferous woodland, shale banks, fields, roadsides, s.l-2000 m.*

**Type:** Described from Syria and Italy (Hb. S-LINN. 42/45!).

**Lectotypus:** Luis Rosúa & Blanca, Taxon 35: 719. 1986.

**Throughout most of Anatolia except W.** A2 İstanbul: Çatalca, Urumov. A2 Kocaeli: Gebze to İzmit, 50 m, P.H.Davis 36237 Bursa: Yenişehir, Yenişehir to Bilecik, Sakız mount, slopes and shrubs, 517 m, 09 vii 2006, E.Karabacak 4789! A3 Bolu: Tataava to Abant G.; 8.vii.1940, B.Post Bolu: Göynük, Göynük to Mudanya, 5 km from Hacıayan pass, slopes, 913 m, 09 vii 2006, E.Karabacak 4808! Bilecik: Söğüt, Küsnak Mvk. S.Çırak 1007! A4 Bolu: Gerede, Aktaş forest, roadside, 1100 m, 3 vii 1975, O.Ketenoğlu 514! Bolu: Gerede to Kızılcahamam, 1350 m, 6 viii 1984, Ö.Seçmen 35, Y.Gemici & H.Tabata-Yasuda 17878! Karabük: town centre environs, 300 m, 13 vii 1985, M.Demirörs 1584! Çankırı: Çerkeş, Gerede to Çerkeş yolu, 5 km before Çerkeş, roadside slopes, 1120 m, 09 vii 2006, E.Karabacak 4823! Kastamonu: İnebolu, Quercus scrub, 1300 m, 12 viii 1960, Khan, Prance & Rateliffe 600! Kastamonu: Vocational Collage garden, 500 m, 13 vii 1986, N.Tanker! Kastamonu: Daday stone pits, 950 m, 23 vi 1980, O.Ketenoğlu 1187! Kastamonu: between Daday and Kanlıgöl, Karamuk village, 800 m, 25 vi 1981, M.Demirörs 411! Kastamonu: 15 km from Tosya to Kastamonu, Ilgaz mount, scree, rocky slopes, 1323 m, 10 vii 2006, E.Karabacak 4842! Ankara: Kızılcahamam to Gerede, 1260 m, Orshan 5147 Ankara: Ankara to Kızılcahamam, 27 vi 1954, K.Karamanoğlu! Ankara: Kızılcahamam, Işık mount, 1400 m, 10 vii 1976, M.Koyuncu & S.Kurucu! Ankara: Kızılcahamam, Soğuksu National Park, 1100-1150 m, 10 vi 1996, Ö.Eyüboğlu 1581! Ankara: Nallıhan, Karakiriş mount, Dadaş village, Çeltik stream, 720 m, 19 vi 1999, N.Aksoy 1659! A5 Kastamonu: Tosya, Gavur mount, summit road, serpentine slopes, 1481 m, 10 vii 2006, E.Karabacak 4877! Kastamonu: Tosya, between Sofular and Deden villages, oakland, 1000 m, 17 vi 1975, M.Kılınç 3728! Amasya: Merzifon, Saraycık village environs, roadside, 872 m, 10 vii 2006, E.Karabacak 4879! Samsun: Ladik, 700 m, Tobey 732 Samsun: Ladik, Aslantaş road, 900 m, 22 viii 1978, Ş.Yıldırım 1210! A6 Tokat: 10 km from Tokat to Sivas, valley, dry slopes, 1000 m, 5 vii 1980, Çelik! Tokat: 13 km from Tokat to Sivas, slopes,

1060 m, 10 vii 2006, E.Karabacak 4885! Tokat: Tokat to Sivas, Kızılınış pass, slopes and shrubs, 1200 m, 10 vii 2006, E.Karabacak 4898! Sivas: Sivas to Tokat, Çamlıbel pass, 6 vii 1992, Kartal! A7 Trabzon: Kalanema De. nr Aktsche Abad (Akçaabat), Hand.-Mazz. 328 Giresun: between Şebinkarahisar and Kelkit, 3 km before Konaklı village, soil slopes, 1536 m, 11 vii 2006, E.Karabacak 4957! Gümüşhane: Torul to Hamsiköy old road, rocky slopes, 1281 m, 12 vii 2006, E.Karabacak 5001! Gümüşhane: 40 km from Gümüşhane to Bayburt, Güvercinlik Mvk., 1850 m, 9 vii 1987, Coşkun & S.Kurucu! A8 Bayburt: Erzurum to Bayburt, 1250 m, Stainton & Henderson 6160 Artvin: Ardanuç, between Boyalı and Akarsu villages, Boyalı environs, Picea orientalis forest, 740 m, 13 vii 2006, E.Karabacak 5026! Erzurum: 20 km from Tortum to Oltu, slopes, 1500 m, 17 vii 1990, M.Koyuncu 8624! Erzurum: Oltu, Azert yaylası, 1350 m, 2 viii 1984, N.Demirkuş 2339! Erzurum: Tortum to Narman turnout, roadside, meadows, 1504 m, 14 vii 2006, E.Karabacak 5086! A9 Artvin: Ardanuç, Arevet, rocks, 732 m, 25 vi 2008, E.Karabacak 6241! Ardahan: Posof, Al village, roadside, 1500-1600 m, 27 vii 1985, N.Demirkuş 3041! B1 Manisa: Soma mount, macchie, 400 m, 26 v 1966, H.Peşmen 440! B2 Kütahya: Kütahya, 6 vi 1935, Reese Kütahya: 20 km before Kütahya, Çaydere Mvk., 24 vi 1991, G.Yıldız ! B3 Eskişehir: Çatacık, 1400m, T.Ekim 659 Afyon: 1 km S of Bayat road, 1100 m, 18 vi 1980, Ö.Seçmen 2239 et al.! Afyon: DazkırıS of Darıcılar village, stream side, 1000 m, 18 vi 1984, Z.Aytaç 1253! Isparta: between Senirkent and Garip village 850 m, 9 vi 1983, L.Bekat 945! B4 Ankara: Ankara Hills above Kalecik 4km to Gülköy, 40 05 067 N 33 22 060 E, 1500 m, 18 vii 2008, SBagherpour 506! Niğde: S. of Tuz G., Bisby 94 B5 Yozgat: Yozgat to Sorgun, near Çalathlı village, roadside, 1214 m, 15 vii 2006, E.Karabacak 5181! Nevşehir: between Ürgüp and Zelve, volcanic turf, roadside, 1080 m, 22 vi 1989, M.Vural 5366! Kayseri: Bakırdağı nr Develi, P.H.Davis 19190a Kayseri: Talas, Ali mountain, steppe, 1400-1800 m, 15 v 1996, S.Çelik 1292 ! B6 Sivas: Şerefıye, Çamlıkale village, fieldside, 1750 m, 11 viii 1984, B.Yıldız 4901 & N.Çelik! Sivas: Cumhuriyet University Campus, deep soil, 1250 m, 6 vii 1983, N.Çelik 2493! Kahramanmaraş: 5 km S. of Göksun, 1600 m, Stainton & Henderson 5545 B7 Tunceli: Tunceli to Pülümür, 1100 m, P.H.Davis 29227 B9 Van: Delandere, 4 km S. of Müküş, 1400m, Frodin 1939:272 C2 Muğla: Muğla to Kale, 720 m, Dudley (P.H.Davis 35065) Muğla: Fethiye, Üzümlü, Kızılbel village,

Karacaören Mvk., 17 vi 1967, H.Peşmen 7019 & E.Leblebici! Denizli: Babadağ, Yeşilköy valley, *Castanea sativa* association, 930 m, 9 vi 1997, S.Oluk 2101! Burdur: Dirmil to Gölhisar, Boncuk Mountains, *Quercus coccifera* forest, 1310 m, 15 vi 2001, E.Karabacak 1218! C3 Antalya: nr Manavgat, 5 m, A.Huber-Morath 17704 Antalya: Elmalı, 1966, C.Regel (EGE19639!) Antalya: Akseki, Güzelsu, Katranlık Mvk., roadside, 1200 m, 28 v 1996, A.Duran 3764! C4 Konya: 45 km from Ermenek to Mut, roadside slopes, 700 m, 29 v 1981, N.Tanker & M.Koyuncu 4154! Konya: between Ermenek and Gülnar, above Üçbölük village, 800-900 m, 17 vi 1982, N.Tanker & M.Koyuncu 5615! Antalya: Alanya, Türbelinaz yaylası, *Pinus nigra* forest, 1100 m, 25 vi 1978, E.Leblebici! Mersin: Gülnar, N. of Yeniceköy, 900 m, H.Demiriz 431 C5 Niğde: Ala Da., Çukurbağ, 1750m, Parry 250 Niğde: by NW foot of Aladağ, near the village of Demirkazık köyü, roadside and grazed flat, 1500 m, 25 vii 1984, G.Görk, P.Hartvig & A.Strid 23969! C6 Kahramanmaraş: Binevler environs, 22 v 1996, A.İlçim 350! Kahramanmaraş: Engizek mount, Engizek village environs, field side, 1400-1500 m, 15 vi 1987, H.Duman 3319! Gaziantep: Gaziantep, 900 m, 7 v 1944, Aysoy Gaziantep: between Gaziantep and Şanlıurfa, roadside, steppe, 800 m, 7 v 2001, M.Vural 8494 et al.! C7 Şanlıurfa: Ceylanpınar, Gümüşsu operational, rocks, 510 m, 2 v 1995, N.Adıgüzel 2236 et al.! C9 Siirt: Cevizli and Siirt junction, dry slopes, disturbed oakland, calcareous rocks, 1000 m, 13 vi 1980, M.Koyuncu 3175 & A.Güner (AEF) Şırnak: 17 km from Şırnak to Hakkari, roadside, 1150 m, 5 vi 2001, M.Ekici 2251! Hakkari: Zap gorge, c. 25 km from Hakkari to Çukurca, 1000 m, P.H.Davis 44800 C10 Hakkari: 2 km from Şemdinli to Yüksekova, 1550 m, P.H.Davis 45033

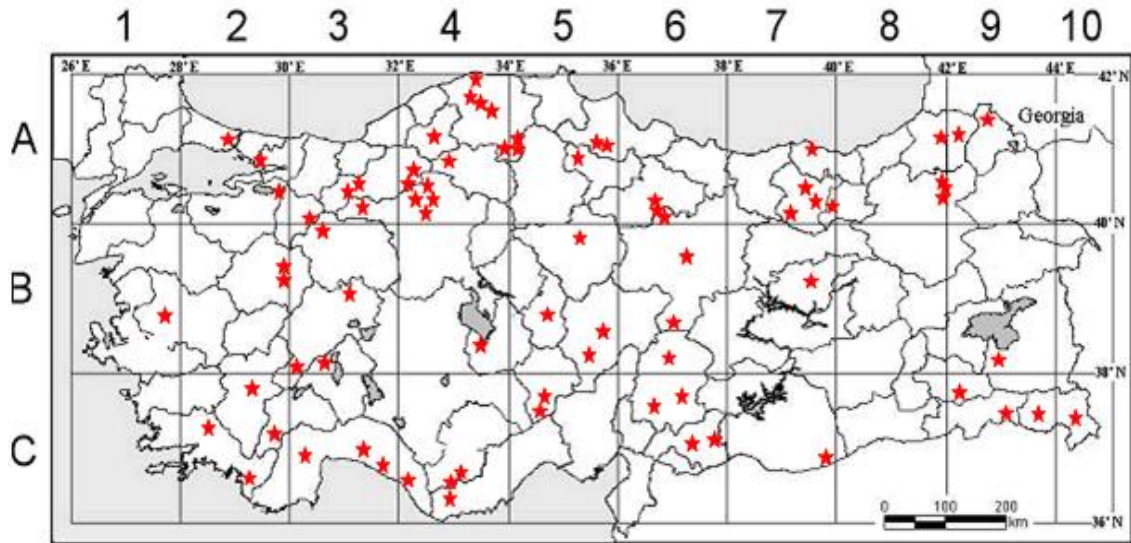
Distinctive on account of its habit and the large coloured bracts, often exceeding the flowers; a fairly oligomorphic species. Hedge (in Rechinger, Fl. Iranica 150: 452. 1982) indicated the inadequate 42.45 (LINN) as the type, but Rosúa & Blanca argued that this collection conflicted with Linnaeus' protologue (and was also identifiable as *S. argentea* L. 1762). They therefore designated Burser material, from Italy, as the lectotype.

