REVISION OF THE GENUS *SALVIA* L. (LABIATAE) IN THE MEDITERRANEAN AND THE AEGEAN GEOGRAPHIC REGIONS OF TURKEY

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REVISION OF THE GENUS *SALVIA* L. (LABIATAE) IN THE MEDITERRANEAN AND THE AEGEAN GEOGRAPHIC REGIONS OF TURKEY

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ABSTRACT

REVISION OF THE GENUS *SALVIA* L. (LABIATAE) IN THE MEDITERRANEAN AND THE AEGEAN GEOGRAPHIC REGIONS OF TURKEY

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A revision of the Mediterranean and the Aegean geographic regions of Turkey of *Salvia* L. (Labiatae) is presented. According to the results, the study area has 60 taxa, 32 of which are endemic (mainly local endemics), 5 of which are non-endemic rare, and the remaining 23 taxa are widely distributed. The rate of endemism is 53% in the area. At the beginning of the thesis, history and worldwide distribution of the family and the genus are briefly given. Phylogenetic studies and infrageneric grouping of the genus are discussed. As well as, recent studies on the genus such as taxonomical, morphological, micromorphological and karyological are provided. Geographic, phytogeographic, topographic, and climatic features of the area are explained.

Since 2005, about 2000 specimens have been collected and examined as the research materials. In addition, a large number of specimens have been seen and studied in ANK, AEF, BM, E, ERCIYES, G, GAZI, HUB, K, KNYA, LE, ISTE and ISTF herbaria. Digital photos of some specimens including type specimens have been seen from B, W and A herbaria. In the field when the specimens were detected

geographical location (including GPS), habitat, phenological data and relevant field observations were all recorded.

In the study, comparative morphological characters and their variations are discussed Anatomical features, such as root, stem, leaf and petiole, micromorphological properties, such as trichome, pollen and nutlet, of the species are comprehensively studied and their taxonomic implications are discussed.

According to field studies and literature surveys, endemism, pyhtogeography, habitat, phenology, chorology, new distribution areas and conservation status of the species are determined.

Infrageneric delimitation of the species using multivariety analysis is performed. In addition, first sectional key and sectional grouping of the species are made. As well as, identification key of the species is given. At the end of the thesis, expanded and corrected description, address, photographs and some notes on taxonomy of the species are given.

The taxonomic studies revealed one new species, *Salvia marashica*, two new varieties, *S. sericeo-tomentosa* var. *hatayica*, *S. cadmica* var. *bozkiriensis*, one new combination, *S. aucheri* subsp. *canescens* and one new record, *S. viscosa*. As well as, *S. sericeo-tomentosa* and *S. quezelii* are rediscovered.

Keywords: Labiatae, *Salvia*, the Mediterranean and the Aegean geographic regions, revision

ÖZ

TÜRKİYE'NİN AKDENİZ VE EGE BÖLGELERİNDE
YAYILIŞGÖSTEREN *SALVIA* L. (LABIATAE) CİNSİNİN REVİZYONU

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Haziran 2010, 263 sayfa

Bu çalışmada Türkiye'nin Akdeniz ve Ege Bölgelerinde yayılış gösteren *Salvia* L. (Labiatae) cinsinin revizyonu sunulmuştur. Sonuçlara gore, çalışma alanında 60 takson yayılış göstermektedir. Bunlardan 32 tanesi endemic (geneli local endemik), 5 tanesi endemic olmayan nadir ve 23 taneside geniş yayılışlı türlerdir. Alandaki türlerin endemism oranı % 53'dür. Tezin başlangıç kısmında, familyanın ve cinsin tarihçesi, ve dünya genelindeki dağılımı özetle verilmiştir. *Salvia* cinsi üzerine yapılan filogenetik çalışmalar ve cinsiçi sınıflandırmalar tartışılmıştır. Ayrıca cins üzerine son zamanlarda yapılan taksonomik, morfolojik, mikromorfolojik ve karyolojik çalışmalar gösterilmiştir. Alanın coğrafik, fitocoğrafik, topoğrafik ve iklimsel özellikleri açıklanmıştır.

2005 yılından beri, araştırma materyali olarak yaklaşık 2000 örnek toplanmış ve üzerlerinde gerekli çalışmalar yapılmıştır. Ayrıca oldukça fazla sayıda herbarium örneği (ANK, AEF, BM, E, ERCIYES, G, GAZI, HUB, K, KNYA, LE, ISTE ve ISTF) görülmüş ve bunlar üzerinde de gereken çalışmalar yapılmıştır. Tip örnekleri dahil bazı dijital fotoğraflar Berlin (B), Viyana (W) ve Harvard (A)

herbaryumlarından görülmüştür. Saha çalışmalarında örnekler bulunduğu zaman onların coğrafik lokasyonları (GPS dahil), habitat, fenolojik özellikleri ve ilgili arazi kayıtları gözlemlenerek alınmıştır.

Bu çalışmada, türlerin kıyaslamalı morfolojik karakterleri ve onların varyasyonları tartışılmıştır. Anatomik özellikler, örneğin kök, gövdei yaprak ve yaprak sapı, mikromorfolojik özellikler, örneğin tüy, pollen ve meyve özellikleri, kapsamlı bir şekilde çalışılmış ve onların taksonomik önemleri tartışılmıştır.

Arazi çalışmaları ve literature çalışmalarına gore, türlerin endemizm, fitocoğrafya, habitat, fenoloji, koroloji, yeni dağılım alanları ve koruma statüleri belirlenmiştir.

Çoklu varyasyon analizi yardımı ile türlerin cinsiçi sınıflandırması yapılmıştır. Ayrıca, ilk seksiyonel tayin anahtarı ve türlerin seksiyonel gruplandırılması verilmiştir. Türlerin tayin anahtarı ayrıca verilmiştir. Çalışmanın son kısmında, türlerin genişletilmiş ve düzeltilmiş tanımları, adresleri, fotoğrafları ve taksonomik açıdan önemli notları verilmiştir.

Taksonomik çalışmalarda 1 yeni tür, *Salvia marashica*, iki yeni varyete, *S. sericeo-tomentosa* var. *hatayica*, *S. cadmica* var. *bozkiriensis*, bir yeni kombinasyon, *S. aucheri* subsp. *canescens* ve bir yeni kayıt , *S. viscosa*, bulunmuştur. Ayrıca, *S. sericeo-tomentosa* ve *S. quezelii* yeniden keşfedilmişlerdir.

Anahtar Kelimeler: Labiatae, *Salvia*, Akdeniz ve Ege Bölgesi, revizyon

To my wife and family

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A.Kahraman	Ahmet Kahraman
C.	Central
c., ca.	circa (about)
cm	centimeter
D.	P.H. Davis
Da.	Mountain
E.	East
Euro-Sib.	Euro-Siberian
F.Celep	Ferhat Celep
G. Akaydın	Galip Akaydın
Ir.-Tur.	Irano-Turanian
EKarabacak	Ersin Karabacak (in distribution of species)
Medit.	Mediterranean
mm	millimeter
N.	North
S.	South
SBagherpour	Safi Bagherpour
Sect.	Section
subsp.	subspecies
Syn.	Synonym
W.	West
var.	variety

CHAPTER 1

INTRODUCTION

1.1. History of the Labiatae

The family Labiatae has cosmopolitan distribution and includes over 250 genera and close to 7000 species (Thorne, 1992). The family is known for its fine ornamental or culinary herbs like basil, lavender, mint, oregano, rosemary, sage and thyme and is a fich source of essential oils for the flavouring and perfume industry (Wagstaff *et al.*, 1998). Despite its economic importance, the most influential classification poorly reflect phylogenetic relationships in the family (Wagstaff *et al.*, 1995). The foundations of Labiatae classification were made by Bentham in a series of papers (1832-1836; 1848; 1876). Briquet (1895-1897) reorganized Bentham's 1876 classification, raising some of his tribes and subtribes to the subfamilial level (Cantino & Sanders, 1986) (Table 1).

Erdtman (1945) suggested that Labiatae is composed of two natural subfamilies (Lamioideae and Nepetoideae) that differ in their pollen. Subfamily Lamioideae usually characterized by tricolpate, binucleate pollen, albuminous seeds, spatulate embryo and the presence of iridoid glycosides. On the other hand, the Nepetoideae, with 133 genera and ca. 3685 species (Thorne, 1992), is usually characterized by hexacolpate, trinucleate pollen, exalbuminous seeds, investing embryo and the presence of volatile terpenoids. Many of the Nepetoideae members are familiar aromatic plants much used for culinary and flavouring purposes (Cantino & Sanders, 1986).

The treatments of relationships within the subfamily Nepetoideae have considerably varied among researchers. For example, Wagstaff *et al.* (1995) recognized 4 tribes on

the basis of cpDNA restriction site analyses within the subfamily Nepetoideae: tribe Lavanduloideae (consisting of *Lavandula*), tribe Ocimeae (defined by declinate stamens and consisting of 52 genera), tribe Elsholtzieae (defined by spreading stamens and consisting of six genera), and the tribe Mentheae, consisting of *Salvia* and 72 other genera, however Wunderlich (1967) recognized 18 tribes in Nepetoideae (Walker *et al.*, 2004)

Labiatae shows a closer relationship to the Verbenaceae. The two families share opposite leaves, zygomorphic flowers and bicarpellate gynoecium. The Labiatae are usually distinguished from the Verbenaceae by a deeply four lobed ovary with a gynobasic style, whereas most Verbenaceae have an unlobed ovary with a terminal style (Wagstaff & Olmstead, 1997).

Labiatae is the third largest family in Turkey. According to recent literatures (Güner *et al.*, 2000), Labiatae is composed of 45 genera and 574 species, 256 of which are endemic. Its endemism ratio is about 44.5 %.

Table 1. Comparison of classifications of Bentham (1876), Briquet (1895-1897) and Erdtman (1945) (Cantino & Sanders, 1986; Wagstaff & Olmstead, 1997)

<table>
<tr><th>Bentham (1876) (Tribe)</th><th>Briquet (1895-1897) (Subfamily)</th><th>Erdtman (1945) (Subfamily)</th><th>Thorne (1992) and Cantino et al., (1992) (Subfamily)</th></tr>
<tr><td>Ajugeae (“Ajugoideae)</td><td>Ajugoideae (including Rosmarinus of Bentham’s Salvieae</td><td rowspan="4">Lamioideae</td><td>Ajugoideae</td></tr>
<tr><td>Prostanthereae</td><td>Prostantheroideae</td><td>Prostantheroideae</td></tr>
<tr><td>Prasieae</td><td>Prasioideae</td><td></td></tr>
<tr><td>Lamieae (“Stachydeae”)</td><td rowspan="4">Scutellarioideae

Lamioideae (“Stachyoideae”)</td><td>Scutellarioideae</td></tr>
<tr><td>Nepeteae</td><td rowspan="4">Nepetoideae</td><td>Lamioideae</td></tr>
<tr><td>Salvieae (“Monardeae”)</td><td></td></tr>
<tr><td>Mentheae (“Satureineae”)</td><td>Nepetoideae</td></tr>
<tr><td>Ocimeae (“Ocimoideae”)</td><td>Ocimoideae
Lavanduloideae
Catopherioideae</td><td>Viticoideae
Chloanthoideae
Pogostemomoideae
Teucrioideae</td></tr>
</table>

1.2. Taxonomic History of the genus *Salvia*

The genus name “*Salvia*” is derived from “Salveo” which means “to save, to heal and to recover” in Latin (Hamlyn, 1969). *Salvia* species are used in traditional medicines all around the world, possessing antibacterial, antioxidant, antidiabetic and antitumor properties (Ulubelen, 2003). In addition, many *Salvia* species are used as herbal tea and for food flavouring, as well as in cosmetics, perfumery and the

pharmaceutical industry (Demirci *et al.*, 2003). In the area, mostly *S. fruticosa* Miller, *S. pomifera* L., *S. cryptantha* Montbret & Aucher ex Bentham and *S. aramiensis* Rech. fil. are used as herbal tea by folk and the *S. fruticosa* is also exported. Furthermore, antioxidant activities of the seed oils of *Salvia* have been reported (Castro-Martinez *et al.*, 1986). *Salvia* species are also grown in parks and gardens as ornamental plants (Marin *et al.*, 1996).

Tribe Mentheae (Wagstaff *et al.*, 1995) is a well supported monophyletic tribe containing 73 genera within the subfamily Nepetoideae (Wagstaff *et al.*, 1995; Walker *et al.*, 2004). *Salvia* is distinguished from the other 72 genera in the tribe Mentheae by having the two posterior stamens aborted, and the connective separating the thecae of the two expressed stamens significantly elongated. It is the elongation of the staminal connective that allows the formation of the lever mechanism of pollination (Claßen-Bockhoff *et al.*, 2003; 2004a; Walker *et al.*, 2004).

Etlinger published the first botanical monograph of *Salvia* in 1777 and recognized 48 species. Then, Bentham in the *Labiatarum* (1833, 1848) provided last world-wide revision of the genus, he separated the genus into 14 sections, nine of them distributed in the Old World and five in the New World. Since then, no comprehensive treatment of the genus has been completed, despite the recognition of over 500 new species of *Salvia* (Walker *et al.*, 2004). Many taxonomist have modified Bentham's (1876) subgeneric arragement (Briquet, 1895-1897; Stibal, 1934; Pobedimova, 1954)). As well as, some researchers have avoided his subgeneric groupings by describing "species-groups" or small sections (Epling, 1938-1939; Hedge, 1974; 1982a; 1982b).

Epling (1938-1939) revised subgenus *Calosphace* and recognized about 470 species, all of which are confined to the New World, mostly in Central and South America. Stibal revised the Chinese (1934) and Indian (1936) species. Recently, Hedge revised the Europan and African species and he also prepared the Turkish and Iranian *Salvia* accounts (Hedge 1972; 1974; 1982a; 1982b)

Today, the genus *Salvia* (Lamiaceae: tribe Mentheae) nearly 1000 species displaying a remarkable diversity in growth forms, secondary compounds, floral morphology and pollination biology. *Salvia* has distributed extensively in three regions of the world: Central and South America (500 spp.), western Asia (200 spp.) and eastern Asia (100 spp.) (Walker & Sytsma, 2007) (Figure 1).

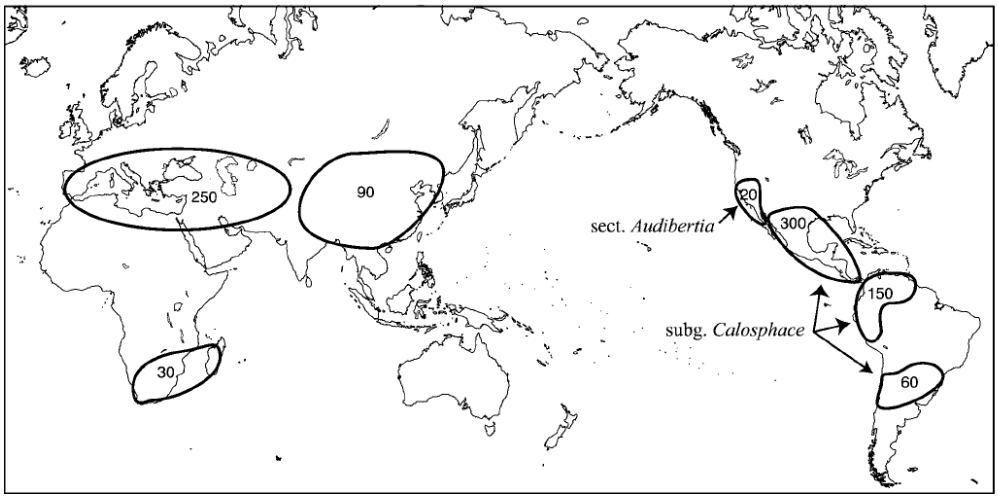

Figure 1. General distribution areas of the Genus *Salvia* (Walker *et al.*, 2004).

Claßen-Bockhoff *et al.* (2004b) stated that the significant species radiations that are correlated with the presence of the lever mechanism in *Salvia*. They suggested that the lever mechanism in a selective regime of pollination is driving evolution in the group. The significance of this lever mechanism to the reproductive biology in *Salvia*, first described by Sprengel (1793), has received considerable attention (Claßen-Bockhoff *et al.*, 2003; 2004a; Wester & Claßen-Bockhoff, 2006; Walker & Sytsma, 2007). Himmelbaur and Stibal (1932–1934) directly addressed staminal evolution in *Salvia*, presenting a hypothesis of parallel evolution of the lever mechanism (from a common ancestor) in the New World and the Old World (Walker & Sytsma, 2007).

Recently, Walker *et al.* (2004) and Walker & Sytsma (2007) have comprehensively studied molecular phylogeny and the staminal morphology of the various lineages of

Salvia and related genera. As well as, they interpreted staminal variations within tribe Mentheae.

According to Walker & Sytsma (2007), the genera *Lepechinia* and *Melissa* are closely related to *Salvia* clade and they form a monophyletic group within the tribe Mentheae. The monophyletic clade *Salvia* consisting of genus *Salvia, Dorystaechas*, *Meriandra*, *Zhumeria*, *Perovskia* and *Rosmarinus*. The clade *Salvia* characterized morphologically by the abortion of the adaxial stamens. The clade *Salvia* divided three distinct lineages as *Salvia* clade I, II and III, each lineage more closely related to other genera than the two other major lineages of *Salvia*. That is, *Salvia* is clearly polyphyletic. As well as, they shown that the staminal lever mechanism has evolved three times independently, each time with a distinct morphology.

In the *Salvia* clade I, there are about 250 species. They are mainly distributed in Europae, western Asia, Russia, central and southern Africa, Mediterranean and 8 species from New world. According to Walker and Sytsma (2007), *Perovskia* and *Rosmarinus* are sister to *Salvia* clade I. They are also sister to the remainder of the "*Salvia* clade".

In the first study (Walker *et al.*, 2004), *Salvia* clade I consists of 33 *Salvia* species, 14 (*S. cadmica* endemic to Turkey in sect. *Hymenosphace*, *S. viridis* in sect. *Horminum*, *S. brachyantha, S. aethiopis, S. argentea, S. indica, S. candidissima, S. palaestina, S. sclarea* in sect. *Aethiopis*, *S. verbenaca*, *S. amplexicaulis*, *S. viscosa*, *S. staminea* in sect. *Plethiosphace*, *S. verticillata* in sect. *Hemisphace*) of which are also known from Turkey. In the second study (Walker & Sytsma, 2007), *Salvia* clade I consists of 23 *Salvia* species, 6 (*S. aucheri* var. *aucheri* endemic to Turkey in sect. *Salvia*, *S. hydrangea* in sect. *Hymenosphace*, *S. sclarea*, *S. aethiopis*, *S. candidissima* and *S. verbascifolia* = synonym of *S. microstegia* in sect. *Aethiopis*) of which are known Turkey. In the studies, 17 species are known from Turkey, 2 of which are also endemic to Turkey for the *Salvia* clade I.

As well as, Walker & Sytsma (2007) recognized two distinct stamen types in the *Salvia* clade I as stamen types A and B. In stamen type A, the two posterior thecae

are expressed and not fused. In the stamen type B, the two posterior thecae are not expressed, and the distal posterior ends of the adjacent connectives are fused into a complex structure blocking access to nectar. Within *Salvia* clade I, two lineages are identified. The first clade, has stamen type A, consists of 16 species, 2 (*S. aucheri* var. *aucheri* endemic to Turkey in sect. *Salvia* and *S. hydrangea* in sect. *Hymenosphace*) of which are known from Turkey. The second clade, has stamen type B, consists of 7 species, 4 (*S. sclarea*, *S. aethiopis*, *S. candidissima* and *S. verbascifolia* = synonym of *S. microstegia* in sect. *Aethiopis*) of which are known from Turkey. Stamen types A and B of *the Flora of Turkey* (Hedge 1982a) and Walker & Systma (2007) are equivalent.

In the *Salvia* clade II, there are about 520 species in subgenus *Calosphace* and the section *Audibertia*. They are mainly distributed in Mexico, the Andean region, southern Brazil and Argentina (subgenus *Calosphace*) and the California Floristic Province and adjacent deserts (section *Audibertia*). The genus *Meriandra* and *Dorystaechas* are sister to *Salvia* clade II. Five distinct stamen types (Stamen types E to I) were recognized by Walker & Sytsma (2007) in *Salvia* clade II. Within it, five lineages are identified, each with a distinct stamen morphology.