**Throughout most of Europe, S.W. & C. Asia.** Threat category: **LC**





**Figure 4.388.** General appearance of *S. sclarea* L.



**Map 44.356.** *S. sclarea* distribution map.

#### 4.2.4 Section *Plethiosphace* Benth.:

Perennial, rarely annual herbs. Calyx campanulate; upper lip concave and 2-sulcate in fruit. Upper lip of corolla straight or falcate; tube not hairy-ringed. Connective longer than filament; arms unequal, the sterile arm shorter, flattened distally.

Species for Sect. *Plethiosphace*:

**36. *S. dichroantha*** Stapf in Denkschr. Akad. Wiss. Wien, Math.-Nat. Kl. 50(2):96 (1885). Syn: *S. sylvestris* sensu Boiss., Fl. Or. 4:628 (1879) p.p. non L.; *S. nemorosa* auct. p.p. non L. (1753).

Perennial herb. **Stems** 25-57 cm, ascending-erect, branched above or not, eglandular-pubescent. **Leaves** simple, narrowly oblong to oblong-lanceolate, ± cordate, 2-11 x 0.7-3 cm, rugulose, pubescent with numerous sessile glands, crenulate; **petiole** 1-10 cm. Verticillasters 2-6-flowered, ± approximating. **Bracts** ovate-acuminate, 2-15 x 2-10 mm. Pedicels 0.5-2 mm. **Calyx** tubular campanulate, 5-7 mm, to c. 8 mm in fruit, pubescent with numerous sessile glands (rarely with some capitate glandular hairs). **Corolla** purpule to violet blue, 10-17 mm ; tube c. 6 mm, ventricose, not squamulate;

upper lip falcate. **Stamens** B. Nutlets rounded trigonous, ovoid, 2 x 1.5 mm. Chromosome count: unknown.

The **pollen** of *S. dichroantha* is isopolar and prolate with  $P = 41.30 \pm 2.89$   $\mu\text{m}$  and  $E = 39.06 \pm 2.04$   $\mu\text{m}$ . The aperture is hexacolpate and the colpi =  $34.33 \pm 3.31 \times 4.33 \pm 0.50$   $\mu\text{m}$ . The exine is  $1.36 \pm 0.14$   $\mu\text{m}$  thick and the intine is  $0.70 \pm 0.08$   $\mu\text{m}$ . Its ornamentation is bireticulate.

*Fl. 7-9. Steppe, clearings in forest, fallow fields, roadsides, 810-1800 m.*

Type not indicated [Turkey C2 Mugla: inter Baschibunar (Başpınar) et Gurdev (Girdev), 19 vii 1882, Luschan] (holo. WU! photo E!).

**N.W., S.W. & C. Anatolia.** A3 Bolu: Abarit G., 6 viii 1941, B. Post! A4 Bolu: Gerece to Aktaş, 1150m, Ketenoğlu 350! A4/5 Kastamonu: Kastamonu to Taşkopr, Hirahasan köyü, 22 viii 1956, Ozen! B2 Kiitahya: Domanic, 900 m, D. 36429. B3 Eskisehir: 2 km W. of Oklubali öoyü to Inonu, 810m, Buttler 13725! B4 Konya: 2 km E. of junction to Zaferiye köyü on way to Ilgin, 1060 m, Buttler 20004! B4 Konya: Bayşehir to Ilgin yolu before Aşağıçığil 38 01 021 N 31 53 868 E, 1386 m, 27 vii 2005, SBagherpou 214! B4 Konya: Zaferiye köy 2 km E. Of Zaferiye köy toward Ilgin Bulasan near river 38 17 533 N 32 00 983 E, 1023 m, 27 vii 2005, SBagherpour 215! B4 Konya: Cihanbeyli roadside 38 38 117 N 32 55 858 E, 884 m. SBagherpour 202.! B5 Niğde: Aksaray to Sultan Saray, 1200 m, D. 32809. B6 Sivas: Sivas Zara 16km to Adamfakı village, 39 52 280 N 37 56 995 E, 1650 m. SBagherpour 517. B6 Sivas: Divriği to Kemaliye 22km from Divriği to Maltepe, 39 31 210 N 38 09 370 E, 1560 m, 06 vi 2006, SBagherpour 305! B6 Sivas: Hekimhan to Kangal, 1800 m, D. 24843. C2 Mugla: Girdev G., 1670 m, D. 13756. C3 Isparta: d. Egridir, Yukari Gokdere, 1700 m, Pesmen & Güner 1817! Antalya: Calbali Da., 1700 m, D. 15247. C4 Konya: 12 km W. of Konya, D. 16128.

Endemic. Ir.-Tur. element. Related to the E. Anatolian *S. nemorosa*, but without the prominent violet bracts of that species and often with a greyish-white indumentum. Two anomalous specimens are from B7 Elazig: Elazig, viii 1944, Sayi! and C3 Isparta: d.

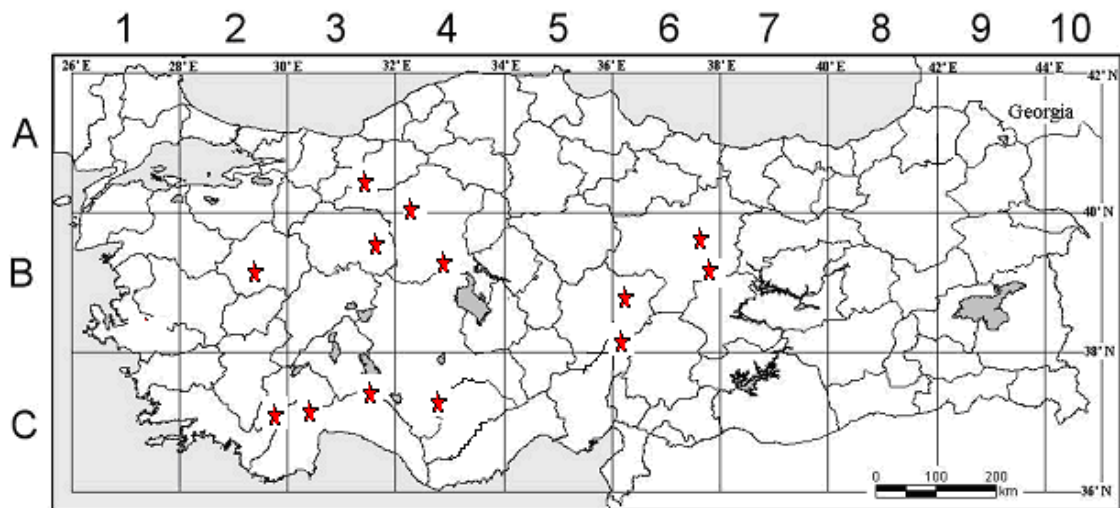


Sutciiler, Sarp Da., D. 15810! Both have a dense glandular calyx indumentum and appear to be intermediate between *S. dichroantha* and *S. virgata*.

**Endemic. Ir.-Tur. element.** Treat category NT



**Figure 4.399.** General appearance of *S. dichroantha* Stapf.



**Map 44.367.** *S. dichroantha* distribution map.

**37. *S. virgata*** Jacq., Hort. Vindob. 1: 14, t. 37 (1770). Syn: *S. sibthorpii* Sibth. & Sm., Fl. Graeca I: 17, t. 22 (1806); *S. similata* Hausskn. in Mitt. Thur. Bot. Ver. N.F. 11:36 (1897); *S. virgata* Jacq. var. *densiflora* Nab. in Publ. Fac. Sci. Univ. Masaryk Bino 70: 52,1. 15 f. 4 (1926); *S. virgata* Jacq. var. *canovelutina* Rech. fil. in Ann. Naturh. Mus. Wien 51 :420 (1941). Ic: Sibth. & Sm., Fl. Graeca 1: t. 22 (1806), as *S. sibthorpii*.

Perennial usually coarse herb. **Stems** erect, (10-)30-100 cm, much branched above or not, indumentum variable, pilose to tomentose, glandular or eglandular. **Leaves** simple, distributed over stem or rarely restricted to basal rosettes, ovate-oblong to broadly ovate, 3.7-30 x 2-15 cm, eglandular-pilose with numerous sessile glands, cordate, rugulose, erose, crenate; serrate to subentire; **petiole** 1-15 cm. Inflorescence a widely branched panicle with long ± slender secondary branches; **verticillasters** 2-6-flowered, distant, rarely condensed. Bracts ovate-acuminate, 2-10 x 2-9mm. **Pedicels** 1-3 mm. **Calyx** ± tubular campanulate, 5-10 mm, to 10-12 mm in fruit with a strongly recurved bisulcate upper lip, glandular or eglandular pilose. **Corolla** violet-blue to lilac, rarely white, 12-20 mm; tube 7-9 mm, ventricose, not squamulate; upper lip falcate. Stamens B. Nutlets rounded trigonous, ovoid, 2.5 x 2 mm. Chromosome count: 2n = 16.

The **pollen** of *S. virgata* is isopolar and oblate with P = 36.20 ±1.51 µm and E = 42.30 ±3.58 µm. The aperture is hexacolpate and the colpi = 29.75 ±1.08 x 3.71 ±0.33 µm. The exine is 1.28 ±0.31 µm thick and the intine is 0.62 ±0.06 µm. Its ornamentation is bireticulate.