In the *Salvia* clade III, there are about 105 species. They are mainly distributed in Europae, western Asia, Russia, central and southern Africa, Mediterranean and 8 species from New World. According to Walker *et al.* (2004), all species of this clade are correspond to Bentham's sect. *Drymosphace*. However, their the *rbcL* analysis suggested that this clade includes additional species outside sect. *Drymosphace* such as *S. fruticosa*, which is Mediterranean element. According to Walker & Sytsma (2007), the genus *Zhumeria* is sister to *Salvia* clade III. In this clade, two stamen types (Stamen types M and N) were described by Walker & Sytsma (2007). The first clade, has stamen type M, consists of 4 species, 1 (*S. aristata*) of which is known from Turkey. *S. aristata* has been recently recorded from Turkey, therefore, its stamen types were not given in *the Flora of Turkey*. However, its stamen type is close to stamen type A described by Hedge (1982a) in *the Flora of Turkey*. In this lineage, stamens have somewhat elongate connectives, both producing pollen, and the posterior thecae never fused. The second clade, has stamen type N, consists of 7

species, 1 (*S. glutinosa*) of which is known from Turkey. In *the Flora of Turkey* (Hedge, 1982a), its stamen types were also described as "stamen type B". In *S. glutinosa*, the posterior thecae are rudimentary, and produce no or very little pollen and the two adjacent posterior thecae post-genitally fuse (Walker & Sytsma, 2007).
The first time, Bentham (1833) recognized 22 species of *Salvia* from Turkey. He placed these species under 6 sections. These sections are as follows: *Eusphace* Benth., *Hymenosphace* Benth., *Aethiopis* Benth., *Plethiosphace* Benth., *Horminum* Benth. and *Hemisphace* Benth.

Boissier (1875), in his *Flora Orientalis,* recognized 75 species of *Salvia* from Turkey. He placed these species under 7 sections according to Bentham's (1833) sectional delimitation. These sections are as follows: *Eusphace* Benth., *Hymenosphace* Benth., *Aethiopis* Benth., *Plethiosphace* Benth., *Horminum* Benth., *Hemisphace* Benth. and *Drymosphace* Benth. After that sect. *Euphace* was changed as sect. *Salvia* by Hedge (1972).

The first comprehensive treatment for *Salvia* L. in Turkey was made by Hedge (1982a), who recognised 87 species one of them doubtful. Since then, three new records, *S. viscosa* Jacq. (Celep *et al.*, 2009a), *S. macrosiphon* Boiss. (Kahraman *et al.*, 2009a) and *S. aristata* Aucher ex Benth. (Behcet & Avlamaz, 2009) and six new species, *S. nydeggeri* Hub.-Mor. (1982), *S. aytachii* Vural & Adıgüzel (1996), *S. hedgeana* Dönmez (2001), *S. anatolica* Hamzaoğlu & A.Duran (2005), *S. marashica* İlçim, F.Celep & Dogan (2009) and *S. ekimiana* F.Celep & Dogan (2010a) and one new variety , *S. sericeo-tomentosa* var. *hatayica* F.Celep & Dogan (2009b), have been described from Turkey. Two synonyms have been reevaluated as valid species (Kahraman *et al.*, 2010a). As well as, *S. aucheri* Bentham var. *canescens* Boiss. & Heldr. has been raised to subspecies rank as *S. aucheri* Bentham subsp. *canescens* (Boiss. & Heldr.) Celep & Dogan. (Celep *et al.*, 2010e).The total species number has now reached 97 in Turkey, demonstrating that Turkey is a major centre of diversity for the genus in Asia.

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) and 21 in the *Flora Palaestina* area (Zohary, 1966).

1.3. Location of the Research Area

Turkey occupies an area of almost 783 562 km^2 and forms a bridge between S.W. Asia and S.E. Europe. It is bordered by eight countries. Bulgaria to the northwest, Greece to the west, Georgia to the northeast, Armenia, Azerbaijan and Iran to the east and Iraq and Syria to the southeast. The Meditarranean Sea is to the south, the Aegean Sea is to the west and Black Sea is to the north (Wikipedia, 3 May 2010).

The research area (Mediterranea and Aegean geographical regions of Turkey) is approximately 194 477 km^2 and lies approximately at 36^0 16' 211" N-26^0 14' 474" E and 37^0 46' 103" N-37^0 51' 359" E (Figure 2). According to Davis' grid system (1965), the area falls within the B1, B2, B3, B6, C1, C2, C3, C4, C5 and C6 squares. The altitude of the study area varies between 0 (sea level) and 3756 m (Aladağlar-Niğde).

According to field trips, herbarium studies and literatures (Hedge, 1982a; Boissier, 1879), the Mediterranean and Aegean Geographic regions of Turkey have 58 *Salvia* species, 31 of which are endemic (mainly local endemics) and 5 of which are rare species.

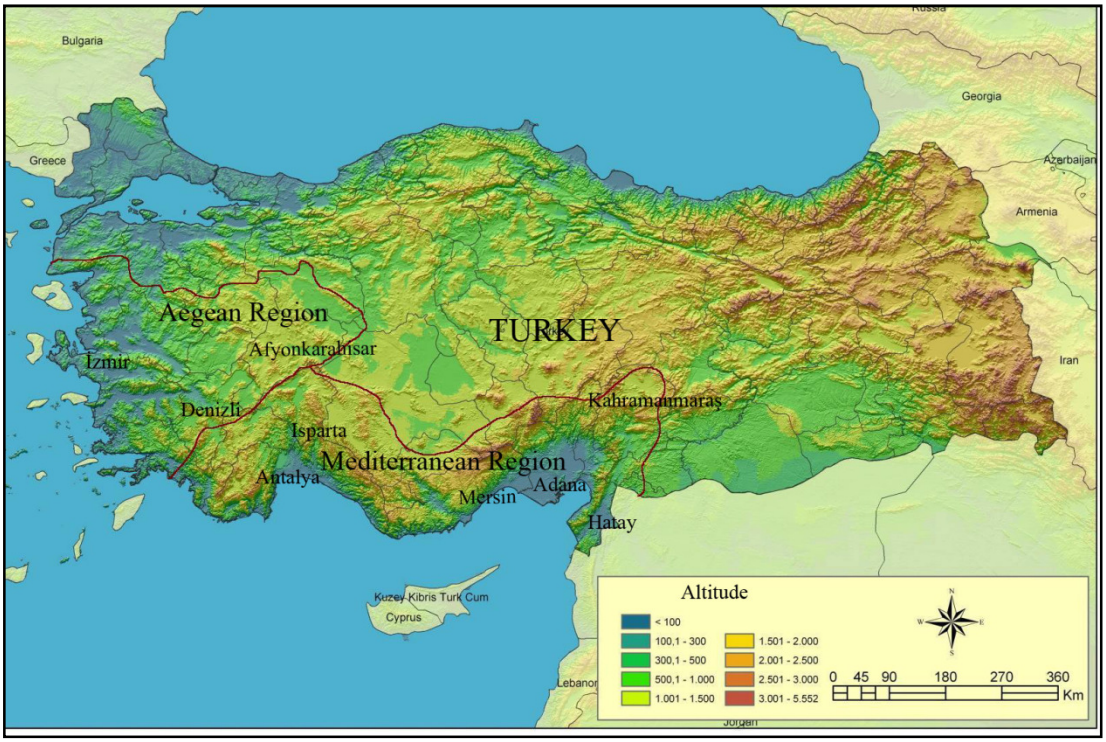

Figure 2. Location of the study area

Turkey is the meeting ground of three phytogeographical regions: Euro-Siberian (represented by the Euxine province), Mediterranean (represented by the East Mediterranean provinces of West Anatolia, Taurus and Amanos Mountains) and Irano-Turanian (represented by Central and Eastern Anatolia). These three phytogeographical regions differ from one another on the basis of their different floristic composition and in vegetational aspects (Davis, 1965).

The study area is mainly within Mediterranean and Irano-Turanian phytogeographical region. The main areas of species-concentration are western, central and eastern Mediterranean phytogeographical region (Figure 3).

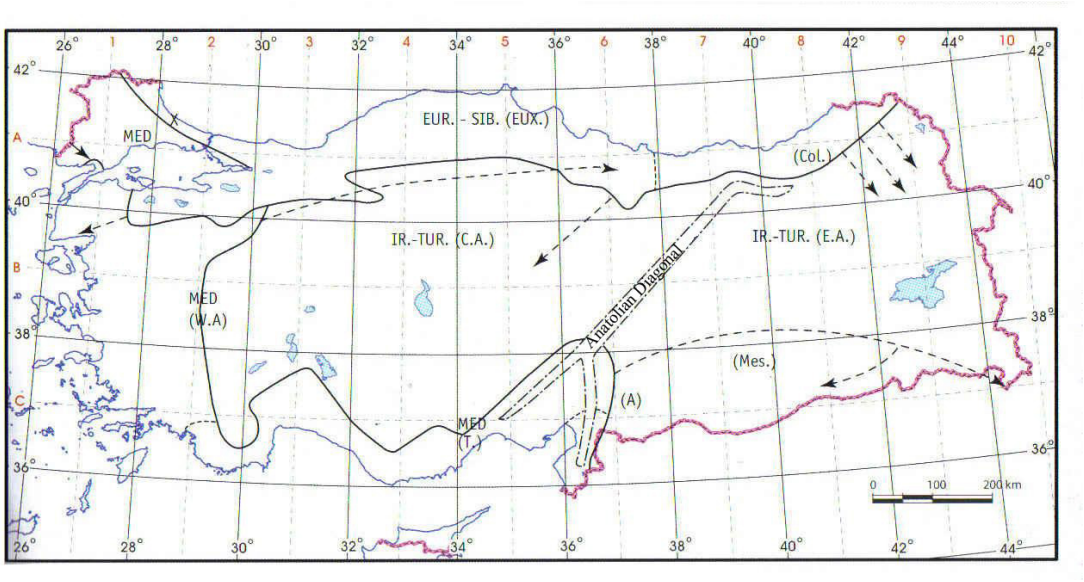

Figure 3. Phytogeographical Regions in Turkey (Davis, 1971). Eur. Sib. (Eux): Euro-Siberian, Ir.-Tur.: Irano-Turanian, Med.: Mediterranean Phytogeograpgical Region. A.: Amanos Mountains, C.A: Central Anatolia, E.A.: East Anatolia, T: Taurus Mountains, Mes.: Mesopotamia.

1.4. Climate of the Research area

Climate is one of the most important factors determining the distribution of plants in general. In the area, the climate varies between the Mediterranean climate and the continental climate of Inner Anatolia (Akman, 1990). It is also possible to see local climatic characteristics in the research area. The Mediterranean climate exists on the narrow shorelines of the Mediterranean and Aegean regions, however, continental Inner Anatolian climate exists in eastern Aegean region and North side of the Taurus Mountains in the research.

In the Mediterranean phytogeographical region, the typical Mediterranean climate is predominant, characterized by hot and dry summers and cold and rainy winters (except in the mountains). Throughout much of the area snow lies in winter above 1000 m, so that the increased cold, low temperatures and drier air lead to the penetration of steppic elements from Inner Anatolia to the high mountains (Davis, 1965).

In the Irano-Turanian phytogeographical region, a typical steppic climate occurs, cold winters and hot dry summers. The climate of Inner Anatolia resembles that of the Mediterranean climate of West and South Anatolia. However, precipitation is less and much of it falls as snow in most areas. Both the Mediterranean and Irano-Turanian regions have a predominantly therophytic climate (Davis, 1965).

In the highest mountains of the area, snow lies throughout the summer. Small glaciers still exist on the top of some of these mountains, such as Berit Mountains, Bolkar Mountains, Aladağlar, Akdağlar and Kızlar Sivrisi (Bey Dağları).

1.5. Topography of the Research Area

Davis (1965) and Doğan (1982) stated that most of the Anatolian peninsula consists of a plateau, rising steadily towards the east and bounded on the north and south by steep mountain ranges. In West Anatolia, many of the mountain ranges run east to west, and are divided by broad meandering river valleys such as Büyük Menderes and Gediz. The geology is very varied; chalk at lower altitudes, basic igneous rocks, limestone, mica schists and granite making up various parts of the country. A considerable area of serpentinous rocks, centred on Sandras Dağı and Marmaris, occurs in south-west Anatolia. The coastline is greatly intended by gulfs and promontories. The West Anatolian Mountains diverge into two big chains; one is the North Anatolian mountain chain, and the other one is Taurus mountain chain .

In South Anatolia, a massive mountain range consists of Ala Dağlar, Bolkar Dağları, Anti-Taurus and Amanos Mountains. These ranges lie parallel to the shore and make communications extremely difficult, though there are a few deep gorges cut by the Göksu, Seyhan and Ceyhan rivers (Davis, 1965; Doğan, 1982).

The dominant rock of the Mediterranean region is hard limestone, but considerable areas of basic igneous rocks, shales and slates occur from the Isaurian Taurus eastwards. There are extensive areas of soft chalky rocks near Ermenek and Mut in the Göksu valley; diorite is found above Bolkar Mountain in the Cilician Taurus.

Limestone is rare (Düldül Dağ) in the Amanos Mountain, where basic igneous rocks predominate (Davis, 1965).

1.6. Scope of the study

Since Davis' *Flora of Turkey and East Aegean Islands* vol. 7 (Hedge, 1982a), a large number of specimens have been collected from Turkey. Species either new to science or new for Turkey has been discovered and the known distributions of other species have been greatly extended.

According to our recent taxonomic revision of Turkish *Salvia*, the Mediterranean and Aegean geographic regions of Turkey have 58 *Salvia* species, 31 of which are endemic (mainly local endemics) and 5 of which are rare species. The rate of endemism is 53 % in the area.

The aims of the present study are as follows:

- To carry out a taxonomic revision of *Salvia* and solve existing taxonomic problems in the Mediterranean and Aegean geographic regions of Turkey
- To determine distribution and the threat categories of the taxa.
- To determine ecological and phytogeographical properties of the taxa
- To construct a new infrageneric grouping
- To construct a new identification key for the species found in the study area.
- To carry out some morphological, anatomical and micromorphological assesements for taxonomic reasons

CHAPTER 2

2. MATERIAL AND METHODS

2.1. Plant Materials

Between 2005 and 2009, according to the standart techniques given by (Woodland, 1997) a large number of specimens were collected from all parts of the Aegean and the Mediterranean regions of Turkey and many herbarium specimens (from ANK, AEF, BM, E, ERCIYES, G, GAZI, HUB, K, KNYA, LE, ISTE and ISTF,) were also used in the study. In addition, the type specimens or their photos from E, K, BM, G, B and W herbaria were used for nomenclatural reasons.

The specimens were cross-checked with the keys provided by Hedge (1982a) and the *Salvia* accounts given in various relevant floras, such as *Flora Orientalis* (Boissier, 1879), *Flora Iranica* (Hedge, 1982b), *Flora of the USSR* (Pobedimova, 1954), *Flora of Syria, Palestine and Sinai* (Post, 1933), *Flora of Cyprus* (Hedge, 1985) and *Flora Europaea* (Hedge, 1972). All the plant name authors are given according to Brummit & Powell (1992).

In the field when the specimens were detected geographical location, habitat, phenological data and relevant field observations were all recorded and determined its vulnerability on the basis of the current version of the conservation status (IUCN, 2001). Distribution maps of the species are also prepared.

The specimens have been preserved in the Middle East Technical University (METU), Department of Biological Sciences.

2.2. Anatomical Investigations

The methods used here have already been described by Metcalfe, however for practical reasons these have been slightly altered. Anatomical studies were carried out on specimens kept in 70 % alcohol. The paraffin method was used for the cross sections of the leaves, stems, roots and petiole. The specimens were embedded in paraffin and then sectioned at 5-15 μm thickness with a Leica RM2125RT rotary microtome. All sections were stained first with safranin-fast green and then mounted with Canada Balsam or Entellan. Measurements and photos were taken using a Leiaca DM1000 binocular ligth microscope with a Leiaca DFC280 camera (Johansen, 1944; Metcalfe & Chalk, 1950; Doğan, 1986).

2.3. Palynological Investigations

For palynological investigations, pollen material was obtained from herbarium materials. The pollen slides were prepared according to Wodehouse (1935) technique. For LM studies, pollen grains were dissected from herbarium samples and placed on clean microscope slides. Glicerin-gelatin and basic fuchsin were added to the pollen and then they were mixed with a clean pin to be scattered. Measurements and observations were made using the Leiaca DM1000 binocular ligth microscope with the Leiaca DFC280 camera. The polar length (P), the equatorial length (E), the colpus length (CLG), the exine and the intine thickness for 30 pollen grains were measured under the light microscope (x 1000) and P/E ratios were calculated. For SEM, unacetolyzed pollen grains were first mounted on double-sided carbon tape affixed to aluminum stubs, covered with gold with an Hummle VII sputter coater and photographed with a JEOL-6060 scanning electron microscope to determine exine ornamentation of the pollen. Pollen terminology of Faegri and Iverson (1975) has been used.

2.4. Nutlet Micromorphology

Mature nutlets were collected from wild populations. In order to study the patterns of variations, specimens were collected from as many different parts of the distribution

areas. In this study, 54 taxa (50 species and 4 subspecies) were examined using stereoscop and Scanning Electron Microscopes (SEM). Material used in this study was mainly deposited at Department of Biological Sciences (METU), Turkey.

Nutlets were first examined and mounted on stubs for scanning electron microscopy using Leica S8AP0 binocular stereoscopic microscope. At least two to four samples were examined for each species after a number of specimens had been compared under stereoscopic microscope for similarity. For the nutlet length and width, 30 samples per specimen of each taxon were measured using Leica DM 1000 microscope (Doğan, 1988).

For SEM, selected mature seeds were mounted on double-sided carbon tape affixed to aluminum stubs. Seeds were coated with gold with a Hummle VII sputter coater and observations were made using a Jeol JSM-6400 scanning electron microscope at the Department of Metallurgical and Materials Engineering, Ankara, and Middle East Technical University and Turkish Petroleum Corporation, Ankara, Turkey. SEM images were used to describe surface sculpturing of the seeds. The descriptive terminology of Stearn (2004) and Punt *et al.* (2007) for seed characteristics were followed.

2.5. Ecology

For understanding the ecology of the species studies, soil samples were taken from the suitable habitats of the species and all soil samples were analyzed at the Soil, Fertilizers and Water Resources Central Research Institute, Ankara. Soil texture, pH, CaCO3, N, P, K and organic matter analysis were made using standart tecniques (Bayraklı, 1987). Results were evaluated according to Kaçar (1972).

2.6. Multivariate Analysis

The morphometric analysis was carried out on the specimens stemming from own collections by measuring 46 vegetative and reproductive characters to investigate their taxonomic delimitations. For multivariate analysis, a similarity matrix was

created first using Gower's (1971) general coefficient similarity (Sneath and Sokal, 1973), which can be used directly with a mixture of character types (binary, alternative, qualitative, quantitative and semi-quantitative characters) as well as taking into account missing values (St-Laurent *et al.*, 2000). This similarity matrix was then clustered by using UPGMA (the unweighted pair-group method using arithmetic averages) and the results are shown in the phenogram. For this analysis, the MVSP (a multivariate statistics package for IBM PC and compatibles) program package for clustering analysis was applied.

CHAPTER 3

3. RESULTS

3.1. Comparative Morphological Characters and their Variation

Both vegetative and reproductive organs were observed in field and also studied by the use of x10 to x80 dissecting binocular microscope. For further investigations (if necessary), the vegetative and reproductive organs put into to boiling water to restored as nearly as possible to their natural shape. They were then placed on a smooth tile and dissected under the microscope, using two fine needles.

3.1.1. Habit

In Turkey, many species are either shrubs or perennials clearly woody below and remaining species are herbaceous. The shrubby species which can be up to over 1.5 m high are mostly distiributed in the central (i.e. *S. wiedemannii, S. recognita, S. tchihatcheffii*), west (i.e. *S. pomifera, S. fruticosa*) and south Anatolia (i.e. *S. pisidica, S. albimaculata, S. heldreichiana, S. cedronella, S. adenophylla, S. potentillifolia, S. marashica* and *S. sericeo-tomentosa*). Herbaceous species occur throughout the area and are mainly perennial and biennial, only one species being annual (*S. viridis*).