*Fl. 5-9. Scrub, woodland, meadows, fallow fields, roadsides etc., s.l.-2300 m.*

Described from cultivated material; no type indicated. **Throughout most of Turkey, Islands.** A1 Kırklareli: Saray to Vize, A. Baytop! A1 Keşan to Enez 30km to Enez, 40 40 571 N 26 20 785 E, 132 m, 03 vi 2008, SBagherpour 457! A1 Kocaeli: Karamürsel to Yalova, 50 m, Hub.-Mor. 17197! A1 Çanakkale: Kazdağı to Çanakkale inside the old city of Troy 39 57 401 N 26 14 468 E, 26 m. SBagherpour 456.! A2 Istanbul: Kilyos, Demiriz 260! A2 Istanbul: Kayışdag, W. slopes, Demiriz 3849! A3

Bilecik: 2 km S.W. of Aktaş, on road to Kayabeli, 480 m, Buttler & Erben 17991! A4 Kastamonu: Daday to Eflani, 1100 m, Coode & Yalt! A5 Sinop: Sinop, 5 m, Tobey 1033! A6 Tokat: Tokat to Artova, 750 m, Hub-Mor. 13045! A7 Sivas: Suşehri to Zara, 1400 m, D. 32699. A8 Coruh: above Arrvin, 900 m, D. 29748. A9 Kars: Benliah-met to Kağızman, Kotek, 1500 m, D. 46668. B1 Izmir: Izmir to Manisa, N. of Bornova, 70 m, Hub.-Mor. 2506! B2 Kütahya: plain of Simav, 750 m, E. Anglia Exped. C2! B3 Eskişehir: 30 km from Eskişehir to Bursa, 860 m, Simon 69-184. B3 Ankara: From Nallıhan 47km to Beypazarı, 40 08 677 N 31 28 713 E, 652 m, 31 v 2006, SBagherpour 239! B4 Ankara Hills above Kalecik 4km to Gülkoy, 40 05 067 N 33 22 060 E, 1500 m, 18 vii 2008, SBagherpour 507! B5 Kırşehir: Kırşehir 40 km to Kayseri, 38 53 558 N 35 06 893 E, 1150 m. SBagherpour 467! B5 Kayseri: Kayseri Ali dağı, 38 40 437 N 35 33 451 E, 1600 m. SBagherpour 472! B5 Yozgat: 5km past Şarkışla toward Akçakışla, 39 24 588 N 36 23 970 E, 1588 m. SBagherpour 486! B6 Sivas to Ulaş roadside, 39 27 489 N 37 01 047 E, 1373 m, 20 vii 2008, SBagherpour 520! B6 Maraş: Elbistun to Gürün, 1200 m, Stn. & Mend. 5663! B7 Gümüşane; Erzincan to Kelkit, 2100 m, D. 31904. B8 Mus,: Mus, to Bingöl, 20 km W. of Muş, 1420 m, Hub.-Mor. 10760! B9 Bitlis: Corgih to Bitlis, 2280 m. Tong 312! C1 Aydın: 7 V m N. of Kuşadası, 27 v 1935, Reese! C2 Antalya: Elmali to Avlan G., Khan et al. 166! C3 Konya: Konya to Bayşehir just pass the dam roadside, 37 53 221 N 32 15 267 E, 1350 m. SBagherpour 210.! C3 Isparta: Barla, Khan et al. 349! C5 Adana: Kozan to Feke, 300 m, Hiib.-Mor. 15318! C6 Hatay: Antakya to Cebeli Kasir, 12 km E. of Antakya, 350 m, Hub.-Mor. 11872! C9 Hakkari: Zap gorge, 3 km below Hakkari, 1400 m, D. 45469.

Is: Lesvos, Sign, Edmondson & McClintock 2643! Khios, Kampochora, Platt 361; Kos, nr Asphendia, Gathorne-Hardy 409b! Rodhos, mt. Smith, Senni. Crimea, Cyprus(?), Balkans, Italy, Caucasia, N. Iraq, Iran, Afghanistan, C. Asia.

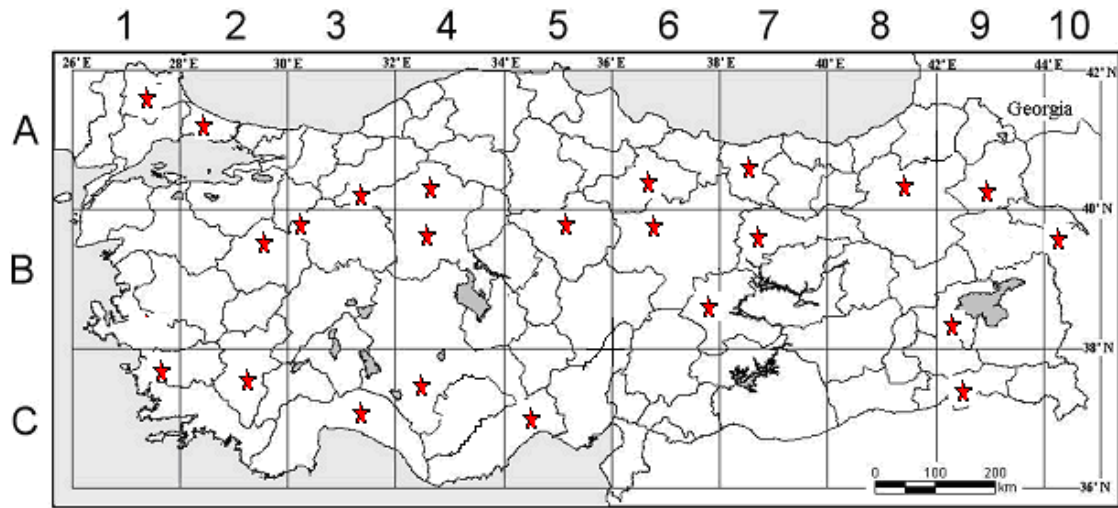
Variable, particularly with regard to degree of branching, leaf shape and margin, and type and density of overall indumentum. Although no definite examples of hybrids with the related *S. nemorosa* and *S. dichroantha* have been recorded, it would be surprising if they do not exist in Turkey.



**Ir.-Tur. element**, penetrating into Medit. territories. Treat category **LC**



**Figure 4.40.** General appearance of *S. virgata* Jacq.



**Map 4.378.** *S. virgata* distribution map.

**38.** *S. halophila* Hedge in Notes R.B.G. Edinb. 23:58, t. 4 (1959).

Perennial herb with erect **stems** c. 50 cm, branched above, ± densely eglandular or glandular-pilose below, glandular-pilose above. **Leaves** simple, ovate-oblong, 3.5-14 x 1.5-6.0 cm, somewhat thick-textured, softly pilose above and below, cordate-truncate, crenulate to subentire; **petiole** 1.5-7 cm. **Verticillasters** 4-6-flowered, distant. Bracts ovate-acuminate, 4-10 x 3-6 mm. Pedicels 1-3 mm. **Calyx** ovoid-infundibular, 6-8 mm, glandular-pilose; upper lip tridentate, shortly mucronate, recurved in fruit. **Corolla** pale lilac with white lip, 10-17 mm; tube 10 mm, not annulate, gradually widening above, pilose-fasciculate; upper lip falcate. **Stamens** B. Nutlets ovate-trigonus, c. 1.5 x 1 mm. Chromosome count:  $2n = 18$ .

The **pollen** of *S. halophila* is isopolar and oblate with  $P = 35.09 \pm 3.04 \mu\text{m}$  and  $E = 40.44 \pm 2.05 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $29.68 \pm 1.98 \times 3.68 \pm 0.38 \mu\text{m}$ . The exine is  $1.11 \pm 0.20 \mu\text{m}$  thick and the intine is  $0.69 \pm 0.09 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 7-10. Salt steppe, 950-1000 m.



Type: [Turkey B4] Nigde: 2 km E. of Sultanhani, between Aksaray and Konya, south of the Tuz Golil, 950 m, salt marsh (now dry), 31 viii 1957, Davis & Hedge, D. 32815 (hdlo. E! - 2n = 18;iso. BM! K!).

**C. Anatolia.** B4 Konya: Cihanbeyli:Gölyazı Kuşabaşı, 38 32 244 N 33 23 323 E, 910 m, 23 vii 2005, SBagherpour 203! B4 Konya: Sultani-Ani 35 km to Aksaray, 38 15 197 N 33 34 712 E, 915 m, SBagherpour 204.! B4 Konya: Sultanhani to Aksaray,44km to Aksaray, 6 km to new salt factory "Balküpü tuz factory", 38 15 197 N 33 34 712 E, 1000 m, 23 vii 2008, SBagherpour 534! B4 Konya: Ciharibeyli, 1000 m, Khan et al. 441! Nigde: S.W. of Tuz G., Wagenitz &Beug 316! C4 Konya: Konya to Kadinhan, D. 14771.

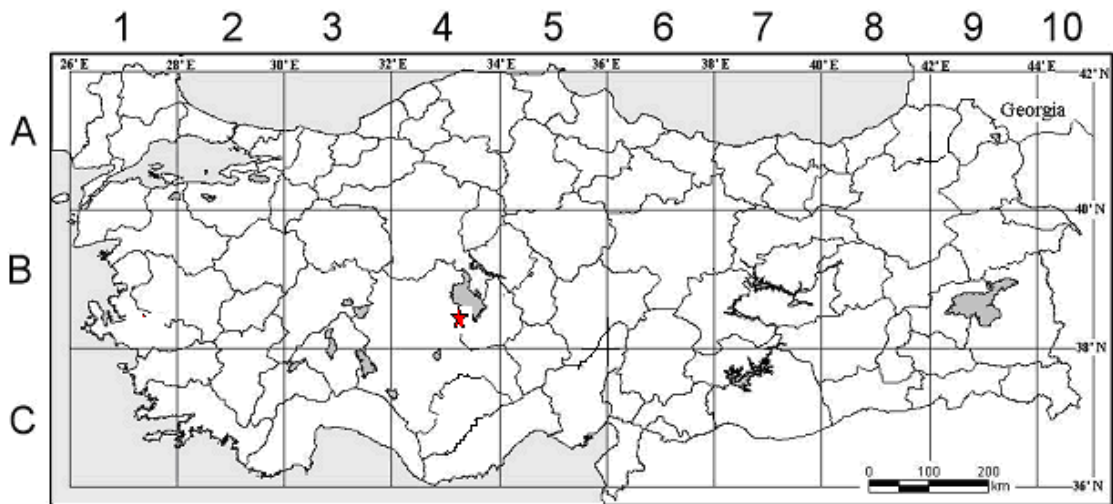
Endemic. Ir.-Tur. element. Related to *S. virgata* but lower growing, with ± thick leaves with subentire margins and later flowering; the chromosome number is also different.

**Endemic. Ir.-Tur. element.** Treat category **EN**



**Figure 4.401.** General appearance of *S. halophila* Hedge.





**Map 44.389.** *S. halophila* distribution map.

**39.** *S. nemorosa* L., Sp. Pl. ed. 2, 35 (1762). Syn: *S. sylvestris* sensu Boiss., Fl. Or. 4:628 (1879) p.p. non L. (1753); *S. tesquicola* Klokov & Pobed. in Fl. URSS 21:662 (1954) or at least sensu Grossh., Fl. Kavk. ed. 2, 7:394 (1967). Ic: Bot. Mag. 153: t. 9169 (1929), as *S. x superba* Stapf; Fl. RPR 8: t. 44 f. 2 (1961).