Some shrubby species have a fairly primitive floral structure, that is with a relatively long corolla, a more or less straight, short lips, not or scarcely falcate upper lip and little differentiated thecae (Hedge, 1974) i.e. *S. fruticosa, S. aramiensis*, *S. cedronella, S. adenophylla, S. potentillifolia, S. heldreichiana*, *S. marashica, S. sericeo-tomentosa*. In addition, some herbaceous species have also similar characters i.e. *S. quezelii*, *S. bracteata, S. pinnata, S. cadmica, S. smyrnaea, S. blepharochlaena.* Most of the perennials on the other hand have more or less

advanced floral structure such as small corolla, clearly falcate upper lip and differentiated thecae as shown by *S. viridis, S. hypargeia, S. aethiopis, S. chrysophylla, S. indica, S. cassia, S. candidissima, S. cilicica, S. microstegia, S. argentea, S. modesta, S. glutinosa, S. adenocaulon, S. dichroantha, S. virgata, S. verbenaca, S. verticillata, S. russellii* and *S. napifolia*.

3.1.2. Stem Morphology

The species have procumbent, ascending to erect stem or rarely stemless. Some herbaceous species have procumbent, ascending to erect stem i.e. *S. pinnata, S. pilifera, S. quezelii, S. cadmica* and *S. blepharochleana,* however some herbaceous plants have clearly erect stem i.e. *S. sclarea, S. candidissima, S. cilicia, S. chrysophylla, S. argentea* and *S. virgata*. Similarly, some shrubby species have ascending to erect stem i.e. *S. albimaculata, S. pisidica, S. heldreichiana, S. marashica* and *S. tchihatheffii*, but some others have clearly erect stem i.e. *S. aucheri, S. cedronella* and *S. pomifera*. In this study, the smallest stem is observed in the population of *S. caespitosa* (ca. 3-5 cm) and *S. cadmica*, the longest stem is observed in the population *S. recognita* and *S. pomifera* (ca. to 170 cm).

3.1.3. Leaves shape, division and texture

Shape and margin of the leaves are very useful taxonomic characters. Leaves are various in their shape between simple, pinnatisect, trisect, lyrate and pinnatifid. Most of Turkish *Salvia* has simple and pinnatisect leaves. In the study area, majority of the endemic species have pinnatisect leaves such as *S. pisidica, S. albimaculata, S. potentillifolia, S. cedronella, S. pilifera, S. heldreichiana, S. caespitosa, S. tchihatcheffii, S. wiedemannii, S. tigrina, S. quezelii* and *S. haussknechtii*. Some other endemic species have simple leaves such as *S. chionantha, S. aucheri* subsp. *canescens, S. sericeo-tomentosa, S. hypargeia, S. cilicica, S. cyanescens, S. modesta.* On the other hand, *S. fruticosa, S. cadmica, S. tomentosa*, *S. aucheri* subsp. *aucheri* have simple leaves with some trilobed forms.

Outline of the leaves is various (linear-lanceolate to broadly ovate) and quite valuable taxonomically. *S. chionantha* and *S. hypargeia* have linear-lanceolate leaves, but *S. sclarea*, *S. cilicica* and *S. cassia* have clearly ovate leaves. However, most of the species have oblong to ovate leaves such as *S. aramiensis, S. tomentosa, S. aucheri, S. cadmica, S. virgata, S. dichroantha, S. adenocaulon, S. verbenaca*.
As well as, there is a great variation on leaves margins such as entire, serrate, crenulate and erose or their variations. Most of the species have crenulate margins such as *S. fruticosa, S. tomentosa, S. aramiensis, S. dichroantha, S. adenocaulon, S. cadmica, S. smyrnaea, S. russellii*. Serrate margin can be seen in *S. glutinosa*, entire margin in *S. wiedemannii*, *S. hypargeia* and *S. chionantha*, erose margin in *S. aethiopis* and erose to dentate margin in *S. indica*.

All species have herbaceous leaves, but some species have thick-textured or membranous. Example is provided by *S. pilifera* and *S. viscosa*. Their juvenile leaves are thick, but their adult leaves are membranous in texture. However, most of the species have usually normal or thick leaves. Especially, *S. chionantha, S. sericeo-tomentosa, S. microstegia* and *S. hypargeia* have thick leaves.

3.1.4. Inflorescence

All *Salvia* species have an inflorescence of opposite reduced cymes which form false whorls usually known as verticils or verticillasters. Some, such as *S. aethiopis*, have widely branched paniculate inflorescences but most species have much less spreading inflorescences and may be unbranched. The number of flowers in a verticil is diagnostic as in *S. aucheri* and *S. quezelii*, where they are 1-2 flowered, but usually the range from 4-10 (-40) flowered.

Floral leaves, sometimes called bracts, are always present. They are either quickly deciduous or persistent. In a few species such as *S. sclarea* and *S. palaestina* the floral leaves are very large and coloured. In *S. viridis*, the inflorescence is topped by a coma of conspicuous floral leaves.

Within the floral leaves, bracts, sometimes called bracteoles, are present but occasionally are apparently absent as in *S. fruticosa*.

3.1.5. Calyx

The calyx provides several important characters for species recognition and for defining species-group. Most of Turkish species have thick-tectured calyx (e.g. the member of sect. *Salvia, Aethopis, Horminum, Drymopshace, Plethiosphace* and *Hemisphace*) and remaining have memranous calyces (sect. *Hymenosphace*, Figure 4). Thick-textured calyces scarcely enlarge after anthesis but membranous calyces enlarge considerably after anthesis until they are broadly infundibular.

The shape of the upper calyx lip may also be important. In *S. verbenaca* and *S. virgata*, the upper lip of the fruting calyces is prominently bisulcate and reflexed. In many other species, the calyx upper lip is not reflexed.

3.1.6. Corolla

The corolla provides some several important characters for species recognition. Useful diagnostic characters at specific and higher level are provided by the size of the corolla (e.g. *S. chionantha*, *S. indica* 30-50 mm and *S. yosgadensis* 12-14 mm), the shape and length of tube, by the presence or absence of an annulus (e.g. *S. caespitosa* annulate, *S. adenocaulon* non-annulate), the shape of the upper lip (*S. chionantha* falcate, *S. cadmica* straight), and the length of the lower lip relative to the upper.

Corolla colour is often characteristic for species. For example, *S. heldreichiana* has blue-purple, *S. nydeggeri* has yellow and *S. cassia* has white corollas. Different corolla types are given in Figure 4.

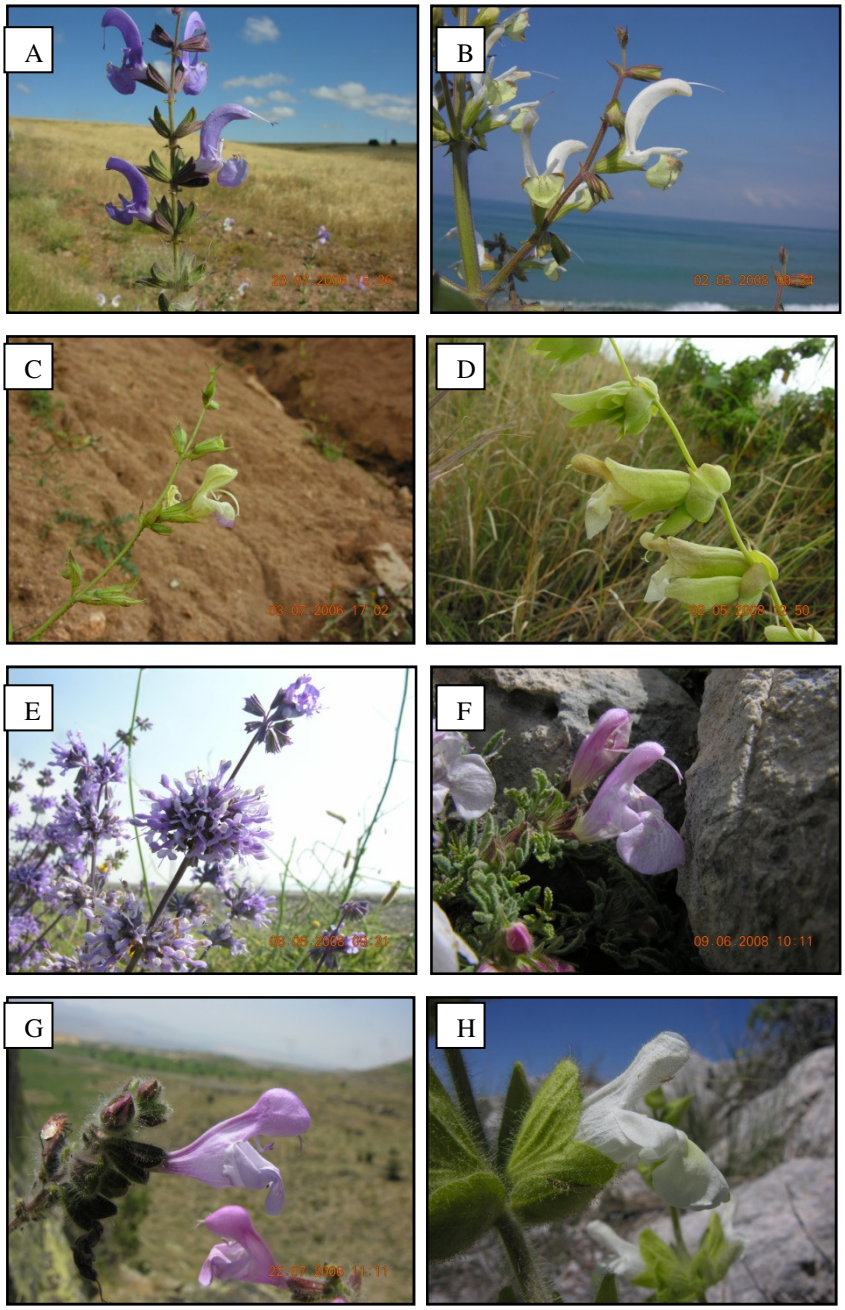

Figure 4. A- *S. cyanescens*, B- *S. cassia*, C-*S. nydeggeri*, D- *S. sericeo-tomentosa* var. *sericeo-tomentosa* (membranous calyx), E- *S. verticillata subsp. amasiaca*, F- *S. caespitosa*, G- *S. recognita*, H- *S. cadmica* (membranous calyx).

3.1.7. Stamens:

Sprengel (1793) described and illustrated the dorsal (nototribic) pollination mechanism in *Salvia*, but the morphology of the staminal lever was first recognized

by Hildebrand (1865). The latter author found that the lever is formed by the connective that widens and separates the two thecae from each other. The upper connective arm always bears two pollen sacs and is usually placed below the upper lip of corolla, whereas the lower connective arm is often sterile and restricts access to nectar. An insect or bird searching for nectar pushes the barrier back and is thus loaded with pollen on its head, bill or back (Figure 5). During a subsequent visit to a flower of the same species, pollen can be transferred to the stigma, which at a more advanced flowering stage often assumes the position earlier occupied by the pollen sacs (Claßen-Bockhoff *et al.*, 2003).

Figure 5. Honey bee-*S. tchihatcheffii* interaction for pollination.

Stamens provide really important features for classification at all levels. Figure 6 gives a schematic representation of the main stamen types found in all *Salvia* species. Walker & Sytsma (2007) correlated their major clades of *Salvia* with stamen types from A to O. Similarly, Hedge (1982a) identified three stamen types for Turkish *Salvia* from A to C. Stamen types A (the simplest form is that shown in Figure 6 where both thecas are well-formed and fertile, although the lower one is smaller, and the connective is more or less equal in length to the filament such as the member of sect. *Salvia* and *Hymenosphace*) and B (the second form is that shown in Figure 6 where staminal connectives clearly longer than filaments; lower theca reduced to a

usually dolabriform plate of tissue such as sect. *Horminum, Aethiopis, Drymosphace* and *Plethiosphace*) of both accounts are equavelent, but stamen type C (staminal connectives longer than the filaments, lower theca subulate, sterile, stamens not articulating such as sect. *Hemisphace* (Figure 6) of Hedge (1982a) is superficially similar to stamen types C and H of Walker & Sytsma (2007). On the other hand, according to Walker & Sytsma (2007), *S. glutinosa* has stamen type N (both posterior thecae aborted, or expressed and producing little or no pollen). However, according to the Flora of Turkey (Hedge, 1982a), *S. glutinosa* has stamen type B. *S. aristata*, which has been recently found in Turkey (Behçet & Avlamaz 2009), has stamen type M (both posterior thecae expressed and not fused to one another). In the light of this information, I can say that Turkish *Salvia* species have 5 different stamen types. In the research area, the species have 4 of them, stamen types A, B, C & H and N.

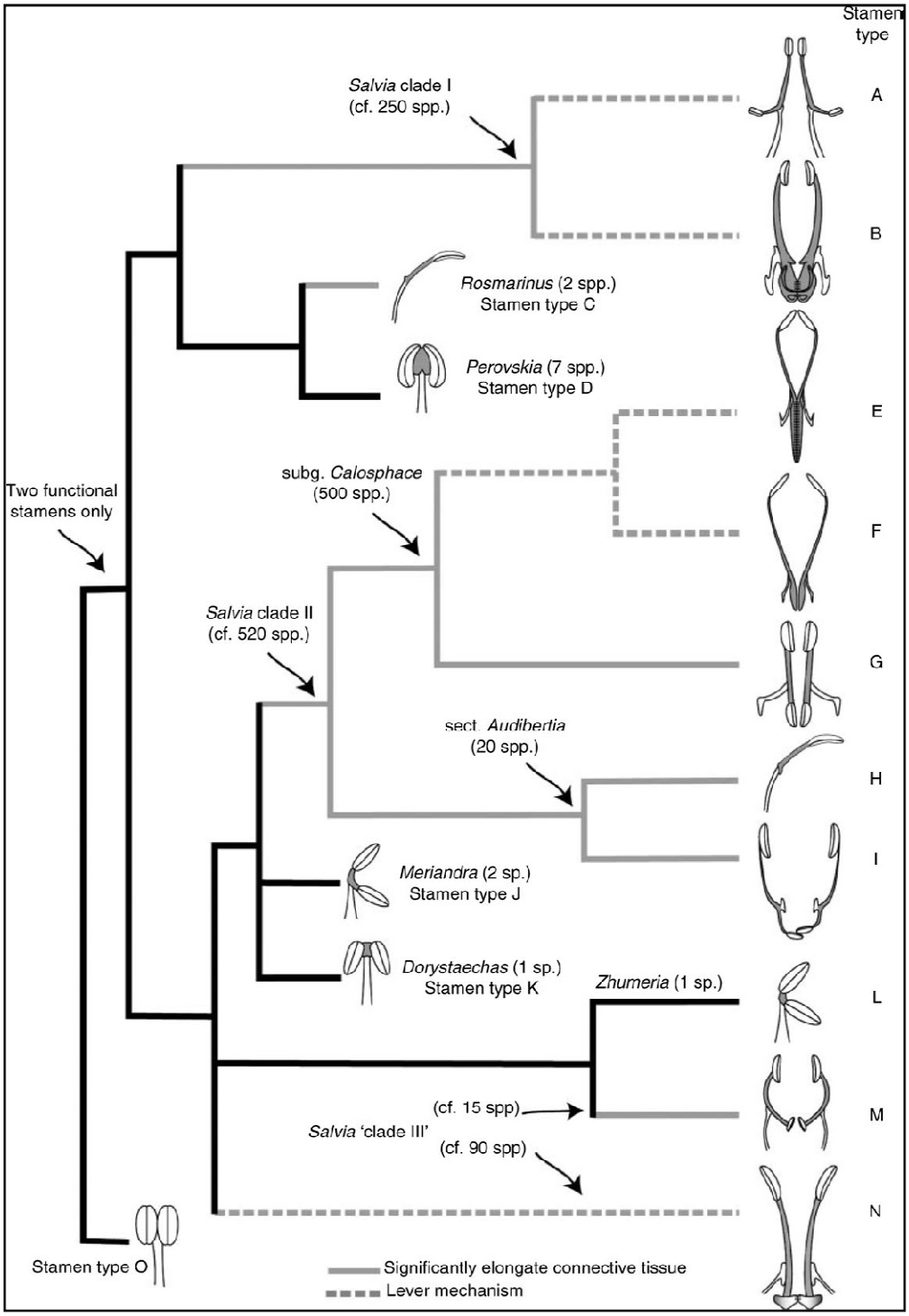

Figure 6. Stamens types (Walker & Sytsma (2007)

According to morphological studies, the most important diagnostic characteristics are generative characters such as calyx shape, corolla colour and shape. As well as, stamen features can be used distinguishing the infrageneric categories in the genus.

3.1.8. Chromosome numbers:

In the genus, the basic chromosome number is rather diverse ranging from 2n = 14 to 2n = 64 among the species. Only nine of 43 Turkish sages were found to be polyploid (Hedge, 1982a; Nakipoğlu, 1993). Below, chromosome numbers of the some species are given.

2n: **14** in *S. fruticosa* (14+1B, 14+2B)*, S. tomentosa, S. recognita, S.wiedemannii, S. albimaculata, S. heldreichiana, S. caespitosa, S. cadmica, S. smyrnaea, S. blepharochlaena* and *S. pomifera*. 2n: **15** in *S. heldreichiana*. 2n: **16** in *S. tomentosa* (16+1B, 16+2B)*, S. pisidica, S. potentillifolia, S. heldreichiana, S. cadmica, S multicaulis, S. cryptantha, S. viridis, S. chionantha, S. microstegia, S. chionantha, S. forskahlei, S. glutinosa, S. virgata* and *S. verticillata* subsp. *verticillata*. 2n: **18** in *S. tchihatcheffii, S. multicaulis* and *S. virgata*. 2n: **20** in *S. palaestina* and *S. frigida*. 2n: **21** in *S. frigida*. 2n: **22** in *S. syriaca, S. hypargeia, S. sclarea, S. chrysophylla, S. argentea, S. frigida, S. candidissima* subsp. *candidissima* and *S. vermifolia*. 2n: **24** in *S. syriaca, S. aethiopis* and *S. candidissima* subsp. *candidissima*. 2n: 32 in *S. cryptantha*, *S. multicaulis* and *S. napifolia*. 2n: **42** in *S. verbenaca* (2n: **46, 48, 59, 60, 64**) and 2n: **44** in *S. ceratophylla*.

3.2. Anatomy

The measurement results taken from cross-sections of the roots, stems, leaves and petioles of *S. pisidica*, *S. sericeo-tomentosa*, *S. viridis*, *S. chionantha*, *S. glutinosa*, *S. adenocaulon* and *S. napifolia* are presented (Tables 2-8). Moreover, their photographs in LM are given (Figures 7-33).

3.2.1. Root Anatomy

The cross-sections of the roots of the studied species show that the periderm layer on the outermost surface comprises squashed or breaking up. A multilayered cortex is present under the periderm. Schlerenchyma groups above several layered phloem consist of 4-10 or more cells Cambium is not distinguishable. The xylem rays consist of 1-12 layered cells. As the pith is occupied by the xylem, it is narrow.

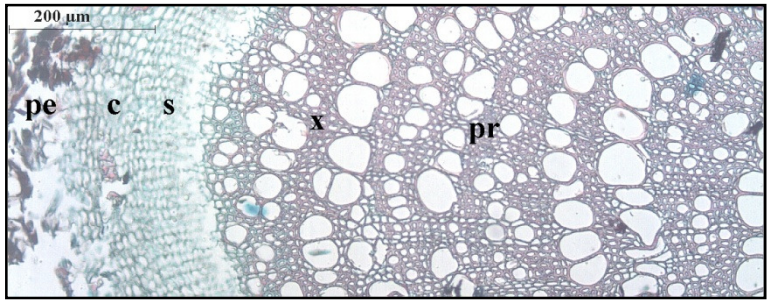

Figure 7. The transverse section of the root *S. pisidica*. pe: Periderm, c: Cortex, s: Sclerenchyma, P: Phloem, x: Xylem, pr: Pith ray.

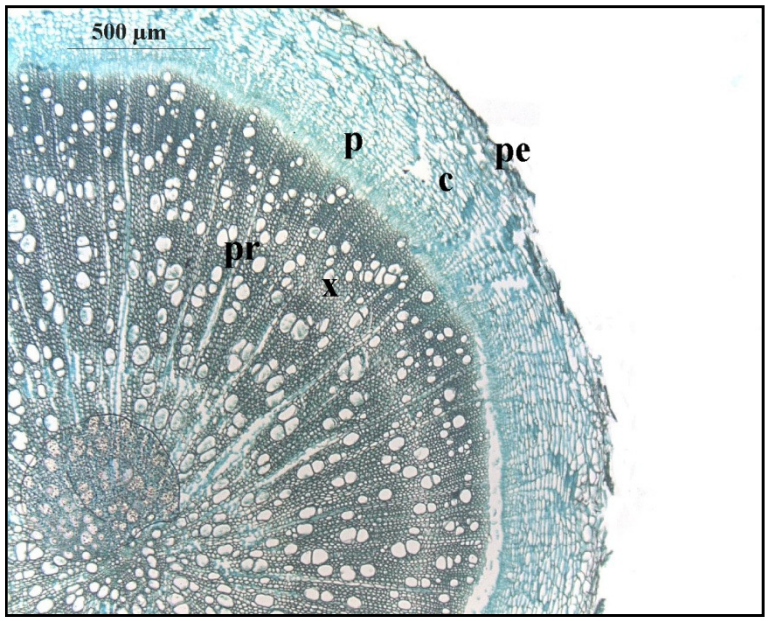

Figure 8. The transverse section of the root *S. viridis*. pe: Periderm, c: Cortex, s: Sclerenchyma, P: Phloem, x: Xylem, pr: Pith ray.

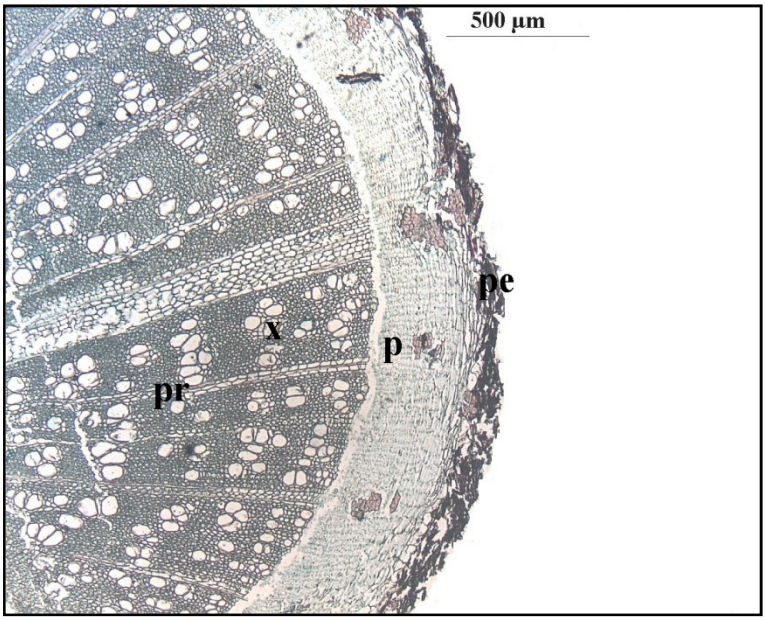

Figure 9. The transverse section of the root *S. chionantha*. pe: Periderm, c: Cortex, s: Sclerenchyma, P: Phloem, x: Xylem, pr: Pith ray.

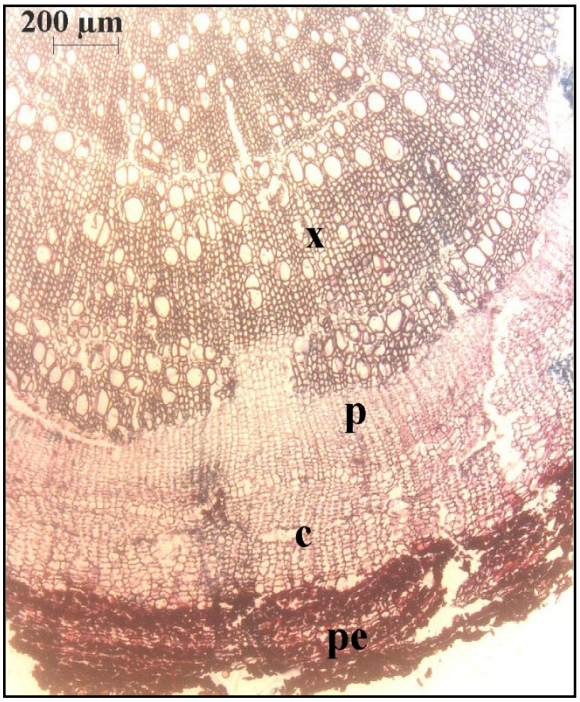

Figure 10. The transverse section of the root *S. glutinosa*. pe: Periderm, c: Cortex, s: Sclerenchyma, P: Phloem, x: Xylem, pr: Pith ray.

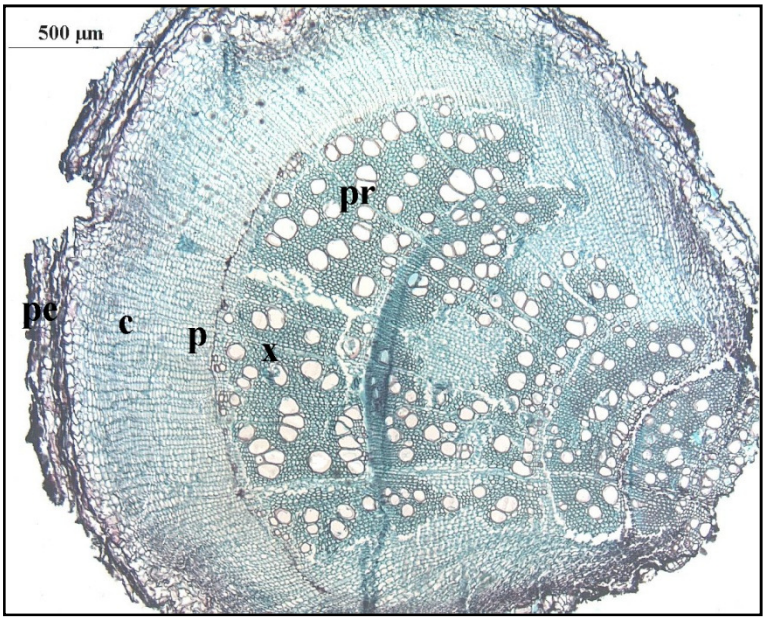

Figure 11. The transverse section of the root *S. adenocaulon.* pe: Periderm, c: Cortex, s: Sclerenchyma, P: Phloem, x: Xylem, pr: Pith ray.

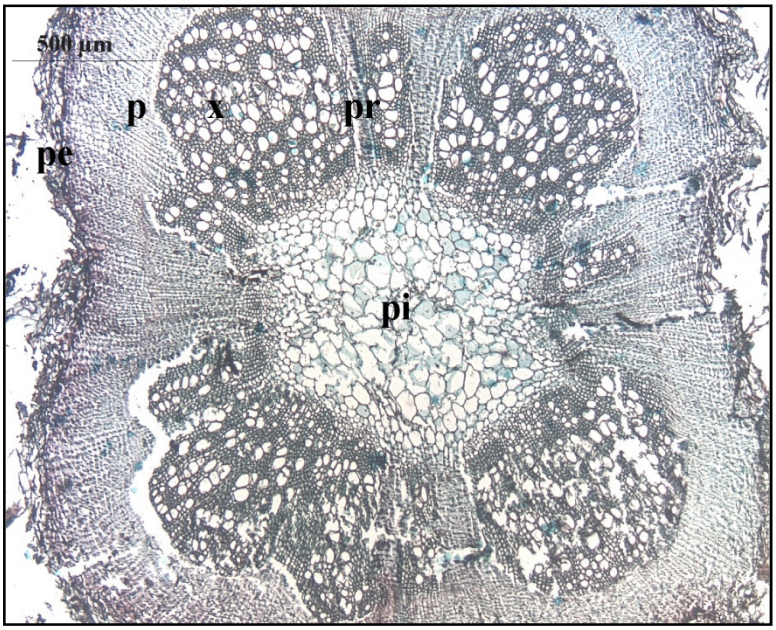

Figure 12. The transverse section of the root *S. napifolia*. pe: Periderm, c: Cortex, s: Sclerenchyma, P: Phloem, x: Xylem, pr: Pith ray, pi: Pith.

3.2.2. Stem Anatomy

The cross-sections of the stems of the studied species show that they are quadrangular or more or less circular in shape. A thin or thick cuticle (2-6 μm) covers the epidermis which comprises a single layer of oval, squarish or rectangular cells. At the corners, there are 1-9 layered collenchyma cells. Between the corners, there are 1-5 layered chlorenchyma cells. The cortex under the collenchyma consists of oval or rectangular cells with intercellular spaces. Vascular bundles are separated by parenchymatic cells or they are next to each other. Sclerenchymatous cells above the phloem are 4-30 or more layered. Cambium is not distinguishable. The xylem consists of trachea and tracheids. The trachea cells are mainly angular or oval. The pith is large and is composed of polygonal or orbicular parenchymatic cells often with large intercellular spaces.

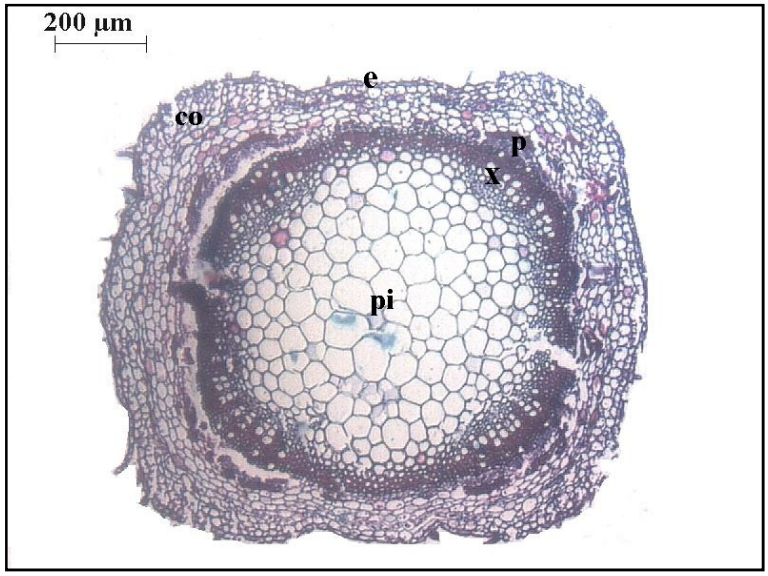

Figure 13. Transverse section of the stem of *S. pisidica*. cu: Cuticle, e: Epidermis, co: Collenchyma, c: Cortex, s: Sclerenchyma, p: Phloem, x: Xylem, pi: Pith region.

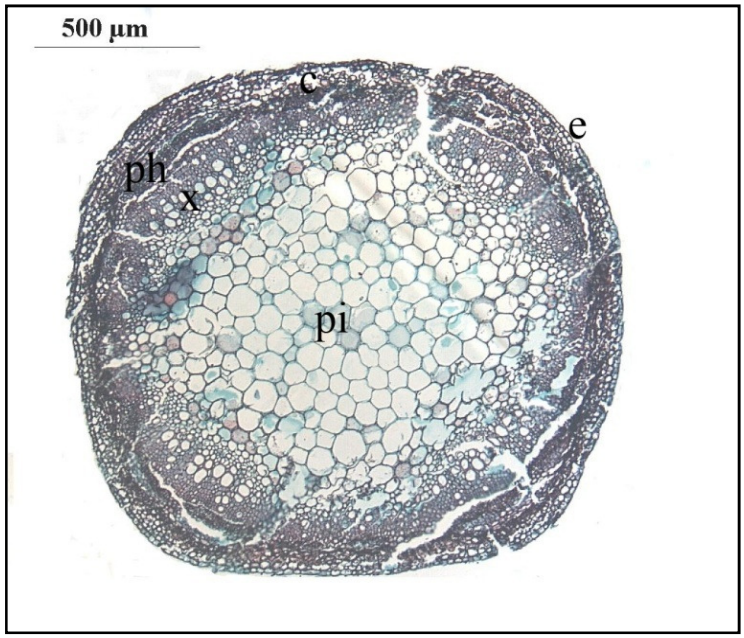

Figure 14. Transverse section of the stem of *S. sericeo-tomentosa* cu: Cuticle, e: Epidermis, co: Collenchyma, c: Cortex, s: Sclerenchyma, ph: Phloem, x: Xylem, pi: Pith region.

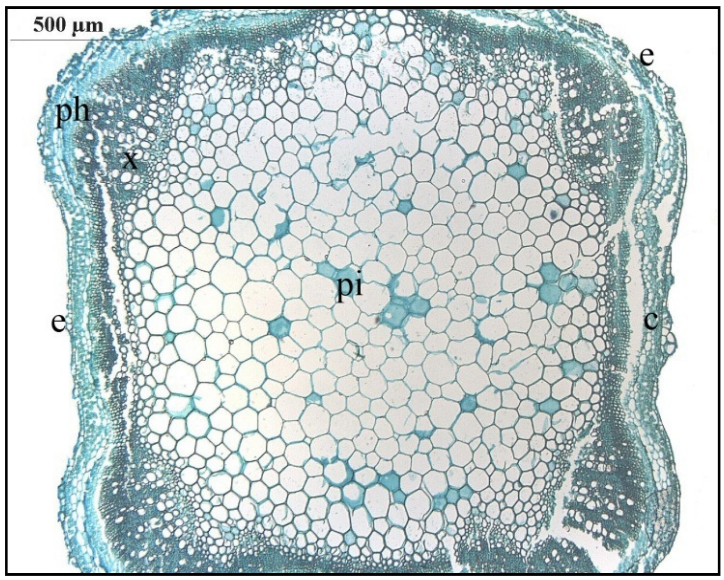

Figure 15. Transverse section of the stem of *S. viridis*. cu: Cuticle, e: Epidermis, co: Collenchyma, c: Cortex, s: Sclerenchyma, ph: Phloem, x: Xylem, pi: Pith region.

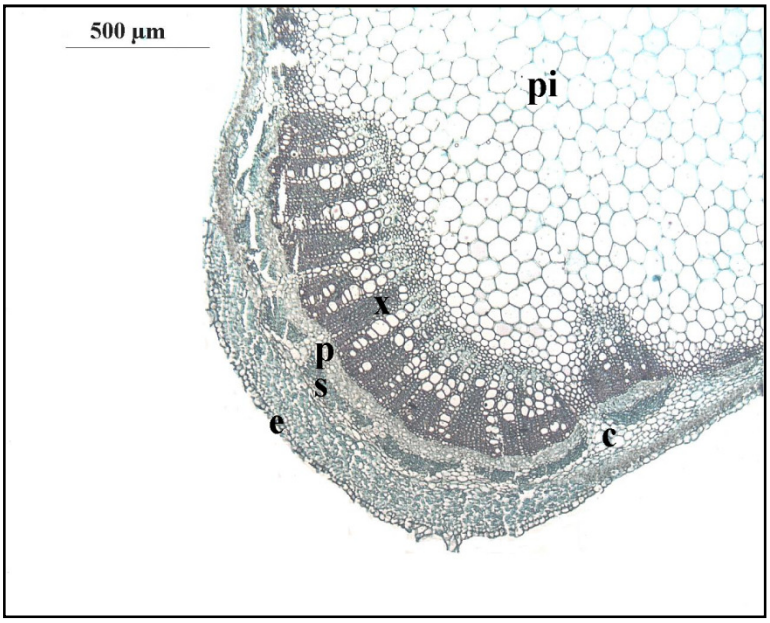

Figure 16. Transverse section of the stem of *S. chionantha*. cu: Cuticle, e: Epidermis, co: Collenchyma, c: Cortex, s: Sclerenchyma, p: Phloem, x: Xylem, pi: Pith region.

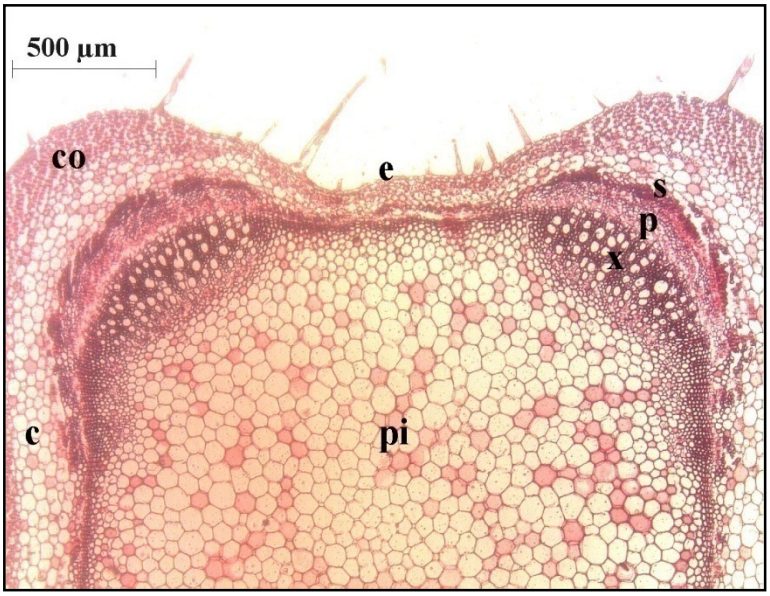

Figure 17. Transverse section of the stem of *S. glutinosa*. cu: Cuticle, e: Epidermis, co: Collenchyma, c: Cortex, s: Sclerenchyma, p: Phloem, x: Xylem, pi: Pith region.

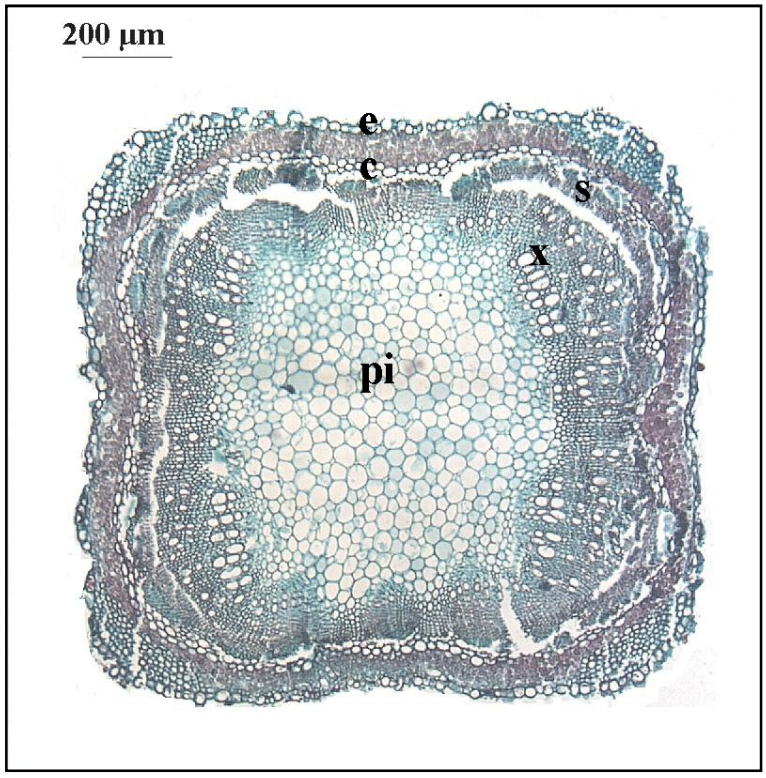

Figure 18. Transverse section of the stem of *S. adenocaulon*. cu: Cuticle, e: Epidermis, co: Collenchyma, c: Cortex, s: Sclerenchyma, x: Xylem, pi: Pith region.