Perennial herb. **Stems** 30-60 (-100) cm, many, erect, branched above, eglandular-pilose to pubescent with short hairs, occasionally retrorse, or longer spreading hairs. **Leaves** simple, oblong-lanceolate, cordate, 3.5-10 x 1.2-4 cm, pubescent with few to many sessile glands, serrulate to crenate. **Petiole** 1-3.5 (-4.5) cm. **Inflorescence** paniculate. **Verticillasters** many, c. 6-flowered, approximating, showy. **Bracts** ovate, acuminate, 5-10 x 3-6 mm, purplish or violet. **Pedicels** 2-3 mm. **Calyx** tubular-campanulate, c. 6 mm, to 8 mm in fruit, pilose to villous with sessile glands; upper lip strongly recurved in fruit. **Corolla** purple to violet-blue, 10-12 mm; tube ventricose, not squamulate; upper lip slightly falcate. **Stamens** B. **Nutlets** rounded trigonous, ± ovoid, c. 2 x 1.5 mm. Chromosome count:  $2n=12$ .

The **pollen** of *S. nemorosa* is isopolar and oblate with  $P = 35.44 \pm 2.93 \mu\text{m}$  and  $E = 40.95 \pm 3.62 \mu\text{m}$ . The aperture is often hexacolpate (rarely octacolpate) and the colpi =  $29.34 \pm 2.94 \times 4.81 \pm 0.75 \mu\text{m}$ . The exine is  $1.37 \pm 0.14 \mu\text{m}$  thick and the intine is  $0.79 \pm 0.15 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl:* (5) 6-9, rocky slopes in steppe, fallow fields, sloping meadows, waste ground and marshy clay, 1000-2830 m.

**Type Specimen:** ‘Tartaria’ (Tartary), Gerber (?) (Hb. Linn. 42/14). For a note on nomenclature see Notes R.B.G. Edinb. 23:563-566 (1961).

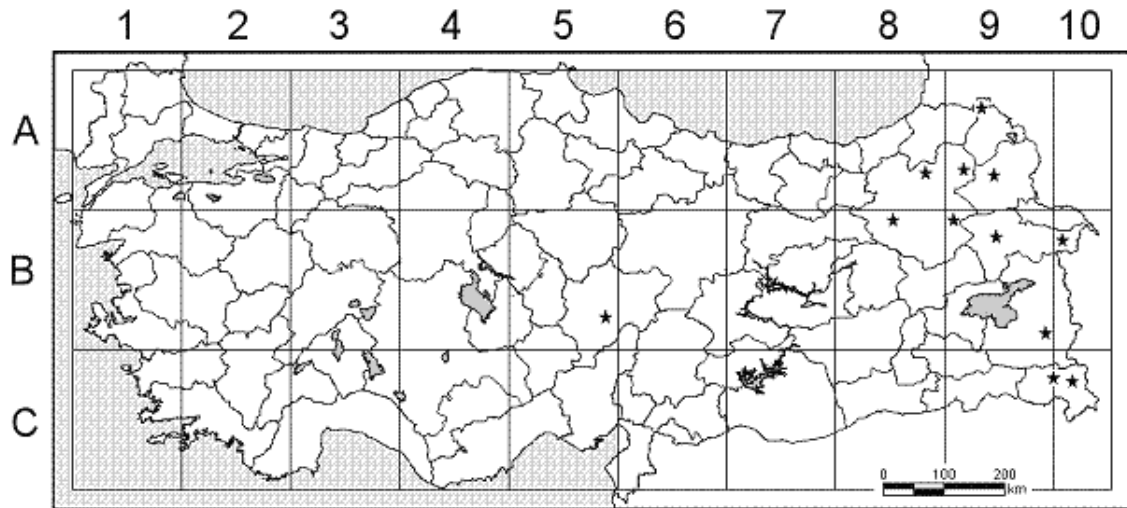
**Mainly E. Anatolia. A7 Gümüşhane:** nr Bayburt, Bourgeau 215. A8 Erzurum: between Balıklı and Öğüt villages, near Huşut, 40 37 53 N 41 36 29 E, 1520 m, 11 vii 2006, AKahraman 1300! Çoruh: S.E. of Hopa (Grossheim 7: map 444). A9 Kars: near Selim, 40 17 40 N 42 39 21 E, 2012 m, 12 vii 2006, AKahraman 1308! Ardahan: Posof, Türkgözü village, 28 vii 2008, AKahraman 1603! Erzurum: Şenkaya, Allahuekber Mountain, 40 33 212 N 42 22 188 E, 2025 m, 27 vii 2008, AKahraman 1600! B3 Ankara: Polatlı 23km to Sivrihisar, 39 32 576 N 31 42 501 E, 816 m, SBagherpour 451! B5 Kayseri: Kayseri to Tomarza, 1 km to Tomarza, 38 28 540 N 35 48 496 E, 1407 m, 10 vi 2008, SBagherpour 473! B8 Erzurum: 8 km from Aşkale to Ilıca, 39 56 12 N 40 47 09 E, 1700 m, 10 vii 2006, AKahraman 1290A! B9 Van: near Güzelsu (Hoşap), 2830 m, AKahraman 1335! Ağrı: between Tutak and Hamur, 2 km to Hamur, 39 36 392 N 42 57 767 E, 1610 m, 12 vii 2007, AKahraman 1456! Erzurum: Horasan-Ağrı road, 17. km, near Delibaba, 1750 m, 27 vii 1989, K. Alpınar 60794 (ISTE!), Bitlis: Kotum to Reşadiye, D. 22384. Van: 5 km N. of Çatak, 1800 m, D. 23245. B10 Ağrı: near Doğubayazıt, 39 30 N 44 00 E, 14 vii 2006, AKahraman 1319A! C9/10 Hakkari: Hakkari to Van, 37 41 990 N 44 05 292 E, 1767 m, 7 vi 2008, AKahraman 1568! C10 Hakkari: Yüksekova, 1950 m, 7 ix 1967, Duncan & Tait (E!).

An overall review of this widespread species together with the narrow splits off it (such as *S. tesquicola* Klokov & Pobed., *S. deserta* Schang and *S. pseudosylvestris* Stapf) is needed, but the characters used (mostly of indumentum) to recognise these segregate species scarcely justify specific separation. Not very common in Central Anatolia, mostly an Eastern Anatolia species.

**C. Europe, Balkans, S. & C. Russia, Crimea, Caucasia, Iran, Afghanistan and Persia.** Treat category LC



**Figure 4.412.** General appearance of *S. nemorosa*.



**Map 44.40.** *S. nemorosa* distribution map.

**40.** *S. verbenaca* L. Species Plantarum page 25 no. 13 (1753) Afzal-Rafii, Z. in Bull. Soc. Bot. Fr. 126, Lettres Bot. 1979, 1: 79-86 (1979). = *S. clandestina* L., Sp. Pl. ed. 2: 36 (1762) = *S. verbenaca* L. vars. *serotina* Boiss. & *vernalis* Boiss., Voy. Bot. Midi Espagne 2:484 (1841). Ic: Sibth. & Sm., Fl. Graeca 1:17, t. 23 (1806) = *S. multifida*; Polunin & Huxley, Fls. Medit. t. 156 (1965).

Perennial herb with a woody rootstock; **stems** erect, 10-80 cm, often branched above, eglandular-pilose below, usually thickly glandular-pilose above. **Leaves** mostly basal, variable, entire to pinnatifid with wide lobes, narrow oblong to ovate, 4-10 x 1.5-7 cm, eglandular-pubescent with sessile glands, crenate to erose; petiole 1.2-8 cm. **Verticillasters** 4-10-flowered, inflorescence distant or condensed above. **Bracts** ovate-acuminate, shorter than the calyx 3-6 x 4-7 mm; bracteoles present. **Pedice**l 2-3 mm. **Flowers** hermaphrodite or female, sometimes cleistogamous. **Calyx** ± campanulate, 5-8 mm, to 8-10 mm in fruit, and broadening, with villous glandular and eglandular hairs; upper lip shortly tridentate, broadly bisulcate. **Corolla** blue, lilac or purple, 6-16 mm; tube ventricose, not squamulate, 6-7 mm; upper lip ± straight to subfalcate. **Stamens** B.

**Nutlets** rounded trigonous, oblong, c. 2 x 1.5 mm. Chromosome count: 42, 46,48,59, 60 and 64.

The **pollen** of *S. verbenaca* is isopolar and prolate with  $P = 53,17 \pm 4,7 \mu\text{m}$  and  $E = 49,94 \pm 3,45 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $46,9 \pm 5,51 \times 4,7 \pm 0,41 \mu\text{m}$ . The exine is  $0,81 \pm 0,15 \mu\text{m}$  thick and the intine is  $0,76 \pm 0,08 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl: 3-11*, Banks, in *Quercus macchie, deciduous woodland, road- and fieldsides, s.l., -900 m.*

**Type:** Described from Europe, cultivated plant form Uppsala (Hb. Linn. 42/20 photo!)

**Mainly Outer Anatolia (E. to 37° E.), Islands. A1(E) Kırklareli:** 3 km S.S.W. of İğneada, Bauer & Spitz. 471 Çanakkale: Eceabat, Gelibolu peninsula, near Behramlı village, Şarlayandere, roadside, bushy, 63 m, 21 v 2006, E.Karabacak 4468! A1 Çanakkale: Renkoei (Erenköy), Sintenis 1883:289 A2 İstanbul: Terkos G., Karaburun, 50 m, Dudley (P.H.Davis 34540) İstanbul: Halkalı, E slopes of Halkalı Train Station, dry pastures, stony slopes, 21 m, 30 v 2006, E.Karabacak 4528! İstanbul: Mecidiyeköy, 4 ix 1939, B.Kasaplıgil! A2 İstanbul: Üsküdar, Ümraniye, 150 m, H.Demiriz 875! Bursa: between Bursa and Mudanya, 19 v 1961, R.Çetik 1018! A3/4 Zonguldak: sine loc., v 1947, Dijkstra. A4 Ankara: Çamlıdere to peçenek roadside, 40 26 627 N 32 24 990 E, 1124 m, 07 vii 2005, S.Bagherpour 155! A5 Samsun: Kızılırmak, after Asar, 350m, Tobey 1781 A6 Samsun: N. of Kızılay Kampı, 3 m, Tobey 38 A8 Rize: Fındıklı environs, 5 m, 5 v 1982, A.Güner 4359! Rize: Gündoğdu, tea grove gardens, moisture roadside, 0-40 m, 4 vii 1979, A.Güner! B1 Çanakkale: Troia ruins, 50 m, 26 vi 1984, Ö.Seçmen 6, Y.Gemici & H.Tabata-Yasuda 17891! Çanakkale: Çan, Etili village, Akyarlar hill, oakland and roadside, 130 m, 24 iv 2000, E.Karabacak 195! İzmir: Çeşme to Şifne, 30 m, P.H.Davis 41799 İzmir: Buca, 15 v 1988, M.Nakipoğlu 31947! İzmir: Urla, Nohutalan village, 25 m, 8 iv 1971, M.Aydar (EGE 6830!) İzmir: Bornova, Ege University houses, 16 v 1967, N.Zeybek 6607! C1 Muğla: Bodrum, Konacık environs, macchie, calcareous areas, 100-150 m, 8 iv 1981, A.Güner 3281 & B.Yıldız! C2 Denizli: Honaz Da., nr Çukurköy, 750 m, E.Tuzlacı (ISTE 24154!) C4



Konya: Ermenek, Kazancı environs, 800-900 m, 12 iv 1984, H.Sümbül 2888! C5 Mersin: Namrun to Tarsus, Çukurova, Deaver T89 Mersin: Tarsus, Yakaköy, 19 xi 1970, Ö.Seçmen 514 & M.Öztürk ! C6 Hatay: below Belen pass, 700 m, Watson et al. 626 IS Çanakkale: Gökçeada, Kuzulimanı port, 10 m, 10 iv 1976, Ö.Seçmen 1301 & E.Leblebici! Çanakkale: Gökçeada, Kaleköy, above Marine Research Station, 30 m, 14 iv 1975, Ö.Seçmen 29 & E.Leblebici! Çanakkale: Bozcaada, pastures, 60 m, 4 v 1975, Ö.Seçmen 326 & E.Leblebici! Hacıhasan hill, 40 m, 14 iv 1976, Ö.Seçmen 1514 & E.Leblebici! Çanakkale: Bozcaada, Ayazma Mvk, sands, 5 m, 19 xii 2006, E.Karabacak 5252!