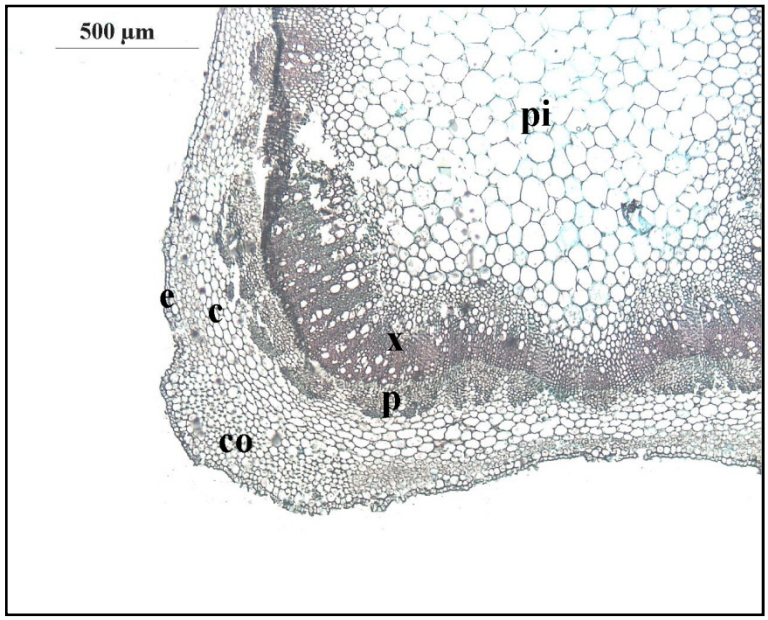

Figure 19. Transverse section of the stem of *S. napifolia*. cu: Cuticle, e: Epidermis, co: Collenchyma, c: Cortex, s: Sclerenchyma, p: Phloem, x: Xylem, pi: Pith region.

3.2.3. Leaf Anatomy

The cross-sections of the leaves of the studied species show that a thin or thick cuticle (1-6 µm) covers the upper epidermis and lower epidermis consisting of oval, rectangular or square cells. Size of the upper epidermis is larger than the lower epidermis or nearly equal to it. The type of the leaf is bifacial or equifacial. Mesophyll (80-270 µm) is composed of 1-4 layered palisade and spongy cells. The midrib region forms a projecting part or not. Below the uniseriate epidermis, there are several layers of collenchymatous cells providing support. Arc-shaped vascular bundles are surrounded by parenchymatic cells. There are one or two vascular bundles in the center and one or no small lateral bundles on each side.

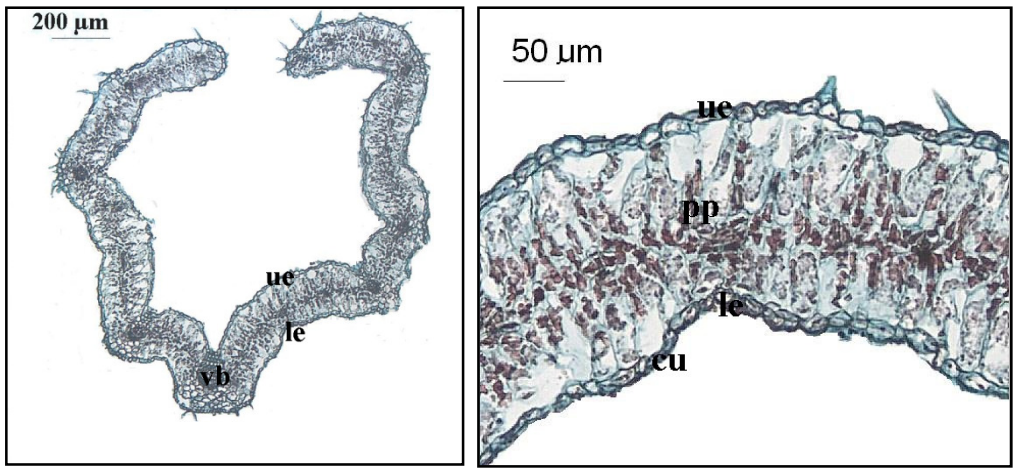

Figure 20. The transverse section of the leaf of *S. pisidica*. cu: Cuticle, eg: Eglandular hair, gh: Glandular hair, le: Lower epidermis, pc: parenchymatic cells, pp: palisade parenchyma, sp: Spongy parenchyma, ue: Upper epidermis, vb: Vascular bundle.

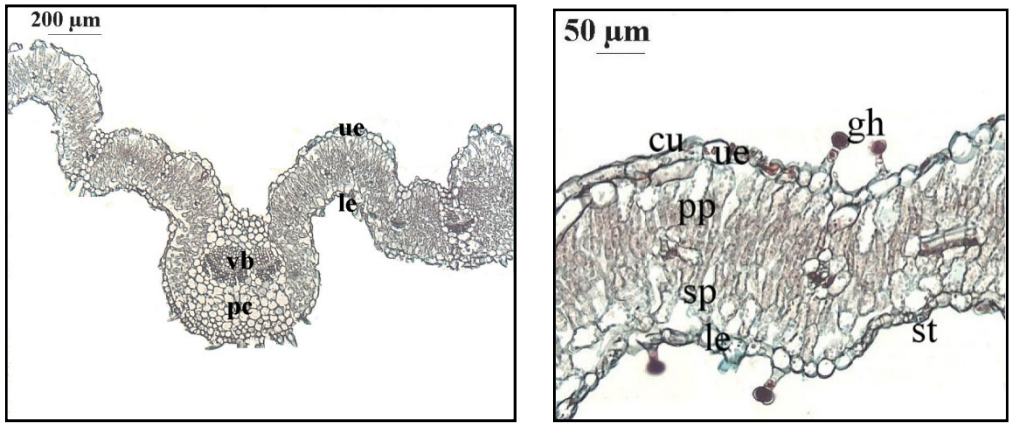

Figure 21. The transverse section of the leaf of *S. sericeo-tomentosa*. cu: Cuticle, eg: Eglandular hair, gh: Glandular hair, le: Lower epidermis, pc: parenchymatic cells, pp: palisade parenchyma, sp: Spongy parenchyma, ue: Upper epidermis, vb: Vascular bundle.

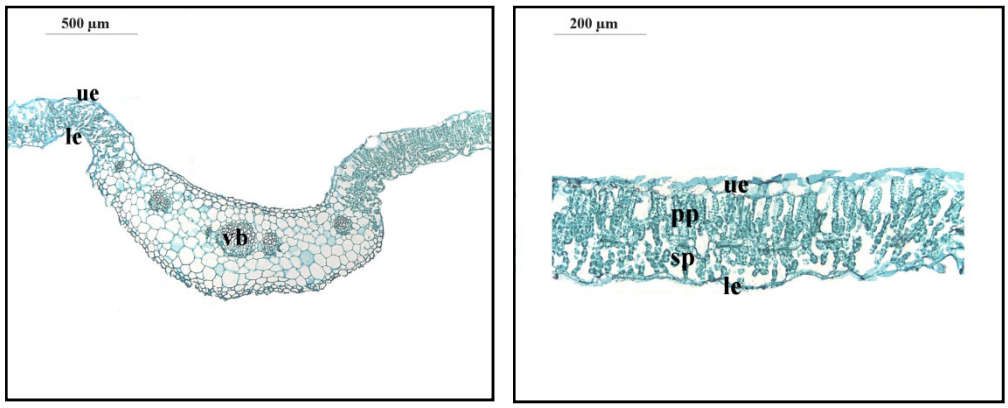

Figure 22. The transverse section of the leaf of *S. viridis*. cu: Cuticle, eg: Eglandular hair, gh: Glandular hair, le: Lower epidermis, pc: parenchymatic cells, pp: palisade parenchyma, sp: Spongy parenchyma, ue: Upper epidermis, vb: Vascular bundle.

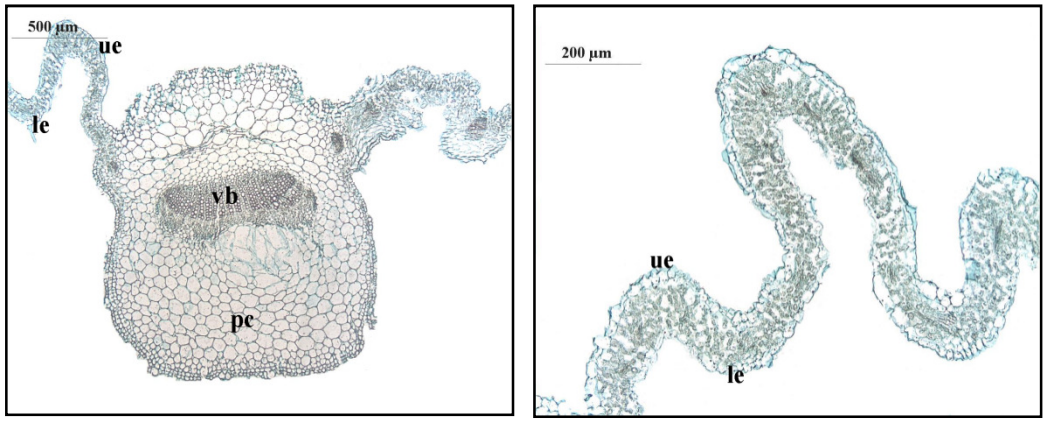

Figure 23. The transverse section of the leaf of *S. chionantha*. cu: Cuticle, eg: Eglandular hair, gh: Glandular hair, le: Lower epidermis, pc: parenchymatic cells, pp: palisade parenchyma, sp: Spongy parenchyma, ue: Upper epidermis, vb: Vascular bundle.

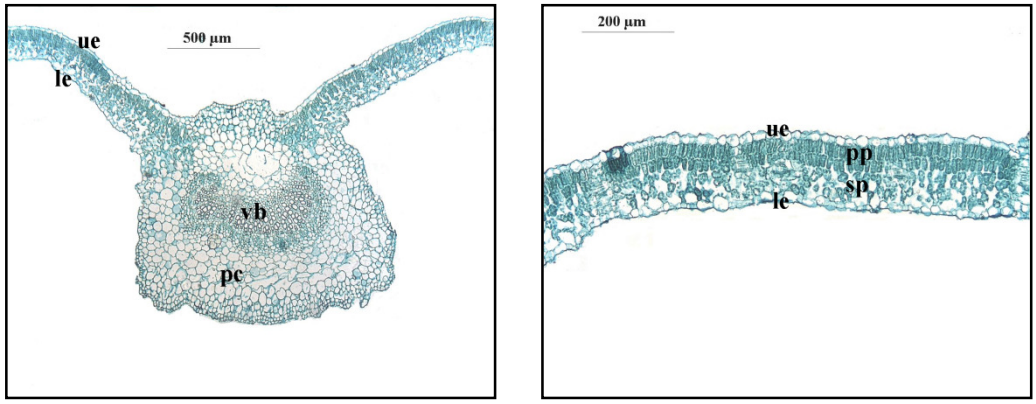

Figure 24. The transverse section of the leaf of *S. glutinosa*. cu: Cuticle, eg: Eglandular hair, gh: Glandular hair, le: Lower epidermis, pc: parenchymatic cells, pp: palisade parenchyma, sp: Spongy parenchyma, ue: Upper epidermis, vb: Vascular bundle.

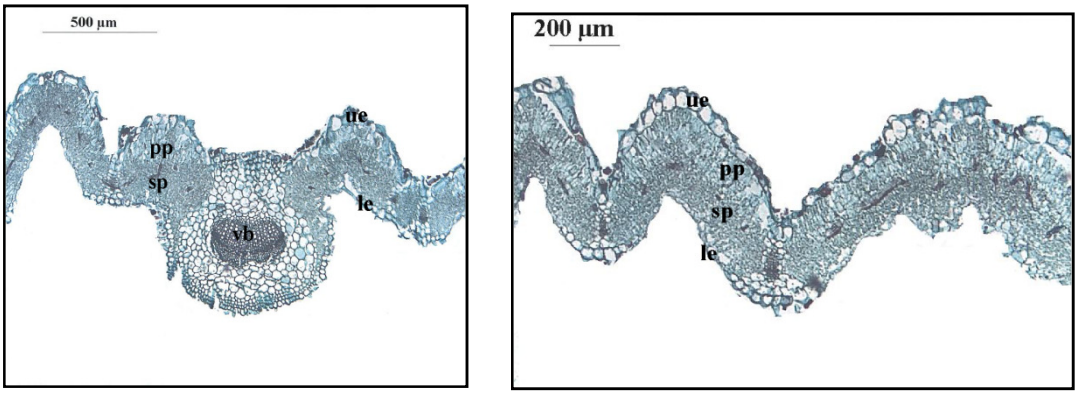

Figure 25. The transverse section of the leaf of *S. adenocaulon*. cu: Cuticle, eg: Eglandular hair, gh: Glandular hair, le: Lower epidermis, pc: parenchymatic cells, pp: palisade parenchyma, sp: Spongy parenchyma, ue: Upper epidermis, vb: Vascular bundle.

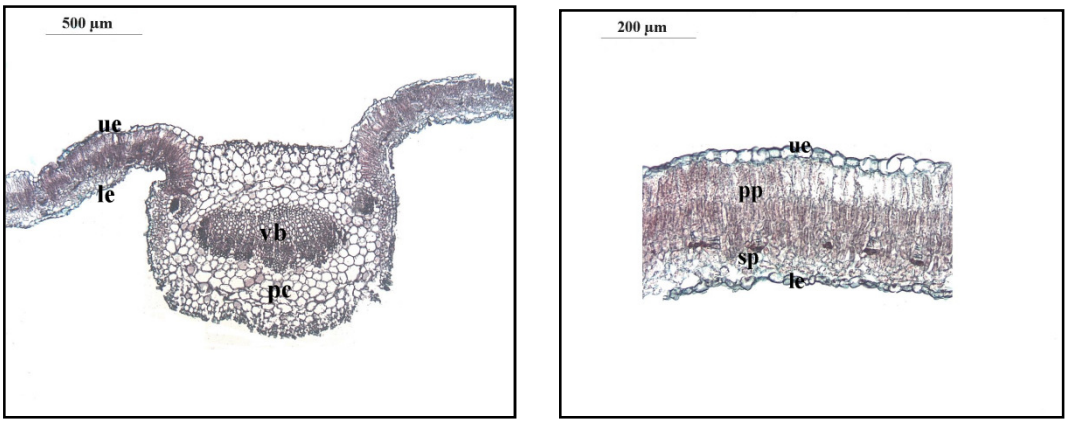

Figure 26. The transverse section of the leaf of *S. napifolia*. cu: Cuticle, eg: Eglandular hair, gh: Glandular hair, le: Lower epidermis, pc: parenchymatic cells, pp: palisade parenchyma, sp: Spongy parenchyma, ue: Upper epidermis, vb: Vascular bundle.

3.2.4. Petiole Anatomy

The transverse sections of the petiole of the studied species show that adaxial surface is concave or flat to convex and abaxial surface is convex. The adaxial epidermis cells are slightly larger than the abaxial epidermis cells or equal to them. Monoseriate epidermal cells of both surfaces are oval, square and nearly rectangular.

There is several layered collenchyma tissue under the epidermis. Shapes of parenchyma cells are hexagonal or nearly circular. Vascular bundles appear a shallow or deeply arc and they are the collateral type. The phloem and xylem are surrounded by the sclerenchyma tissue. There are one to four in the middle and two to eight on sides.

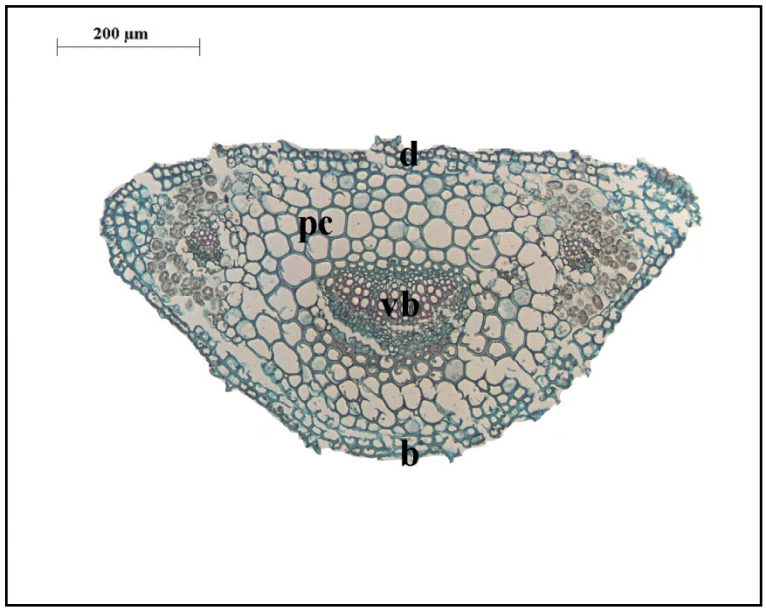

Figure 27. The transverse section of the petiole of *S. pisidica*. d: Adaxial epidermis, b: Abaxial epidermis, c: Cortex, vb: vascular bundle, pc: paranchymatic cells.

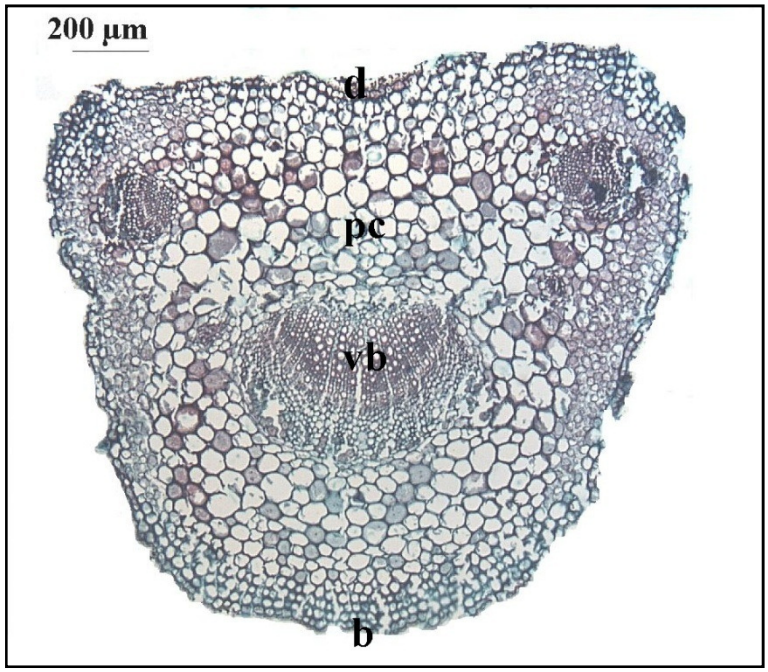

Figure 28. The transverse section of the petiole of *S. sericeo-tomentosa*. d: Adaxial epidermis, b: Abaxial epidermis, c: Cortex, vb: vascular bundle, pc: paranchymatic cells.

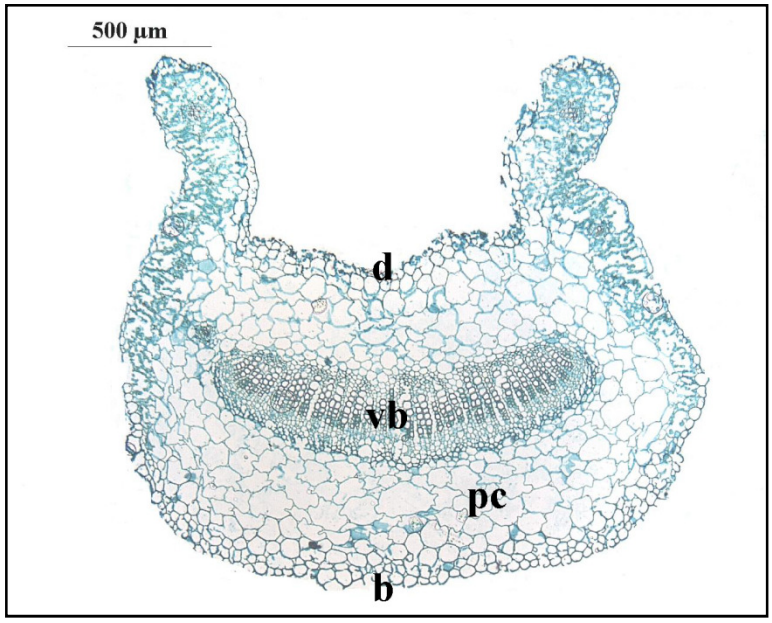

Figure 29. The transverse section of the petiole of *S. viridis*. d: Adaxial epidermis, b: Abaxial epidermis, c: Cortex, vb: vascular bundle, pc: paranchymatic cells.

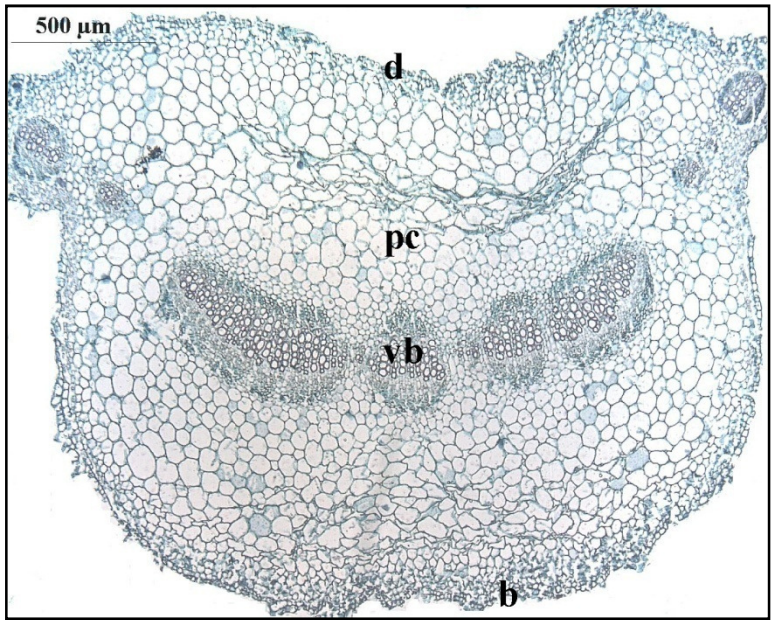

Figure 30. The transverse section of the petiole of *S. chionatha*. d: Adaxial epidermis, b: Abaxial epidermis, c: Cortex, vb: vascular bundle, pc: paranchymatic cells.

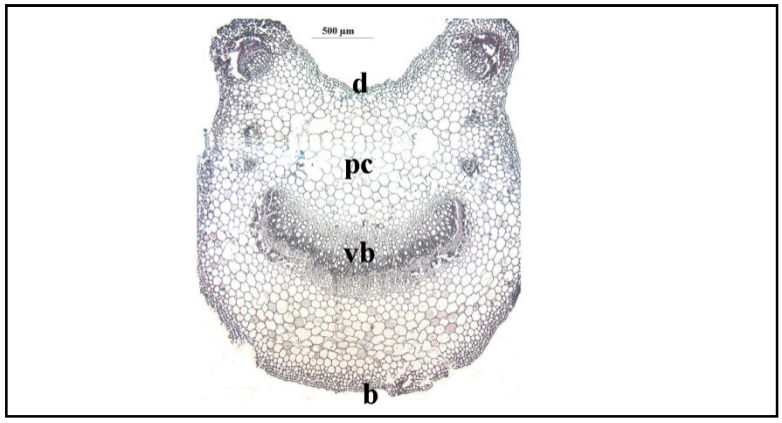

Figure 31. The transverse section of the petiole of *S. glutinosa*. d: Adaxial epidermis, b: Abaxial epidermis, c: Cortex, vb: vascular bundle, pc: paranchymatic cells.

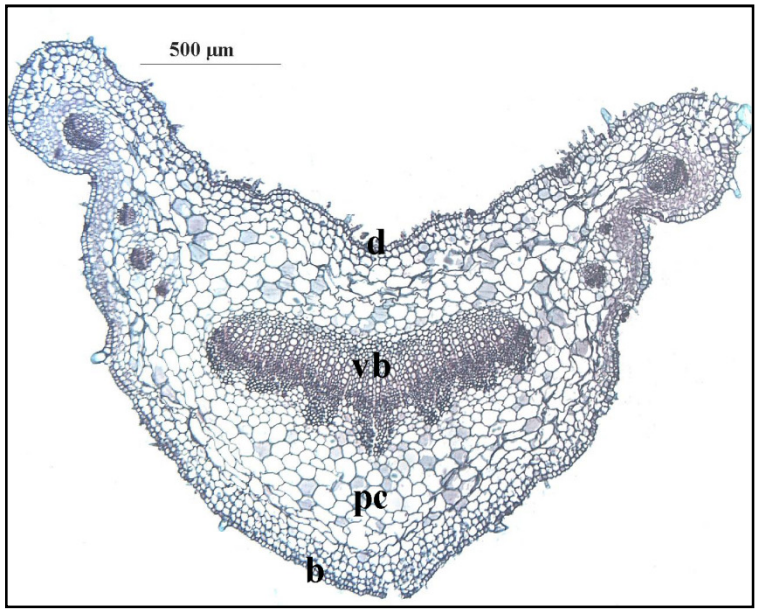

Figure 32. The transverse section of the petiole of *S. adenocaulon*. d: Adaxial epidermis, b: Abaxial epidermis, c: Cortex, vb: vascular bundle, pc: paranchymatic cells.

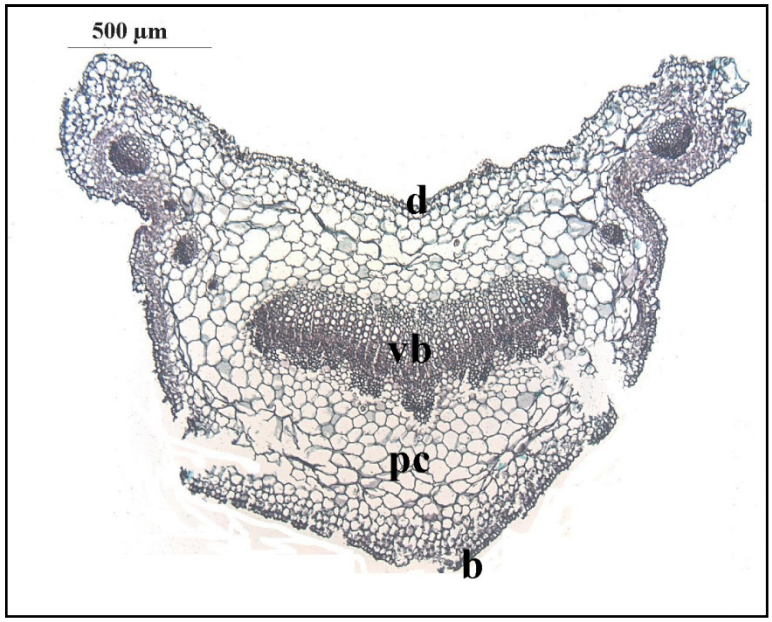

Figure 33. The transverse section of the petiole of *S. napifolia*. d: Adaxial epidermis, b: Abaxial epidermis, c: Cortex, vb: vascular bundle, pc: paranchymatic cells.

Table 2. Root, stem, leaf and petiole anatomy of *S. adenocaulon*

	Width (μm)	Length (μm)
	Min. - Max.	Min. - Max.
Root		
Trachea cell	25-78	25-73
Pith ray	8-15	25-53
Stem		
Cuticle	2.5-4	
Epidermis cell	12-35	12-30
Pith cell	15-60	15-60
Leaf		
Cuticle	3-5	
Upper Epidermis Cell	35-65	25-40
Lower Epidermis Cell	15-25	12-20
Petiole		
Abaxial Epidermis	10-20	10-15
Adaxial Epidermis	10-20	10-15

Table 3. Root, stem, leaf and petiole anatomy of *S. chionantha*.

	Width (μm)	Length (μm)
	Min. - Max.	Min. - Max.
Root		
Trachea cell	20-60	20-60
Pith ray	10-25	15-50
Stem		
Cuticle	3-4	
Epidermis cell	15-25	10-15
Pith cell	20-140	20-130
Leaf		
Cuticle	1.5-2	
Upper Epidermis Cell	10-35	10-20
Lower Epidermis Cell	8-25	6-15
Petiole		
Abaxial Epidermis	10-25	10-15
Adaxial Epidermis	10-25	10-15

Table 4. Root, stem, leaf and petiole anatomy of *S. glutinosa*

	Width (μm)	Length (μm)
	Min. - Max.	Min. - Max.
Root		
Trachea cell	30-70	30-80
Pith ray	-	-
Stem		
Cuticle	2-3	
Epidermis cell	10-30	10-15
Pith cell	30-100	20-100
Leaf		
Cuticle	1-3	
Upper Epidermis Cell	20-40	20-30
Lower Epidermis Cell	25-35	20-30
Petiole		
Abaxial Epidermis	15-35	15-20
Adaxial Epidermis	15-35	15-20

Table 5. Root, stem, leaf and petiole anatomy of *S. napifolia*

	Width (μm)	Length (μm)
	Min. - Max.	Min. - Max.
Root		
Trachea cell	15-50	15-60
Pith ray	-	-
Stem		
Cuticle	3-6	
Epidermis cell	8-20	8-15
Pith cell	30-130	30-130
Leaf		
Cuticle	3-6	
Upper Epidermis Cell	20-40	15-20
Lower Epidermis Cell	15-40	10-20
Petiole		
Abaxial Epidermis	10-20	8-15
Adaxial Epidermis	10-20	8-15

Table 6. Root, stem, leaf and petiole anatomy of *S. pisidica*

	Width (μm)	Length (μm)
	Min. - Max.	Min. - Max.
Root		
Trachea cell	15-60	15-65
Pith ray	4-8	8-20
Stem		
Cuticle	2-4	
Epidermis cell	10-25	7-15
Pith cell	15-80	15-80
Leaf		
Cuticle	2.5-3.5	
Upper Epidermis Cell	10-20	7-15
Lower Epidermis Cell	10-20	8-15
Petiole		
Abaxial Epidermis	8-20	6-14
Adaxial Epidermis	10-20	7-15

Table 7. Root, stem, leaf and petiole anatomy of *S. sericeo-tomentosa*.

	Width (μm)	Length (μm)
	Min. - Max.	Min. - Max.
Stem		
Cuticle	2.5-4	
Epidermis cell	15-30	7-12
Pith cell	30-100	30-100
Leaf		
Cuticle	2-3	
Upper Epidermis Cell	15-45	13-30
Lower Epidermis Cell	10-40	10-30
Petiole		
Abaxial Epidermis	10-30	8-25
Adaxial Epidermis	10-30	8-25

Table 8. Root, stem, leaf and petiole anatomy of *S. viridis*

	Width (μm)	Length (μm)
	Min. - Max.	Min. - Max.
Root		
Trachea cell	15-75	15-80
Pith ray	6-20	18-25
Stem		
Cuticle	2-3	
Epidermis cell	15-50	8-30
Pith cell	30-150	30-150
Leaf		
Cuticle	2-4	
Upper Epidermis Cell	10-40	8-25
Lower Epidermis Cell	10-40	8-25
Petiole		
Abaxial Epidermis	15-55	10-35
Adaxial Epidermis	15-80	10-60

According to our anatomical studies on the genus *Salvia*, they appear to have important taxonomic value in separating some sections of *Salvia* because of variation in number of pith rays of root cross-sections. *S. pisidica* (sect. *Salvia*), *S. viridis* (sect. *Horminum*) and *S. adenocaulon* (sect. *Plethiosphace*) roots have 1-4 layered pith rays whereas *S. chionantha* (sect. *Aethiopis*) roots have more layers of pith rays (up to 12).

Metcalfe and Chalk (1950) stated that the stems of some genera of Labiatae species are quadrangular and have collenchyma cells occupying a broad area of the corners. They also reported that scleranchymatic tissue encircles the vascular tissue. We observed same anatomical features in the studied species. Our anatomical studies show that the stems of all the species are quadrangular except for those of *S. sericeo-tomentosa* more or less circular. Also, *S. pisidica* stems has 1-2 layered collenchyma and chlorenchyma cells, but the others' stems are more layered collenchyma and chlorenchyma cells.

Leaf mesophyll of *Salvia* species is entirely parenchymatic and the midrib is surrounded by collenchymatous cells (Metcalfe and Chalk, 1950). The upper epidermis cells of *S. adenocaulon* are clearly larger than the lower epidermis cells, but the upper epidermis cells of the other species are nearly equal to the lower. Regarding the mesophyll structure, *S. pisidica* leaves are monofacial, *S. chionantha* leaves are equifacial and the leaves of the other species are bifacial. Also, the mesophyll of *S. chionantha* is much smaller that of the other species. While mesophyll in *S. chionantha* is 55-100 μm, mesophyll in *S. adenocaulon* 120-230 μm, *S. glutinosa* 140-165 μm, *S. napifolia* 180-270 μm, *S. pisidica* 120-190 μm, *S. sericeo-tomentosa* 130-220 μm and *S. viridis* 135-200 μm. Regarding the midrib structure, the midrib forms a projecting part in other species except for *S. viridis*. Also, there are five or six vascular bundles in the midrib of *S. viridis*. There are one or two vascular bundles in the center of the midrib of the other species, but there are one or two small vascular bundles on the wings or not.

The structure of the vascular bundles in the petiole of the studied species could be used as a diagnostic feature. In the petiole of *S. pisidica*, *S. sericeo-tomentosa* and *S. viridis*, there is one large bundle in the center and there is one small subsidiary bundle on each wing. In the petiole of *S. chionantha*, there are four large bundles in the center and there are two small subsidiary bundles on each wing. In the petiole of *S. glutinosa*, *S. adenocaulon* and *S. napifolia*, there is one large bundle in the center and there are three or four small bundles on each wing. Vascular bundles of *S. pisidica* and *S. sericeo-tomentosa* are deeply crescentiform in shape, but those of the other species are shallow crescentiform in shape. The adaxial surface of *S. pisidica*, *S. sericeo-tomentosa*, *S. viridis* and *S. chionantha* are flat to convex, but the adaxial surface of *S. glutinosa*, *S. adenocaulon* and *S. napifolia* are concave.

3.3 Scanning Electron Microscopy (SEM) Studies

3.3.1. Trichome Micromorphology

Glandular trichomes are usually distributed over the aerial reproductive and vegetative organs of the *Salvia* species. They are the primary secretory organs of the plants. The essential oil produce by these glandular trichomes may act to protect the aerial parts of the plants against herbivores and pathogens (Werker, 1993), and the biological activity of the secondary metabolites in the secreted products is of the interest to the pesticide, pharmaceutical, flavouring and fragrance industries (Duke, 1994, Serrato-Valenti *et al.*, 1997). Hallahan (2000) and Werker (2000) studied glandular trichomes of the Labiatae. They recognized them as peltate and capitate hairs. Their morphology, ultrastructure, type and release of secretation were studied by Serrato-Valenti *et al.* (1997) and Bisio *et al.* (1999).

Indumentum characteristics of stem, leaf, inflorescence axis and calyx are useful at specific level. In this study, mainly three different trichome types and their subtypes on stems, inflorescence axis, leaves, petioles and calyces were observed: peltate, capitate glandular and non-glandular trichomes (Kahraman *et al*., 2010c).

The peltate glandular trichomes are composed of a basal epidermal cell, a very short monocellular stalk and a broad, round multicellular secratory head consisting of four or twelve cells (one or four central cells surrounded by four or eight peripheral cells) in a single shield (Figures 34-36).

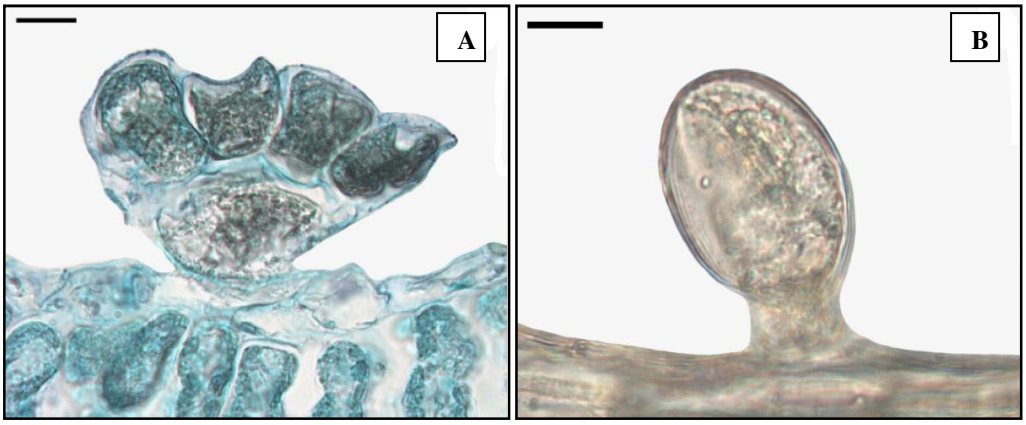

Figure 34. A- Peltate glandular trichomes on the leaf abaxial surface, B- Peltate glandular trichomes on the stem. Bars= 10 µm.

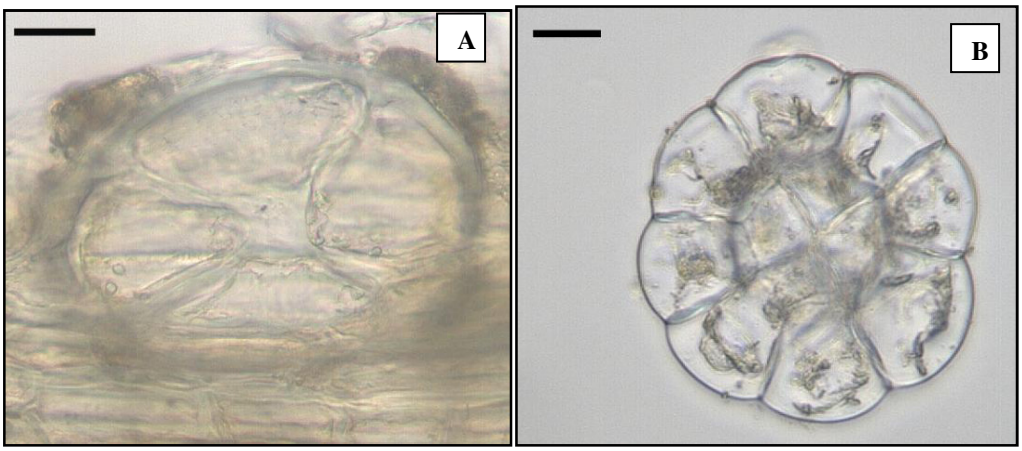

Figure 35. A- Peltate glandular trichomes on the inflorescence axis head consisting of four cells, B- Type A peltate glandular trichomes on the calyx head consisting of twelve cells. Bars= 10 µm.

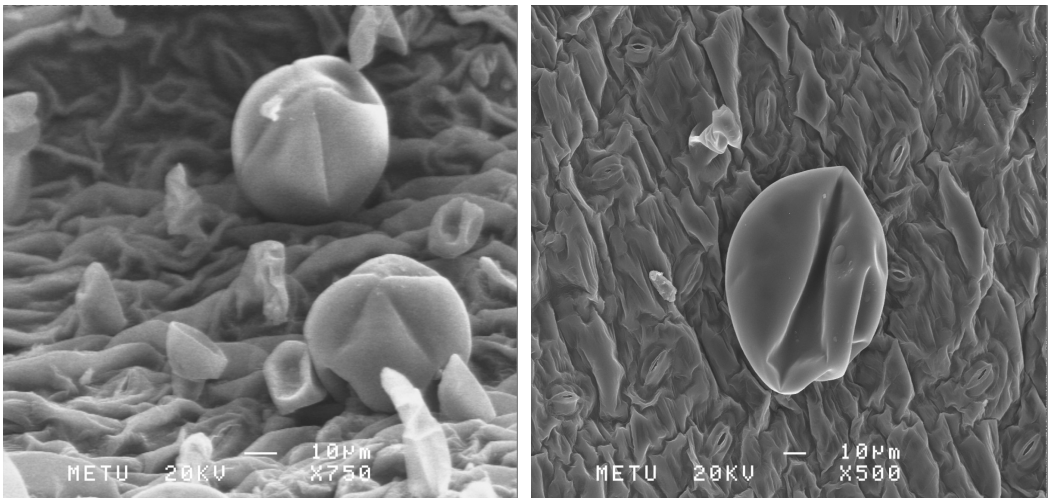

Figure 36. SEM photos of the peltate glandular trichomes

The capitate glandular trichomes are composed of a basal epidermal cell, unicellular to multicellular stalk of variable length (5-2500 µm), a neck cell (3-30 µm) and a large, cutinized, unicellular or bicellular secratory head (Figures 37-43). These trichomes can be mainly subdivided into four subtypes. Type I: A globose unicellular or bicellular head and one to four stalked (30-900 µm). A large percentage of these trichomes have one head cell. Type II: A cup-shaped unicellular head and one to five-celled stalk (35-2000 µm). Type III: A hemispherical unicellular head and a unicellular or bicellular stalk, rarely three-celled on the inflorescence axis (35-500 µm). Type IV: An ovoid unicellular head and a short unicellular stalk (15-120 µm), sometimes bicellular stalk (up to 150 µm) on both surfaces of the leaves.