A polymorphic species with numerous variants. Very variable in indumentum, leaf shape and degree of lobing. Gynodioecism is frequent.

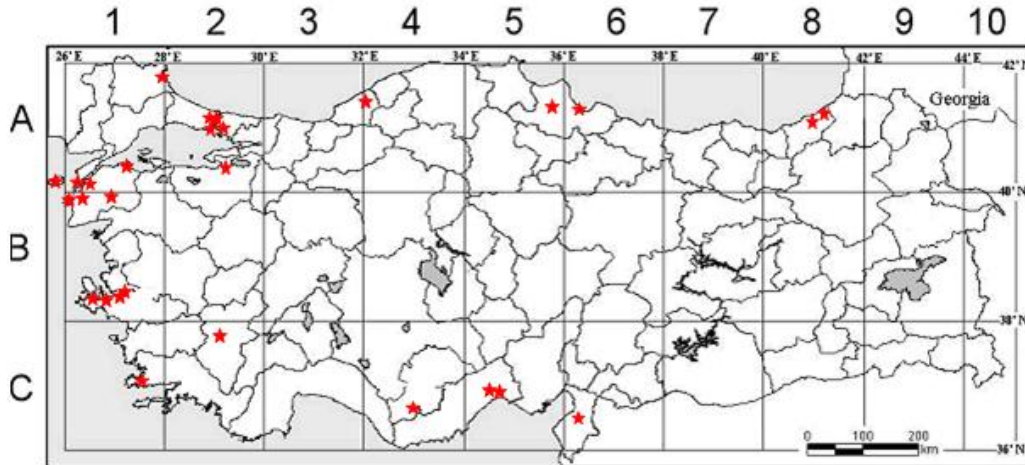
S. & W. Europe, N.W. & N. Africa, Crimea, Cyprus, Palestine, Azerbaijan, Caucasus. Naturalised in other parts of the world (America, S. Africa, Australia).

**Medit. element.** Treat category **LC**





**Figure 4.423.** General appearance of *S. Verbenaca*.



**Map 44.391.** *S. verbenaca* distribution map.

#### 4.2.5 Section *Hemisphace* Benth.:

Perennial herbs. Calyx tubular or campanulate, deflexed in fruit. Upper lip of corolla more or less straight; tube hairy ringed. Connective longer than filament and not articulated with it; arms unequal, the sterile arm shorter, subulate.

Species for sect. *Hemisphace*:

**41. *S. verticillata*** L. Species Plantarum page 26 no. 18. (1753) Rech. fil. in Bot. Jahrb. 71.539-544 (iy41) Péntzes in Borbasia 5-6 (1-3): 1-31 (1944).

Perennial herb; **stems** erect or ascending, 15-80 cm, many, branched above or not, pilose to villous below with sessile glands. **Leaves** simple, ovate to oblong, 2.5-15 x 2-9 cm, or lyrat with one or two pairs of unequal basal lobes, pilose to villous with many sessile glands, subentire to serrate, ovate-triangular, cordate to truncate or rounded at base, acute, petiole 1.5-10 cm. **Verticillasters** (8-)15-40-flowered, clearly distant. **Bracts** ovate-acuminate, c. 6 x 3 mm, deciduous. **Pedicels** 2-7 mm, some ± deflexed. **Calyx** tubular, 5-6 mm to c. 7 mm in fruit with a bisulcate upper lip, violet-blue, pilose to villous or scabridulous with sessile glands, teeth mucronate. **Corolla** violet-blue, lilac, rarely white; c. 12 mm; tube straight, c. 8 mm with a V-shaped annulus; upper lip straight, narrowed at base. **Stamens** C. **Nutlets** c. 2.2 x 1.3 mm. Chromosome count: 16.

1. Leaves broadly ovate, clearly cordate; stem, leaf and calyx indumentum of villous soft hairs; plant to c. 70 cm, much branched subsp. *verticillata*

2. Leaves oblong, elliptic, or oblong-ovate, rounded or subcordate; indumentum of short ± scabridulous hairs; plant 15-50 cm, little branched subsp. *amasiaca*

The **pollen** of *S. verticillata* subsp. *amasiaca* is isopolar and prolate with  $P = 32.13 \pm 0.98 \mu\text{m}$  and  $E = 33.28 \pm 1.60 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $26.32 \pm 1.46 \times 6.48 \pm 1.06 \mu\text{m}$ . The exine is  $1.22 \pm 0.24 \mu\text{m}$  thick and the intine is  $0.55 \pm 0.16 \mu\text{m}$ . Its ornamentation is bireticulate.

subsp. *amasiaca* (Freyne & Bornm.) Bornm. Bull. Herb. Boiss. ser. 2, 8:110 (1908). = *S. amasiaca* Freyne & Bomm. in Ost. Bot. Zeitschr. 41:58 (1891) = *S. paalii* Pénzes in Borbasia 5-6 (1-3): 14 (1946) Ic: Fl. URSS 21: t. 17 f. 1 (.1954).

**Type:** [Turkey A5 Amasya] Amasia: in rupestribus ad 4-600 m, 11 vi 1899, Bornmuller 611.

*Fl:* 5-9, In a wide variety of habitats: rocky slopes, Stipa steppe, sandy banks, meadows, Quercus and Pinus woods, fields and roadsides, 20-2300 m.

**Widespread throughout Anatolia.** A1(E) Kırklareli: nr Vize, A. Baytop (ISTE 13216) A2 İstanbul: Therapia (Tarabya), Aznavour 1736 A2(A) Bursa: Ulu Da., Kirazlı Y., 1160 m, H. Demiriz 756 A3 Bolu: Nallıhan to Mudurnu, 1200 m, P.H. Davis 37064 Bolu: Abant, Abies forest, 850 m, 7 vii 1978, E. Yurdakulol, M. Kılınç & M. Aydoğdu! Bolu: Kıbrısçık, Cuma stream, 1000-1200 m, 15 vii 1980, Coşkun 507 Bolu: Göynük, Taraklı-Göynük road, 5 km from Yeni Mahalle village, serpentine slopes, 585 m, 09 vii 2006, E. Karabacak 4804! Bolu: Göynük, Göynük-Mudanya road, 5 km from Hacıyan pass, slopes, 913 m, 09 vii 2006, E. Karabacak 4809! Ankara: Beypazarı, above Karaşar, moisture pastures, 1550 m, 1 vii 1972, Y. Akman 8787! A4 Zonguldak: Karabük to Eğriova, Keltepe Bölge. Bozakman & Fitz 732 Çankırı: Çerkeş, Gere-de-Çerkeş road, 5 km before Çerkeş, roadside slopes, 1120 m, 09 vii 2006, E. Karabacak 4821! Kastamonu: Azdavay, 600 m, 20 vi 1978, O. Ketenöglü 646 ! Kastamonu: İhsangazi, İsalır quarter, tomb environs, steppe, 870 m, 9 ix 1990, Z. Aytaç

3463! Kastamonu: 15 km form Tosya to Kastamonu, Ilgaz munt, scree, rocky slopes, 1323 m, 10 vii 2006, E.Karabacak 4841! Ankara: Çubuk dam, 10 vi 1932, W.Kotte 470! Ankara: Kızılcahamam, Işık mount, foothils, 1700 m, 17 viii 1960, Khan, Prance & Rateliffe! Ankara: Kızılcahamam, Kargasekmez, Quercus pubescens association, 1000 m, 3 vii 1974, O.Ketenoglu 135! Ankara: Çubuk, Karagöl, 1620 m, 30 vii 1986, Ö.Seçmen 4011! Ankara: Kızılcahamam, Hodulca mount, banks, moisture places, 1550 m, 1 viii 1981, M.Vural 5906! A5 Sinop: Boyabat, Ilıca village, Killik stream, argillaceous slopes, 350 m, 3 vi 1980, M.Koyuncu 9846 Kastamonu: İnebolu, Abana, macchie, 20 m, 12 vi 1990, E.Yurdakulol 3116! Kastamonu: Tosya, Gavur mount, summit area, subalpine meadows, 1944 m, 10 vii 2006, E.Karabacak 4862! Kastamonu: Tosya, Gavur mount, summit road, serpantine slopes, 1481 m, 10 vii 2006, E.Karabacak 4873! Amasya: Galatia, Manissadjian 1011 (ANK!) Çorum: Alacahöyük ruins, 1150 m, 9 viii 1984, Ö.Seçmen 38, Y.Gemici & H.Tabata-Yasuda (EGE 17893!) A6 Tokat: Çamlıbel mount, slopes, steppe, 1650-1750 m, 5 vii 1980, Coşkun (AEF) Tokat: Tokat-Sivas road, Kızılınış pass, slopes and scrubs, 1200 m, 10 vii 2006, E.Karabacak 4899! Sivas: Sivas to Suşehri, 1810 m, Buttler 20340 Sivas: Suşehri, Aksu village environs, edge of field, 1700 m, 26 vi 1985, B.Yıldız 5628! A7 Giresun: between Şebinkarahisar and Kelkit, 5-6 km from Karaçayır village, soil slopes, 1335 m, 11 vii 2006, E.Karabacak 4954! Giresun: Şebinkarahisar to Kelkit, 3 km before Konaklı village, soil slopes, 1536 m, 11 vii 2006, E.Karabacak 4958! Gümüşane: Erzincan to Kelkit, fallow fields, 2100 m, 1 viii 1957, P.H.Davis 31905 & I.C.Hedge (ANK!) A8 Gümüşane: 55 km from Bayburt to Gümüşane, rocky area, 1640 m, 27 vii 1956, K.Karamaoğlu 619 (ANK!) Bayburt: Bayburt, Bourgeau 1862:216 Bayburt: between Bayburt and Aşkale, Kop pass, 2350 m, 16 viii 1984, Ö.Seçmen 57, Y.Gemici & H.Tabata-Yasuda (EGE 28315!) Bayburt: Gümüşane to Bayburt, Nişantaşı village, Osluk (Korgan) bridge environs, stepe and stony slopes, 1616 m, 11 vii 2006, E.Karabacak 4964! A9 Erzurum: Oltu, Dutlu mount, Eskidutlu Mvk., 1950-2200 m, 19 vii 1982, N.Demirkuş 1353! Kars: 7 km from Akçay to Cumaçay, 1600 m, P.H.Davis 46830 B2 Kütahya: Domaniç, 900 m, P.H.Davis 36429b Kütahya: N above Şaphane, S foot of Şaphane mount, 1050-1150 m, stony slopes, H.Demiriz 2110! B3 Kütahya: 1 km S of Bayat road, 1100 m, 18 vi 1980, Ö.Seçmen 2226 et al.!