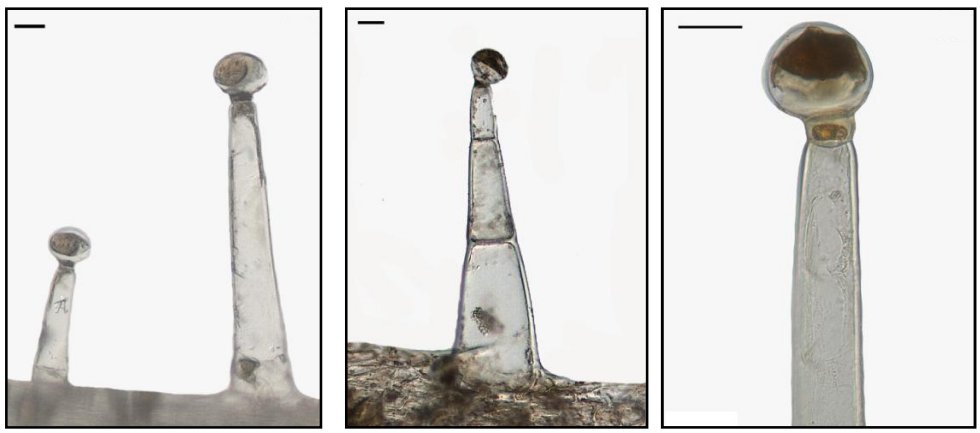

Figure 37. The capitate glandular trichomes Type I. Bars= 30 µm.

Figure 38. The capitate glandular trichomes Type II. Bars= 30 µm.

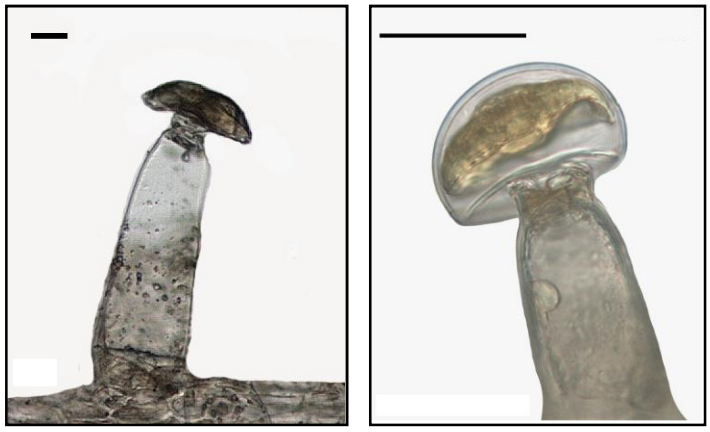

Figure 39. The capitate glandular trichomes Type III. Bars= 30 µm.

Figure 40. The capitate glandular trichomes Type IV. Bars= 30 µm.

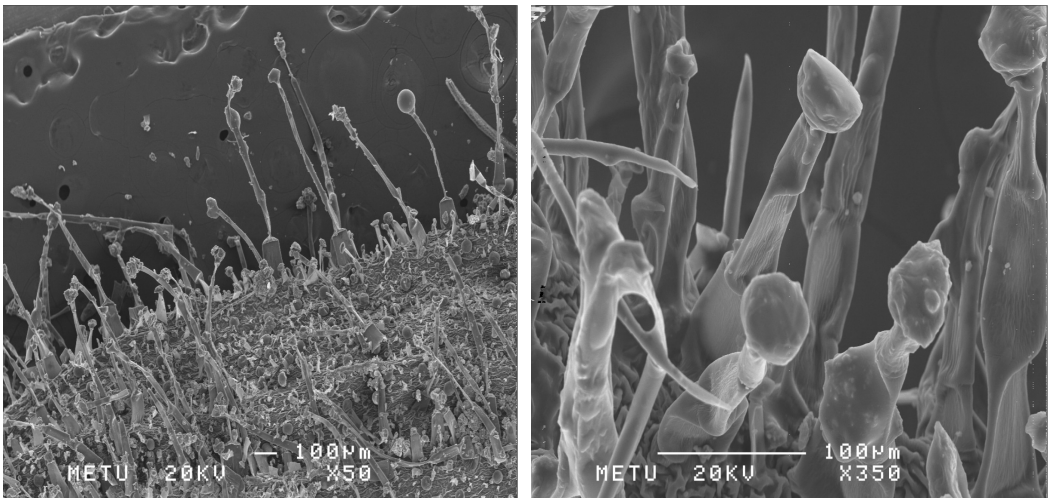

Figure 41. SEM photos of capitate glandular trichomes Type I.

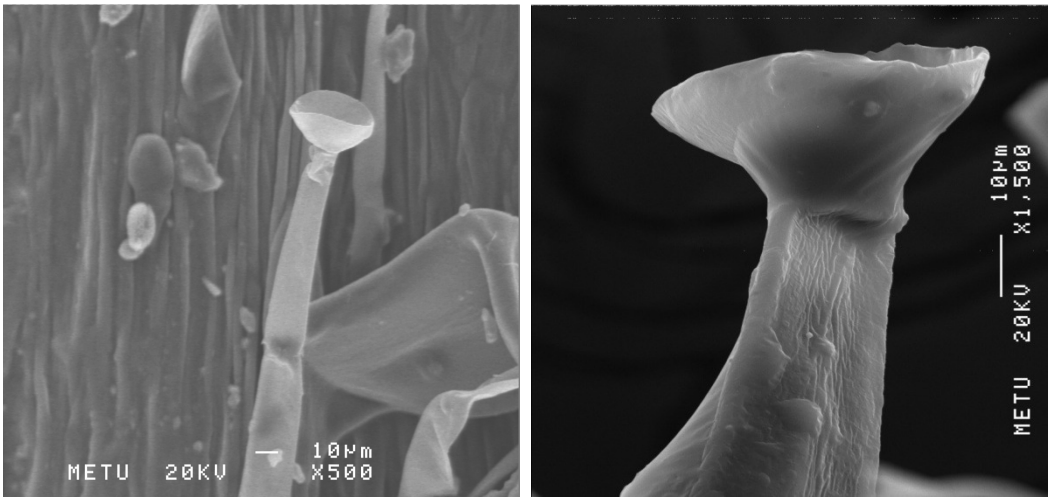

Figure 42. SEM photos of capitate glandular trichomes Type II.

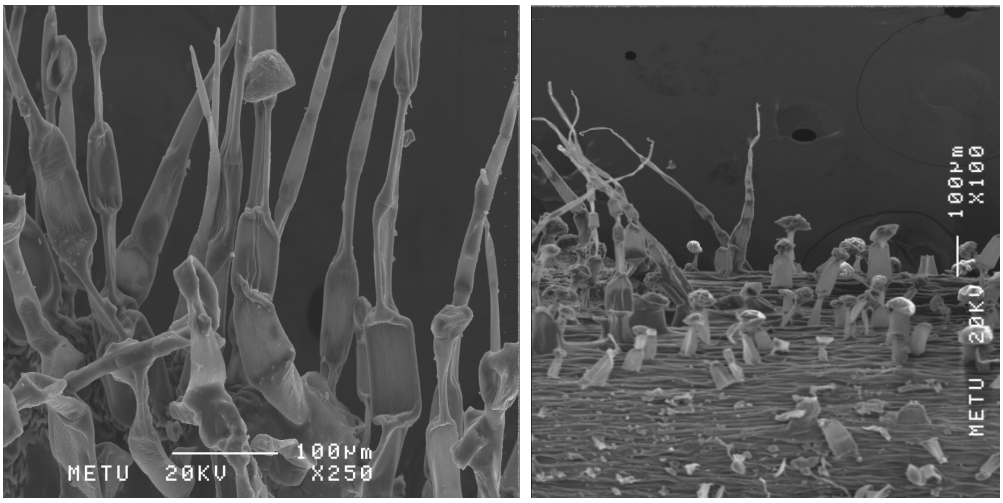

Figure 43. SEM photos of capitate glandular trichomes Type III.

The non-glandular trichomes composed of one to three or more basal epidermal cells are unicellular to multicellular, uniseriate, unbranched (Figures 44-49). They are quite variable in length (5-8000 µm). Their cell walls contain micro-papillae or not. These trichomes can be mainly subdivided into three subtypes. Type I: One to three basal epidermal cells and unicellular to multicellular (up to seven) acicular trichomes in a single order. Especially, unicellular trichomes are thick-walled and densely covered by micro-papillae. These trichomes vary in length between 50 and 1000 µm. Multicellular trichomes are curved or straight at the tip. Type II: One basal epidermal cell, multicellular (up to thirteen), uniseriate flagelliform trichomes with the distal end of the terminal cells delicate and much elongated. Their lengths are 1500-4500 µm (Figure 45). Type III: One basal epidermal cell and multicellular (five to eight) trichomes with ridges and marked internodes. These trichomes are between 500 and 1400 µm long (Figure 46).

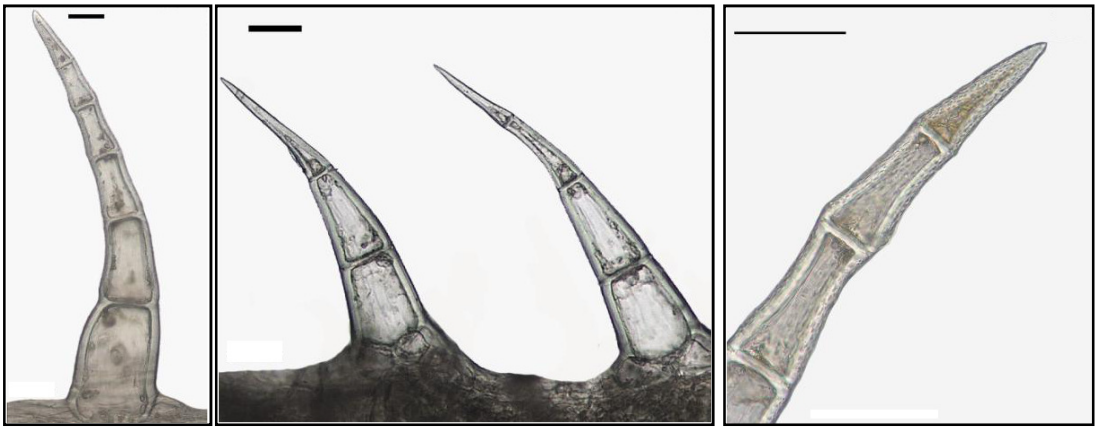

Figure 44. The non-glandular trichomes Type I. Bars= 50 µm.

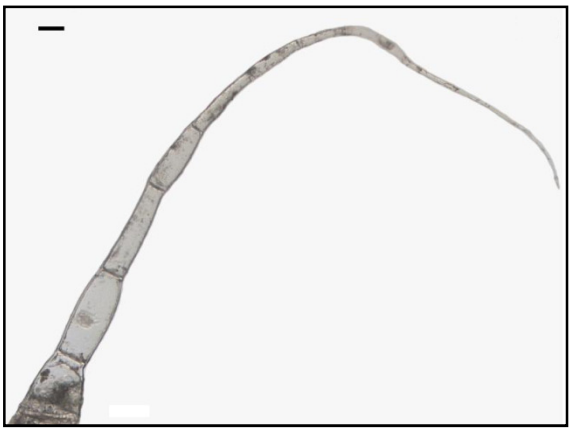

Figure 45. The non-glandular trichomes Type II. Bars= 50 µm.

Figure 46. The non-glandular trichomes Type III. Bars= 50 µm.

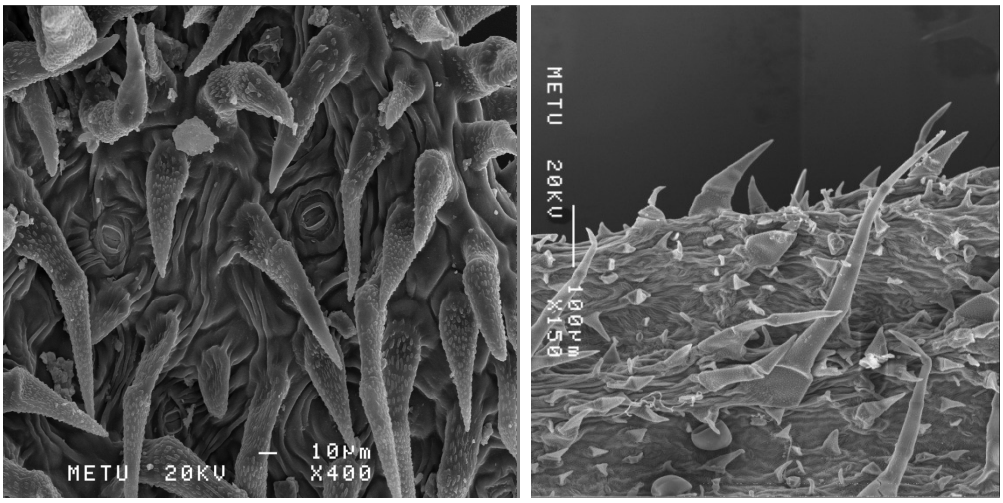

Figure 47. SEM photos of the non-glandular trichomes, pectinate and retrorse hairs.

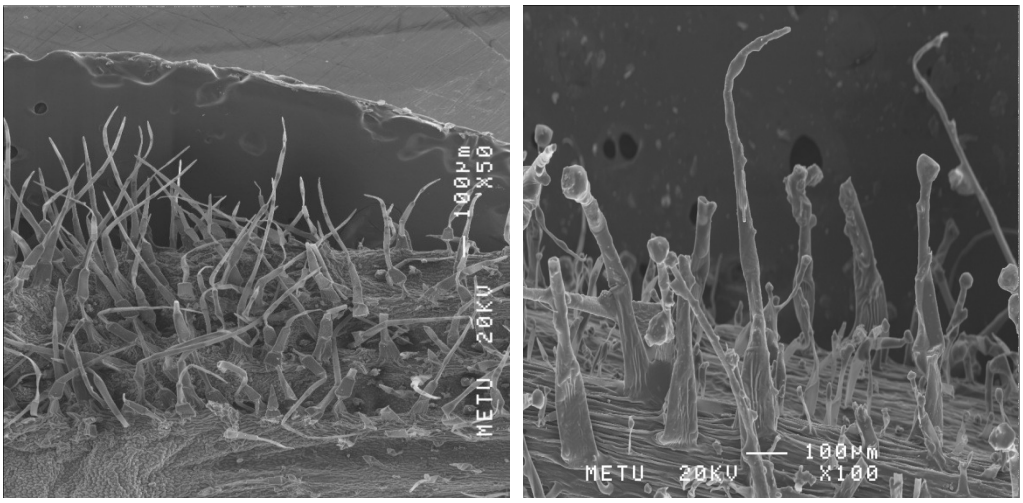

Figure 48. SEM photos of the non-glandular trichomes, pilose hairs.

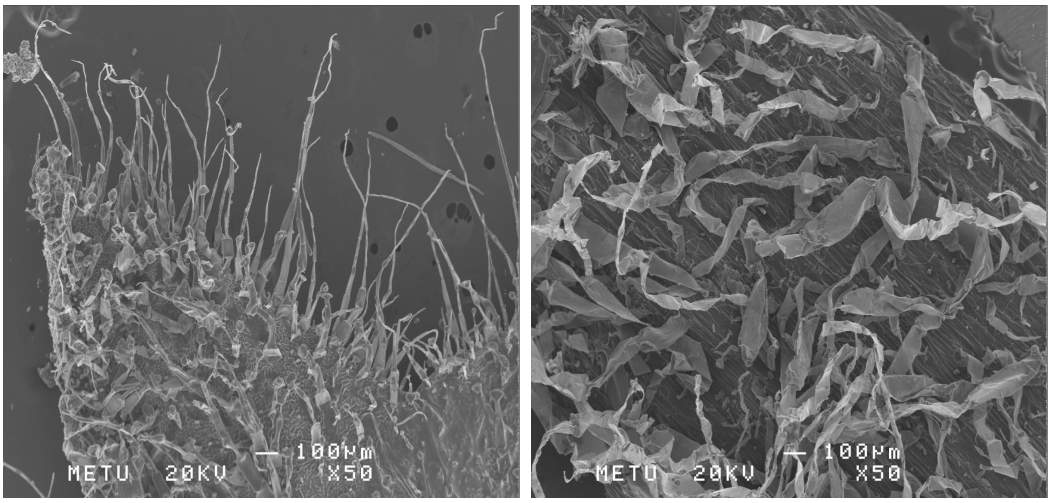

Figure 49. SEM photos of the non-glandular trichomes, villous and lanate hairs.

On the other hand, the non-glandular trichomes can also be divided as pectinate, tomentose, pilose, villous, lanate, antrorse and retrorse according to their morphological properties. As well as, dendroid hairs can be seen on the stem of *S. cryptantha*.

In a very few species, such as *S. viscosa*, *S. pilifera* and *S. tigrina* the leaves are more or less glabrous but in the great majority of species the indumentum is very prominent and varies.

The differences and types of indumentum that occur on upper and lower leaf surfaces, stems, inflorescence and on the calyx often provide diagnostic characters.

3.3.2. Pollen Micromorphology

The main features of the investigated pollen grains are summarized in Table 9. Selected SEM micrographs of pollen grains studied are presented in Figures 50-61. The basic shape of the pollen grains in most taxa studied is suboblate, oblate and spheroidal and their subgroups. The ratio of P/E is between 0.81 and 1.08. The most frequent aperture form is 6-colpate and rarely 8-colpate, radially symmetrical and isopolar. The shape is mostly circular in polar view and circular to oval in equatorial view.

The exine pattern is reticulate or bireticulate. Regarding the muri thickness, reticulation shape and the number of lumina, pollen grains were grouped below. Among the reticulate taxa, the reticule number is between 3 and 23 in 5 µm ^{2}, reticule diameter is 0.83-4.42 µm and muri width is 0.20-0.62 µm. However among the bireticulate taxa, seconder reticule number is 1-34, reticule diameter is 0.35-1.62 µm and muri width 0.10-0.32 µm. Among the examined taxa, the size of pollen grain ranges from P x E: 56.96 ± 3.56 x 57.51 ± 3.41 - 28.42 ± 0.87 x 30.72 ± 1.00 µm. The biggest pollen grains are observed in *S. smyrnae* and *S. candiddissima* ssp. o*ccidentalis* and the smallest pollen grains are observed in *S. russellii*, *S. sclarea*, *S. verticillata* subsp. *amasiaca* and *S. virgata*. Colpi are wide and long and their tips are round. Colpus surface is verrucate, scabrate, granulate or granulate-gemmate. Similary, the longest colpus is observed in *S. smyrnaea* and the smallest one is observed in *S. sclarea*. The length of colpus ranges from (Clg) 26.8 ± 1.84 to 49.39 ± 3.27 and the width ranges from (Clt) 3.37 ± 0.48 to 8.64 ± 1.17 µm. The exine thickness is 0.81 ± 0.09-1.80 ± 0.10 µm and the intine thickness is 0.49 ± 0.05 - 1.10 ± 0.2 µm.