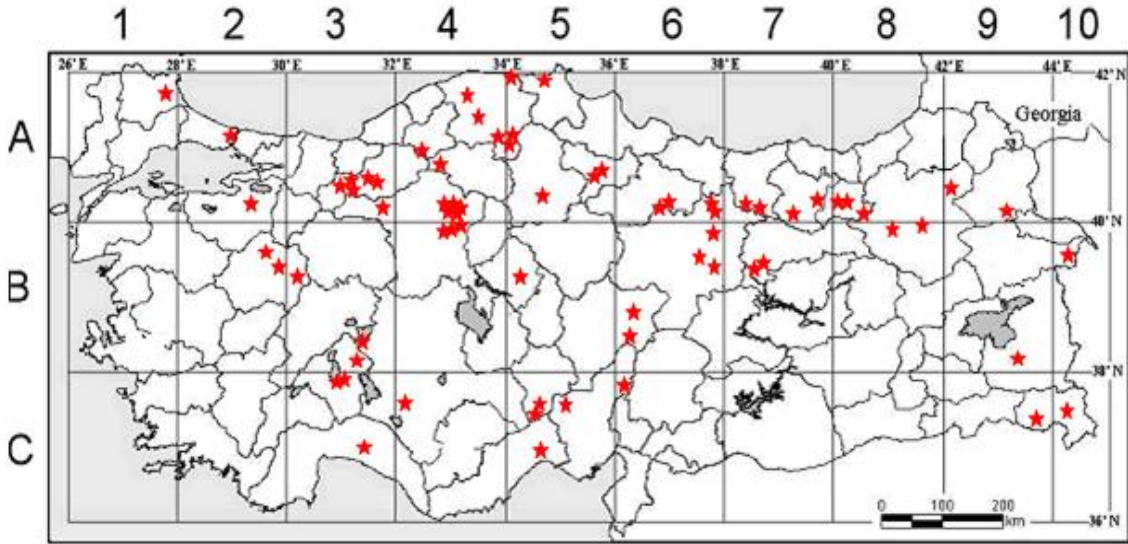
Isparta: Şarkıkaraağaç, Sazlıpınar to Kolonkaya, 1150-1250 m, 24 vi 1994, B.Mutlu 708! Konya: Sultandağ, F.Sorger 68-46-37 B4 Ankara:Polatlı 23km to Sivrihisar, 39 32 576 N 31 42 501 E, 816 m, 30 v 2008, S.Bagherpour 450! Ankara: Dikmen De., 1400 m, 20 vi 1942, Romieux Ankara: Dikmen tepe, 31 v 1935, Gassner 19! Ankara: Lalahan Samsun road, 26 vi 1987, S.Erik! B5 Nevşehir: Göreme, 800 m, 24 vii 1971, Shmida & Lev-Ari B6 Sivas: 28 km N.W. of Divriği, 1500 m, F.Sorger 69-42-88 Sivas: Ulaş, Tecer mount, Beşgözler Mvk., 1600-1800 m, 10 vii 1984, B.Yıldız 4152! Sivas: Zara to Şerefiye, near Arapça, shrubby slopes, 1534 m, 11 vii 2006, E.Karabacak 4920! Kayseri: Pınarbaşı, Kaynar, above Yassıpınar, Hınzır mount, 1900 m, N.Çelik 1981! Kayseri: Sultansazlığı, Yahyalı to Develi, Sarıca village, water side, 1071 m, 17 ix 1984, M.Öztekin 1945! B7 Erzincan: d. Kemaliye, Salihli, 1400 m, A.Huber-Morath 5983 Erzincan: Yaylabaşı village environs, 1300 m, 7 viii 1980, Ş.Yıldırım 3986! Tunceli: Ovacık, 1200 m, 25 vi 1979, S.Yıldırım 2092! B8 Erzurum: Erzurum to Aşkale, 1700 m, Lamond 2594 Erzurum: Tortum, 7 km from Tortum to Oltu, 1500-1700 m, 17 vii 1990, T.Ekim, H.Duman & Z.Aytaç 3130! B9 Van: 5 km N. of Çatak, P.H.Davis 232531 B10 Ağrı: Doğubayazıt to Taşlıçay, 2000 m, H.Demiriz 3429 C3 Isparta: Eğridir, 29 vi 1955, A.Baytop & T.Baytop! Isparta: Eğridir, Yaka village, above Çamova Mvk., calcareous rocky valley, 1600-1480 m, 2 vii 1974, H.Peşmen & A.Güner 1572! Antalya: Manavgat to Beyşehir, 1370 m, Buttler & Erben 17615 C4 Konya: Konya to Beyşehir, 1510 m, Buttler 13646 C5 Niğde: by NW foot of Aladağ, near Demirkazık village, roadside and grazed flat, 1500 m, 25 vii 1984, G.Görk, P.Hartvig & A.Strid 23968! Niğde: Ulukışla, Çiftehan, Horozköy, gardens, 1200-1350 m, 30 vii 1984, Ş.Yıldırım 7166! Mersin: Tarsus, Namrun road, Sarıkavak village environs, 900 m, 6 vi 1981, M.Koyuncu & E.Sezik Adana: Göksu gorge below Himmetli, 750m, P.H.Davis 19840 C6 Adana: 25 km N.E. of Feke, 1200 m, F.Sorger 77-26-26 C9 Hakkari: Cilo Da., 2280 m, P.H.Davis 23946 C10 Hakkari: Bacırge, 1750 m, P.H.Davis 45256.

Bulgaria, Caucasia, Iran, N. Iraq. **Irano-Turanian element**. By far the commoner subspecies in Anatolia. Treat category **LC**





Figure 4.434. General appearance of *S. verticillata* subsp. *amasiaca*.



Map 44.402. *S. verticillata* subsp. *amasiaca* distribution map.



**42. *S. russellii*** Benth. In DC., Prodr. 12:357 (1848)

Perennial herb. **Stems** 20-60 cm, erect, usually simple, many, arising from a woody rootstock, eglandular-pubescent. **Leaves** simple, linear-oblong, sometimes sublyrate or deeply lobed at base, 5-8 x c. 1 cm, rugulose, cuneate, eglandular-pilose especially on veins and with numerous sessile glands; petiole 2-8(-10) cm. **Verticillasters** 20-30-flowered, clearly distant. **Bracts** c. 6 x 2 mm, ovate-acuminate. **Pedicels** 2-6 mm, erectopatent. **Calyx** tubular, c. 6 mm, purplish-blue, eglandular spreading pilose and with sessile glands, ovate in fruit with a concave-bisulcate upper lip, teeth not mucronate. **Corolla** violet-blue, c. 10 mm, tube straight with an inverted V-shaped annulus; upper lip straight, compressed, narrowed at base. **Stamens** C. **Nutlets** ovate, 2.5 x 1.5 mm. Chromosome count: Unknown.

The **pollen** of *S. russellii* is isopolar and prolate with  $P = 28.42 \pm 0.87 \mu\text{m}$  and  $E = 30.72 \pm 1.00 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $23.95 \pm 0.99 \times 3.67 \pm 0.80 \mu\text{m}$ . The exine is  $1.03 \pm 0.11 \mu\text{m}$  thick and the intine is  $0.59 \pm 0.08 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl: 5-7, Rocky slopes, grassy meadows amongst Quercus, fallow and cultivated fields, 100-1600 m.*

**Type:** [Syria] prope Aleppo, *Russell* (holo. BM)

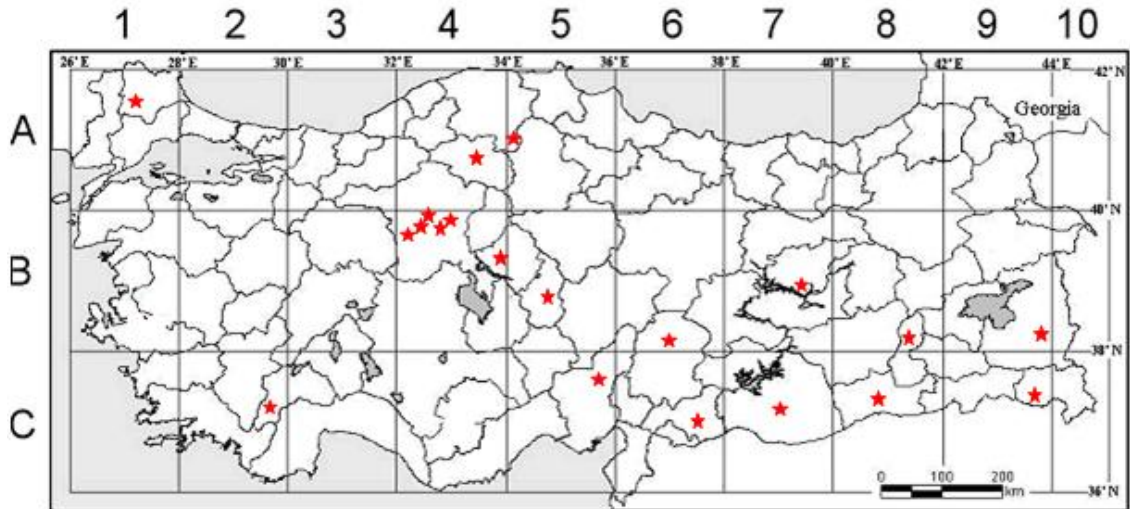
**Mainly Inner Anatolia; rare in Turkey-in-Europe.** A1 Kırklareli: 9 km E. of Babaeski, 125 m, F.Sorger 62-96-3 A4 Çankırı: Kalecik to Çankırı, P.H.Davis 21452 Çankırı: Kalecik to Çankırı, 1 km after Border of Ankara-Çankırı, edge of fields, 791 m, 13 vi 2007, E.Karabacak 5393! A5 Kastamonu: Tosya, 7.vi.1892, Sintenis 1892:4167! A4: Eldivan to Ankara 4km to Şabansi, 40 28 847 N 33 18 851 E, 1199 m, 01 vi 2006, SBagherpour 258! B4 Ankara: Ankara to Sivrihisar, 850 m, Dudley (P.H.Davis 35992) Ankara: Beypazarı, Nallıhan, 7 vi 1936, Gassner 523 (ANK!) Ankara: Solfasal hills, 850 m, 6 vii 1975, T.Ekim 60 (ANK!) Ankara: Çal mount, steppe, 1100 m, 29 vi 1985, M.Vural 3455! Ankara: ODTU campus, 907 m, grassy meadows, 12 vi 2007, E.Karabacak 5376! Kırşehir: Kaman, Hirfanlı dam, 6 vi 1973, S.Erik! B5 Nevşehir: 8 km S.E. of Ürgüp, 1200 m, F.Sorger 64-32-11 B6

Kahramanmaraş: Göksun to Elbistan, 1400 m, Stainton & Henderson 5593 B7 Tunceli: above Pertek, 1600 m, rocky igneous slopes, P.H.Davis 31054 & I.C.Hedge (ANK!) B8 Siirt: N. of Sason, Sason Da., Batman, 1000 m, Watson 5597 B9 Van: Ereğ Da., 2200 m, Nabelek 1598 C2 Burdur: Tefenni to Yeşilova, 1100 m, Dudley (P.H.Davis 35297) C5 Adana: d. Saimbeyli, Doğanbeyli to Akçal, fallow fields (steppe), 1300 m, 12 vii 1952, P.H.Davis 19893, Dodds & R.Çetik! C6 Gaziantep: Gaziantep, 850 m, Balls 1166 C7 Urfa: N. of Urfaj Hand.-Mazz. 1911. C8 Mardin: Mardin station to Kızıltepe, 600 m, P.H.Davis 28637 C9 Hakkari: Çukurca, 1200m, P.H.Davis 44820.

Syrian Desert, N. Iraq, N.W. Iran. **Ir.-Tur. element.** Treat category **LC**



**Figure 4.445.** General appearance of *S. russellii* Bentham.



Map 44.413. *S. russellii* distribution map.

#### 4.2.6 Section *Horminum* (Moench) Dumort:

Annuals. Calyx tubular, deflexed in fruit. Upper lip of corolla more or less straight; tube not hairy ringed. Connective longer than filament; arms unequal, the sterile arm shorter and more or less distally.

Species for Sect. *Horminum*:

43. *S. viridis* L. Species plantarum, page 24, no. 7 (1753).= *S. horminum* L., Species plantarum, page 24, no. 8 (1753) Ic: Sibth. & Sm., Fl. Graeca 1: t. 19 & t. 20 (1806), as *S. horminum*; Hegi, 111. Fl. Mittel-Eur. 5(4): f. 2488, 2489 (1927).

Annual herbs. **Stems** simple or branched, 7-50 cm, erect, glandular-pilose or eglandular-pilose, with or without a coma of violet, green, pink or white sterile bracts. **Leaves** simple, oblong or ovate, c. 5x2.5 cm, regularly crenate, rounded or cordate at base, obtuse, pubescent; petiole 2-5 cm. **Verticillasters** 4-8-flowered, distant or approximating. **Bracts** broadly ovate, c. 10x10 mm; bracteoles present. **Pedicels** 2-5 mm, erect, flattened. **Calyx** tubular, 7-10 mm, to c. 12 mm in fruit and strongly deflexed, eglandular-pilose or glandular; upper lip  $\pm$  truncate. **Corolla** lilac-purple to white, generally upper lip of corolla lilac-purple, lower lip of corolla white-lilac, 12-18 mm; tube straight, glabrous within; upper lip broad,  $\pm$  falcate. **Stamens** B. **Nutlets** oblong-elliptic, 3 x 1.5. mm. Chromosome count:  $2n = 16$ .

The **pollen** of *S. viridis* is isopolar and prolate-spherical with  $P = 39.34 \pm 3.00 \mu\text{m}$  and  $E = 38.34 \pm 5.73 \mu\text{m}$ . The aperture is hexacolpate and the colpi =  $33.82 \pm 2.52 \times 5.13 \pm 0.85 \mu\text{m}$ . The exine is  $1.14 \pm 0.13 \mu\text{m}$  thick and the intine is  $0.58 \pm 0.07 \mu\text{m}$ . Its ornamentation is bireticulate.

*Fl.* 3-7. *Rocky slopes, macchie with Cistus, phrygana, sand-dunes, fields and waste ground, s.l.-1300 m.*

**Turkey-in-Europe, Outer, C. & S.E. Anatolia; Islands.** A1 Tekirdağ: Tekirdağ to Silivri, c. 15 m, Dudley (P.H.Davis 34697) Tekirdağ: 15 km from Tekirdağ to Silivri, road and field side, 11 m, 28 v 2006, E.Karabacak 4489! Tekirdağ: Marmara Ereğlisi, Silivri to Tekirdağ road, German Site environs, dry meadows, 23 m, 30 v 2006, E.Karabacak 4529! Çanakkale: Eceabat, Gelibolu Peninsula, 2 km from Havuzlar to Behramlı, roadside, 6 m, 21 v 2006, E.Karabacak 4463! Çanakkale: Eceabat, Gelibolu Peninsula, near Behramlı village, Şarlayandere, roadside, scrubs, 63 m, 21 v 2006, E.Karabacak 4469! Çanakkale: Gelibolu, between Kavak and Şarköy, roadside, 15 m, 28 v 2006, E.Karabacak 4477! A1 Çanakkale: Erenköy, Sintenis 1883:73 Çanakkale: Güzelyalı, Pinus brutia forest and roadside, 50 m, 18 v 1997, T.Tütenocaklı (CBB!) Çanakkale: Çanakkale Onsekiz Mart University, Terzioğlu Campus, macchie with Cistus, 100 m, 24 iv 2002, E.Karabacak & T.Tütenocaklı (CBB!). A2 İstanbul: Halkalı station, 20 m, H.Demiriz 4776 A2 İstanbul: Caddebostanı, 15 m, H.Demiriz 380 İstanbul: Halkalı, E slopes of Halkalı Train Station, dry meadows, stony slopes, 21 m, 30 v 2006, E.Karabacak 4526! A2 İstanbul: Constantinopol, auf Anhöhen um die Stadt (on hills around the city), gemein (common), Mai (May), Dr. Noë (ANK!) A2: İstanbul: Pendik, 24.v.1931, K.Krause 3221! Bursa: Mustafa Kemalpaşa, 10.v.1945, B.Kasaplıgil (ANK!) Bursa: Orhangazi to Gemlik, 3.v.1950, A.Berk 2478! A3 Bolu: nr Seben, 600m, Kühne 2212 Bolu: Seben, Karakiriş mount, Çeltik stream, rocks, stony places, 735 m, 29 vi 1999, N.AKSOY 1665 ! A4 Zonguldak: Karabük to Safranbolu, 450 m, P.H.Davis 37949 Karabük: Cumayanı Industrial Area, steppe, 700 m, 21 vi 1985, M.Demirörs 1549! Kastamonu: Karaçomak dam, S of Yüklük hill, 920 m, 7 vii 1982, H.Sakallıoğlu 536! Kastamonu: Daday environs, 700 m, 1 vi 1978, O.Ketenoğlu 1203! Kastamonu: Ilgaz to Tosya road, 4 km before Tosya, near Akçakavak village, roadside, stepe with Artemisia, 800 m, 10 vii 2006, E.Karabacak 4831! Ankara: Ayaş, road and field sides,

100 m, 4 v 1986, M.Vural 4089! Ankara: Beypazarı, Kumkaya, 28.iv.1986, N.Aksoy 1002! Ankara: Çubuk dam, 10 vi 1932, W.Kotte 471 ! Ankara: Çubuk gorge, 2 vi 1982, N.Tanker (AEF) Ankara: Çubukdere, 29 iv 1936, G.Gassner 262! Kırıkkale: Kırıkkale, mountain stepe, 04 vi 1961, K.Karamanoğlu! A5 Çorum: Saraycık to Osmancık, 500 m, Tobey 2570 Çorum: Osmancık, Juniperus woodland in below of Ardıç village 600-800 m, 15 vi 1975, M.Kılınç 3727 ! Amasya: Yukarı Baraklı village, Kurşunatacak place, under shrubs, 800 m, 15 v 1987, S.Peker 1105!, Amasya: Merzifon, Manissadjian 176! A6 Samsun: Samsun, Hand.-Mazz. 133 Samsun: Samsun, c. 50 m, 20 vi 1973, M.Ahmet (EGE!) Sivas: Suşehri, Kelkit valley, schistic land, 700-800 m, 30 iv 1985, B.Yıldız 7180 (EGE!) A7 Sivas: Suşehri, 1300 m, Stainton 8442 A8 Çoruh: nr Artvin (Grossheirn 7: map 433) Artvin: Yusufeli to Olur, Bulanık bridge environs, sEdirmentary rocks, 770 m, 13 v .2004, Z.Aytaç 8687 & H.Duman! Artvin: Yusufeli to Olur road, Taşlı quarter environs, roadside, 695 m, 17 v 2004, H.Duman 9438! Artvin: 10 km from Yusufeli to Kılıçkaya, Çoruh river side, 640 m, 11 vi 2004, Z.Aytaç 8670 & H.Duman! Artvin: Ardanuç to Arevet, calcareous rocks, 565 m, 25 vi 2008, E.Karabacak 6245! B1 İzmir: Bournabat (Bornova) nr İzmir, Bal. 1854:312 İzmir: opposite of Çiğli Airport, salty habitat, 11 iv 1979, Ö.Seçmen 1870 & L.Bekat (EGE!) İzmir: Bornova, Ege University Campus, near Herbarium, 26.iv.1969, K.Fitz & F.Spitzenberger (EGE!) İzmir: Bornova, Ege University Campus, August 1975, Ö.Seçmen 545 & M.Öztürk (EGE!) Manisa: Akhisar, Gölarmara, 29.iv.1966, H.Peşmen 720 ! B2 Kütahya: 10 km before Kütahya, old road, roadside, 1 vi 1993, G.Yıldız (AEF) Denizli: Çivril to Işıklı, between Beydilli and Homa, 900 m, 06 vi 1983, Y.Gemici 2099 (EGE!) B3 Eskişehir: next to Sarıcakaya, Ilıca village environs, 350 m, 19 v 1991, N.Tanker & M.Koyuncu 8983 (AEF) B4 Ankara: Ankara, Bornm. 1892:3092 Ankara: Beytepe, houses, rocks, 960 m, 22 v 1975, S.Erik 1138! Ankara: Beytepe, W side of Hacettepe University Campus, steppe, 1000 m, 14.vii.1980, S.Erik 1510! Ankara:Polatlı 31km to Sivrihisar, 39 33 599 N 31 47 914 E, 853 m, 10 v 2008, SBagherpour 414! Kırıkkale: Keskin, Böbrek mount, Köprüköy, cemetery, steppe, 600 m, 22 vi 1996, Ü.Güler 1829! B5 Adana: Saimbeyli, 1100 m, P.H.Davis 19883 B6 Adana: Tscham (Çam) Oluk, Maniss. 1008 B7 Erzincan: İliç station, roadside, 900 m, 26 vi 1972, T.Gözler & T.Kesercioğlu! C1 İzmir: S. of Kuşadası, 30 m, P.H.Davis 40718 Aydın: Milet ruins, 04 iv 1995, A.Erdağ, G.Görk & N.Keyikçi

98! Aydın: Bozdağ-Haydara ovası, 170 m, 11 vii 1962, K.Karamanoğlu (AEF) Aydın: 6 km from Çine to Aydın, 16 iv 1980, Ö.Seçmen 2144, E.Leblebici & L.Bekat ! Muğla: Marmaris-Datça, Hisarönü village, Gulf, 23 iv 1969, K.Fitz & F.Spitzenbeger ! Muğla: Bodrum, Konacık environs, macchie, calcareous area, 100-150 m, 8 vi 1981, A.Güner 3278 & B.Yıldız. C2 Aydın: Nazilli, between Amasya and Akyaka villages, 200m, 21 iv 1994, Ö.Seçmen 4573! Muğla: Dirmil to Fethiye, Karabell pass, coniferous forest, 1300 m, 28 vi 2004, E.Karabacak 3585! Muğla: Marmaris, 30 m, P.H.Davis 25281 Muğla: Köyceğiz, Toparlar village environs, metamorphic S slopes, 10-200 m, 18 iii 1991, A.Güner 8249 et al. ! Muğla: Köyceğiz, Çayıçi quarter, stony field, 30 m, 18 iii 1991, A.Güner 8263 et al.! Muğla: Köyceğiz, Sorgun village, roadside, 40-220 m, 22 iii 1991, A.Güner, H.Duman & H.Sağlam! Muğla: 3 km before Kekova, phrygana, 250 m, 11 iv 1995, A.Erdağ, G.Görk & N.Keyikçi 159! Muğla: Fethiye to Ölüdeniz, exit of Fethiye, Maden road, 100-200 m, rocky slopes, M.Koyuncu 5900 & S.Erik (AEF) Denizli: Dereköy (ENE of Denizli), 23 ii 1969, K.Fitz & F.Spitzenberger (EGE!) C3 Isparta: Sütçüler, 1 km before Çobanisa, calcareous rocky slopes, macchie, Juniperus excelsa forest, 1080 m, 26 v 1974, H.Peşmen 1076 & A.Güner (AEF) Burdur: Bucak, Çobanpınarı village, Kapanaltı Mvk. in dry stream, 350 m, 29 iv 1968, Meyer, H.Pesmen & S.Oflas (EGE!) Antalya: Finike, Gökliman, 24 iv 1970, Ö.Seçmen & M.Aydar (EGE!) Antalya: 6 km from Manavgat, s.l., Dudley (P.H.Davis 35726) Antalya: Kemer, W of Göynük stream, s.l.-5 m, seashore, 9 v 1978, H.Peşmen 3708! Antalya: Akseki, between Murtiçi and Çukurköy, Olcağzı place, macchie clearings, 550-650 m, 2 v 1996, A.Duran 3453! Antalya: Alanya, Kızılot village environs, s.l., coast, 2 vii 1992, A.Ö.Koçak s.n.! Antalya: Gündoğmuş, 150 m, 14 v 1971, R.Çetik 3755! C4 Karaman: Mut to Karaman, Coode & Jones 930 Mersin: Anamur, Kızıllı, 300 m, 20 xi 1970, Ö.Seçmen 535 & M.Öztürk (EGE!) Mersin: between Mut and Ermenek, Suçatı, field, 150 m, 30 iv 1980, S.Kurucu (AEF) C5 Adana: 2 km W. of Yumurtalık, nr s.l., McNeill 809 Adana: Kurttepe, 150 m, 15 iv 1969, G.Oğuz ! Mersin: Tarsus, Egemen village, 26.iv.1955, K.Karamanoğlu (AEF) C6 Osmaniye: Bahçe, Haruniye, 450 m, P.H.Davis 26924 Osmaniye: Haruniye, Kurtlar village, 450 m, 1 iv 1951, Düziçi Köy Enstitüsü ! Hatay: Antakya, Harbiye environs, 200 m, slopes, 25 vi 1978, Coşkun 324 & Şener (AEF) Kahramanmaraş: Zeytun, Armutludere place, rocks, 1600-1900 m, 6 vi



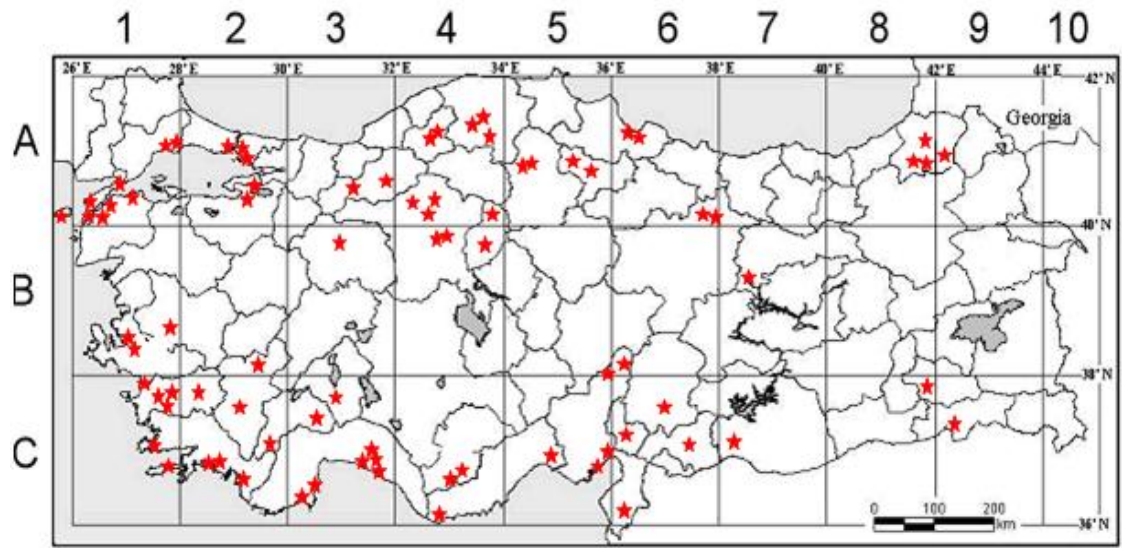
1989, Z.Aytaç 2695 (GAZI!) Gaziantep: Fevzipaşa, 600 m, 15 I .1935, Balls 2130 (ANK!) C7 Şanlıurfa: Birecik to Suruç, c. 750 m, P.H.Davis 27973 C8 Siirt: 3-5 km S. of Siirt, 700 m, P.H.Davis 43288 C9 Mardin: Kasrik gorge, 9 km from Cizre, 350 m, P.H.Davis 42662 IS Çanakkale: Gökçeada, Kömürburnu environs, 85 m, 20.v.1975, Ö.Seçmen 837a & E.Leblebici ! Çanakkale: Gökçeada, Uğurlu village port, 1-5 m, scrubs and sands, 06.v.2008, E.Karabacak 5750!

The only annual species of *Salvia* in Turkey. There are several apparently distinctive forms based on coma features. In Turkey, the most frequent is that with a prominent violet coma; less frequent are those in which the coma is absent or is white, green or pink. The violet form is often called var. *horminum* (L.) Batt. & Trab.

Most of the Mediterranean area, Crimea, Cyprus, Caucasia, Iran (except C.), N. Iraq. **Medit. element.** Treat category **LC**



**Figure 4.456.** General appearance of *S. viridis* L.



Map 44.424. *S. viridis* distribution map.

## CHAPTER 5

### CONCLUSION

In conclusion, *Salvia* taxa were exposed to extensive morphological analysis. They were studied according to their root, stem, leaves, essential characters of flowers, and reproductive organs. This information includes indumentum characteristics, inflorescence shapes, nutlet observations and measurements all of which were recorded in the infragenic description of each *Salvia*. The data deficient descriptions were completed and stem, leaf, calyx, corolla dimensions were updated.

Anatomical section preparations of distinctive parts of the plants were observed for taxonomic evaluation. For the first time, the anatomical characteristics of *S. vermifolia* endemic to Turkey were examined in detail, and identified sessile, capitate glandular and non-glandular trichomes on stems, leaves blades and petioles, as well as, size, shape, colour and sculpturing pattern of the nutlets were clarified (Bagherpour et al., 2010).

Pollen features of *Salvia* were studied. Statistical analysis were done on each set of data and the results were tabulated in tables 3.1 and 3.2. For the first time each species pollen data was provided in the description.

When the species were detected, the area of occupancy and distribution, populations and their size and the number of mature individuals were documented. Threat categories were re-evaluated using IUCN Red List Categories Version 3.1 (2001). In final assessment, of the 43 *Salvia* species in Central Anatolia only 4 are from the Mediterranean origin, 2 are multi regional or from unknown origins and the remainder

are Irano-turanian based (% 85.7). Endemic Central Anatolian taxa of *Salvia* consist of 2 CR (Critically Endangered), 7 EN (Endangered), 8 VU (Vulnerable), and 9 NT (Near Threatened).

Geographic locations of all *Salvia* species distributed in Central Anatolia were obtained, their habits were photographed and their phenological and distribution characteristics of were updated. For the first time, GPS coordinates and soil characteristics of each species were recorded. On a field trip conducted in Yenipazar, South of Yozgat, one taxon was re-discovered after 116 years (Bagherpour et al., 2009) and two new records *S. nemorosa* and *S. tobeyi* were found in Kayseri and Ankara, respectively.

We found three major areas of distributions of *Salvia* in Central Anatolia. These areas are: Ankara Beypazari, Kayseri- Pinarbashi and the greater Sivas area. Therefore, three areas were recommended for conservation.

According to the soil analysis collected from suitable habitats for taxa of *Salvia* (Table 3.4), they generally prefer clayish soil which are slightly alkali (Ave. pH 7.83) with low organic content (Ave. 1.99%). The preferred N and CaCO<sub>3</sub> content of the soil was 0.13% and 20.71% respectively. The average amounts of P and K present were 4.82 and 151.52 ppm respectively. Salt concentration in Central Anatolia varies from 0.01 to 0.07%. The higher concentration of salt around Salt Lake (Tuz Gölü) produces a habitat in which only a limited number of plants (*S. halophila*) can adapt and survive. Cluster analysis of relationship of *Salvia* species to soil type was graphed. The endemic species such as *S. cryptantha* and *S. wiedemannii* share the same soil type with *S. aethiopsis* and *S. syriaca* (none endemics); however they limit themselves to Central Anatolia borders. This fact shows the effect of climate on restrictions of endemics to Central Anatolia.

For the first time sectional delimitation was presented to place each taxon in its proper position. This included the detailed work of character analysis, measurements, data tabulation and evaluation of all species. The presented revision is based on and ordered according to the numeric analysis of the 43 species found in the Central Anatolia. The

species key specific to Central Anatolia is presented. This work would afford future taxonomist the ability to recognize species relationship with confidence. The unique inferagenic classification is also a first for Central Anatolia.

While observing the results of cluster analysis it was noticed that *S. anatolica* indeed is not related to *S. bracteata* which belongs to section *Salvia* as described by Hamzaoğlu (2005), but the numeric results placed it in section *Hymenosphace* in the same section as *S. blepharochlaena*. The habit of *S. anatolica* resembles *S. blepharochlaena* and not at all to *S. bracteata*. Therefore re-evaluation of *S. anatolica* is recommended.

Multivariate analysis has been conducted on the basis of the *S. euphratica* sensu lato (*S. cerino-pruinosa*, *S. euphratica*, *S. leiocalycina* and *S. pseudeuphratica*) and its closely related species (*S. kronenburgii* and *S. sericeo-tomentosa*) in order to understand their taxonomic status (Kahraman, Celep, Doğan, Bagherpour, 2010). In the Flora of Turkey, *S. euphratica*, *S. kronenburgii* and *S. sericeo-tomentosa* were evaluated as separate species. On the other hand, *S. cerino-pruinosa* and *S. pseudeuphratica* were regarded as synonyms of *S. euphratica*. As a result of the present study, *S. cerino-pruinosa* and *S. pseudeuphratica* are accepted as distinct species.

Finally an expanded description of each species is presented utilizing the information gathered in the field and the laboratory.

As the result of this research thirteen publications were presented.



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