According to SEM micrographs, exine sculpturing

Type 1: Ornamentation reticulate

Muri smooth, reticule number is between 4 and 14 in 5 µm ^{2}: *S. aramiensis*, *S. bracteata*, *S. cedronella*, *S. recognita*, *S. pilifera*, *S. potentilifolia*, *S. tchihatcheffii*

Type 2: Ornamentation bi-reticulate

2.A.Primary lumina prolonged:

2.A.1. Secondary lumina number is less than 10: *S. adenophylla*

2.A.2. Secondary lumina number is bigger than 10: *S. candidissima* subsp. *candidissima*

2.B. Primary lumina angular

2.B.1. Secondary lumina developed

2.B.1.1. Secondary lumina number between 5 and 8: *S. chrysopyhlla*

2.B.1.2. Sekondary lumina number between 13 and 18: *S. cilicica*, *S. palaestina*, *S. cyanescens*, *S. candidissima* subsp. *occidentalis*

2.B.2. Sekondary lumina undeveloped: *S. ceratophylla, S. pisidica*, *S. sericeo-tomentosa*

2.C. Primary lumina prolonged-angular

2. C.1. Secondary lumina number between 3 and10:

2.C.1.1. Seconder lumina diameter 0.30-0.60 µm:

2.C.1.1.1. Primary muri smooth: *S. pomifera, S. albimaculata*, *S. verticillata* ssp. *amasiaca*, *S. suffruticosa, S. wiedemannii*, *S. microstegia*, *S. frigida*, *S. smyrnaea*, *S. marashica*, *S. russellii*, *S. multicaulis, S. cryptantha*, *S. viridis*

2.C.1.1.2. Primary muri sinuate: *S. aucheri* subsp. *aucheri*, *S. frigida*

2.C.1.2. Secondary lumina diameter 0.61-1.00 µm: *S. caespitosa*, *S. aethiopis, S. dichronantha, S. chionantha, S. yosgadensis*, *S. glutinosa S. blepharochleana*

2.C.1.3. Secondary lumina diameter bigger than1.00 µm: *S. cadmica*, *S. indica*

2.C. 2 Secondary lumina number bigger than 10

2.C.2.1. Secondary muri 0.10-0.20 µm: *S. indica*

2.C.2.2. Secondary muri bigger than 0.20µm: *S. virgata*, *S. fruticosa*, *S. heldreichiana*, *S. nydeggerii S. hypargeia*

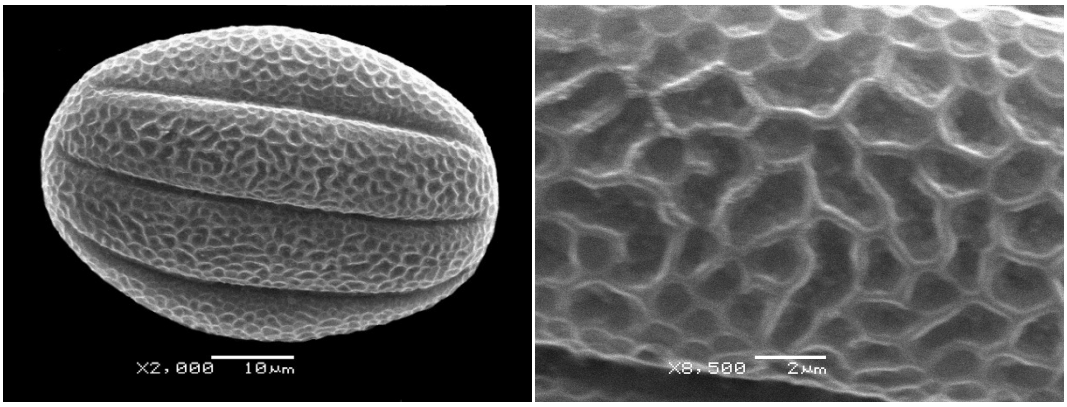

Figure 50. SEM micrographs of pollen grains in *S. cedronella*, Type 1

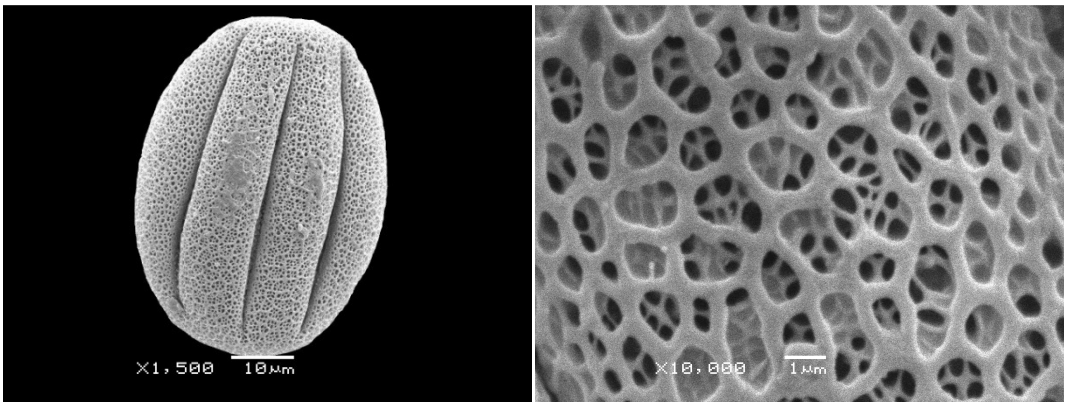

Figure 51. SEM micrographs of pollen grains in *S. adenophylla*, Type 2.A.1.

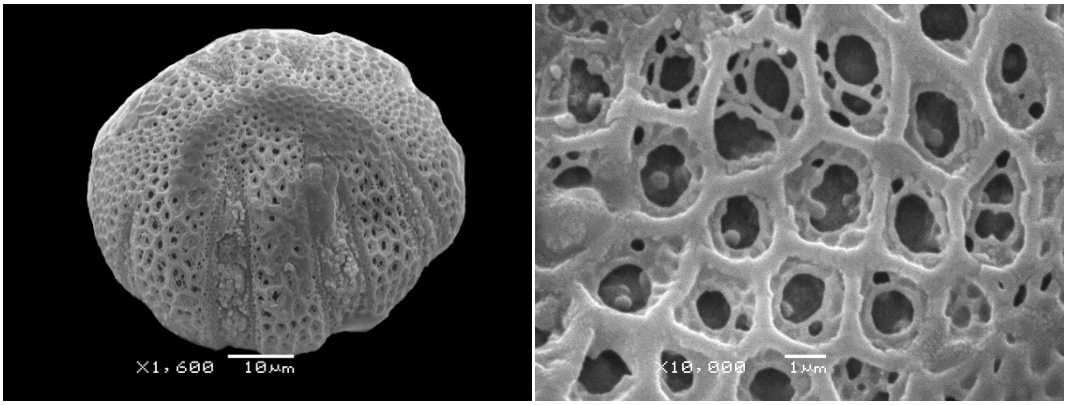

Figure 52. SEM micrographs of pollen grains in *S. candidissima* subsp. *candidissima*, Type 2.A.2.

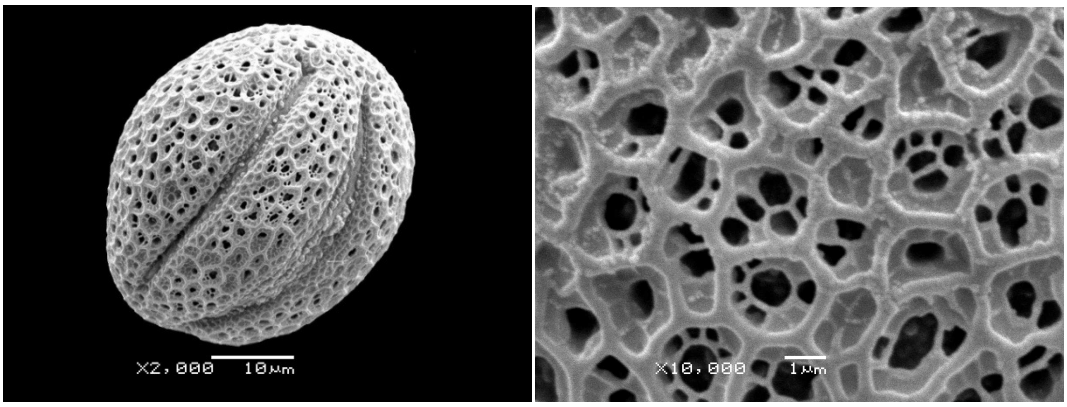

Figure 53. SEM micrographs of pollen grains in *S. chrysophylla*, Type 2.B.1.1.

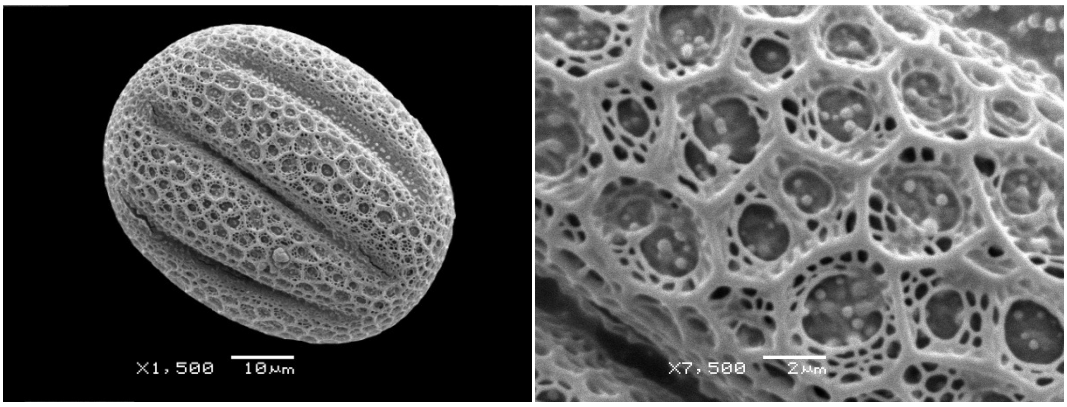

Figure 54. SEM micrographs of pollen grains in *S. candidissima* subsp. *occidentalis*, Type 2.B.1.2.

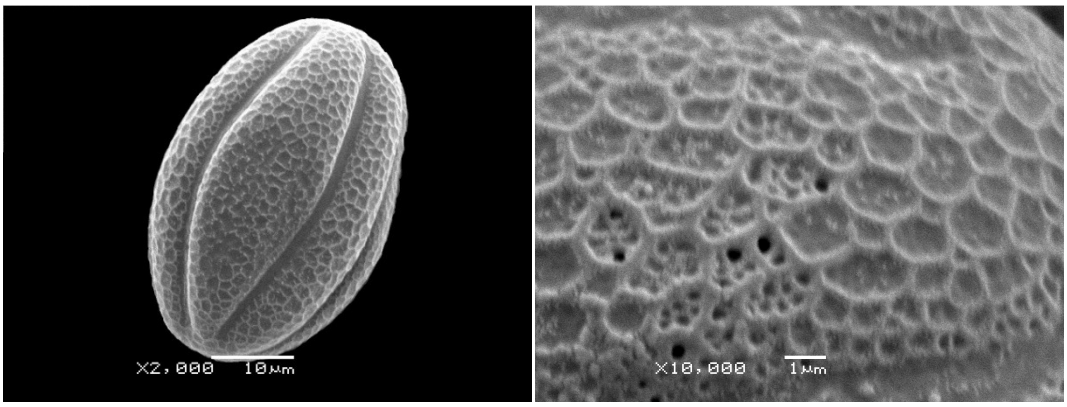

Figure 55. SEM micrographs of pollen grains in *S. pisidica*, Type 2.B.2.

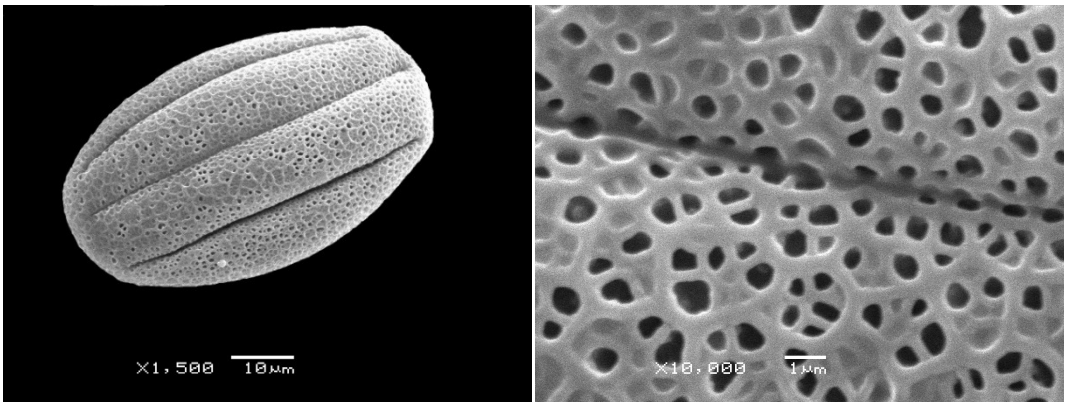

Figure 56. SEM micrographs of pollen grains in *S. smyrnaea*, Type 2.C.1.1.1.

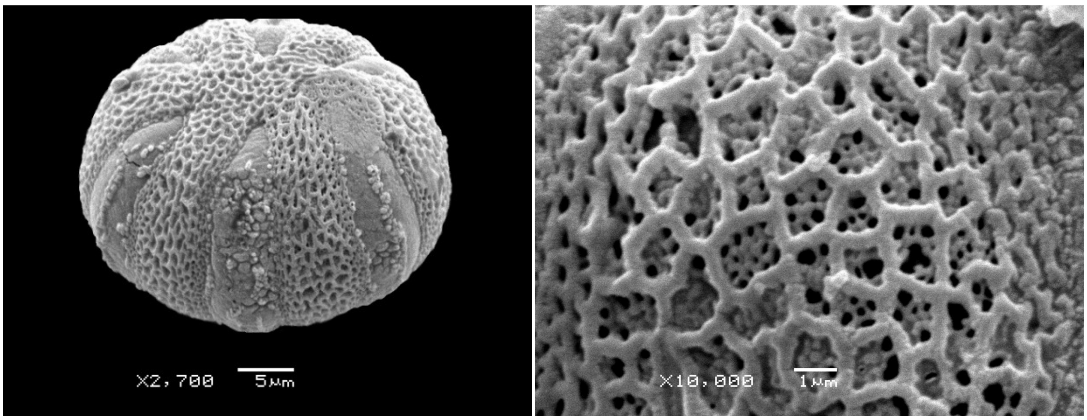

Figure 57. SEM micrographs of pollen grains in *S. frigida*, Type 2.C.1.1.2.

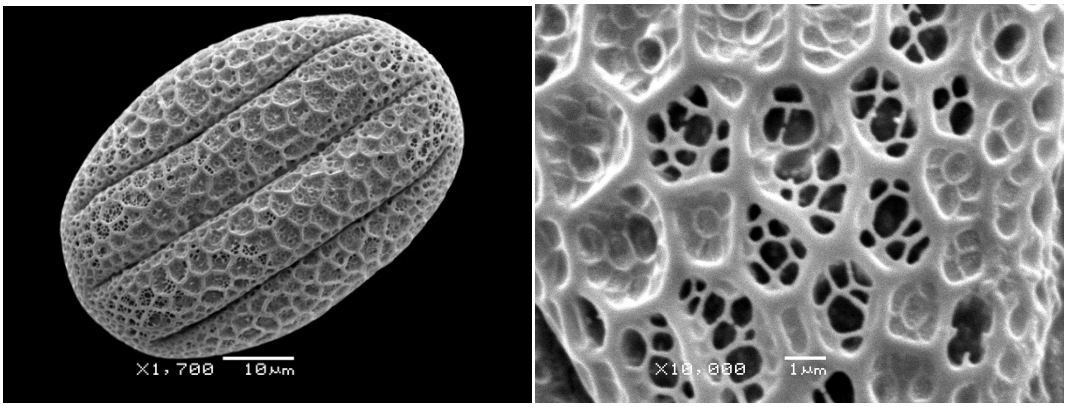

Figure 58. SEM micrographs of pollen grains in *S. chionantha*, Type 2.C.1.2.

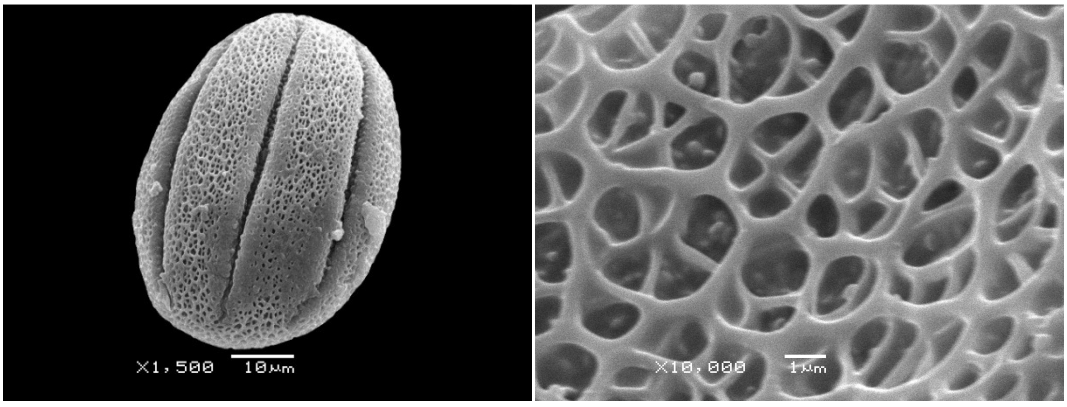

Figure 59. SEM micrographs of pollen grains in *S. cadmica*, Type 2.C.1.3.

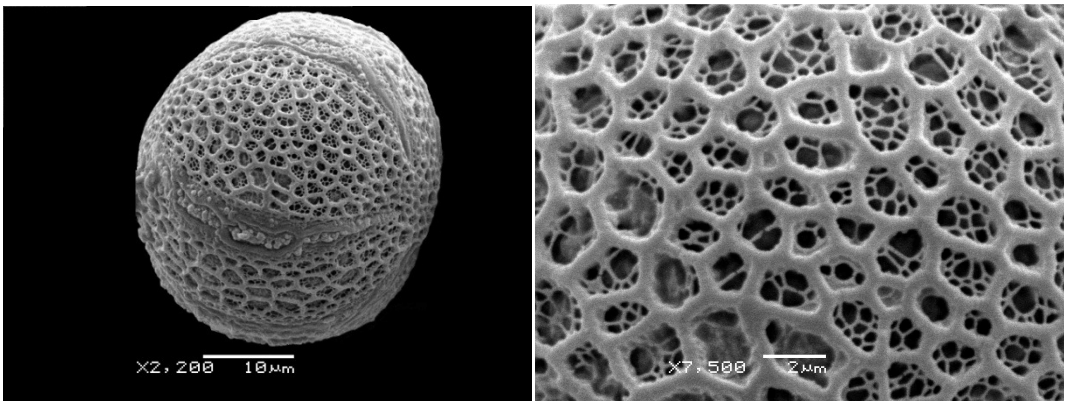

Figure 60. SEM micrographs of pollen grains in *S. indica*, Type 2.C.2.1.

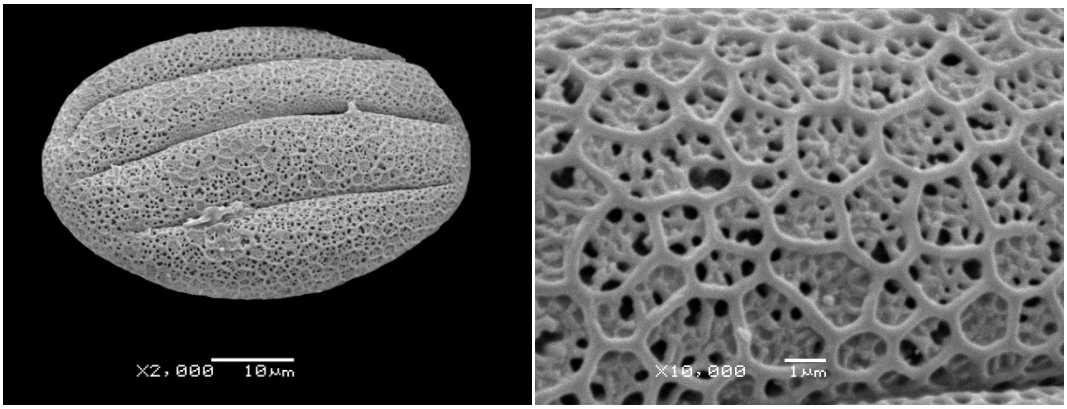

Figure 61. SEM micrographs of pollen grains in *S. heldreichiana*, Type 2.C.2.2.

Table 9 Pollen measurements of studied species (Average ± Standart deviation (Collector FC: F.Celep, AK: AKahraman, SB: SBagherpour)

Collector number	Taxa	Polar (P)	Equotorial (E)	Colpus length (Clg)	Colpus width (Clt)	Exine	Intine
FC 1359	*S. aucheri* subsp.*aucheri*	45.5±4.39	46.33±3.12	39.86±5.63	5.46±0.93	1.05±0.06	0.96±0.16
FC 1126	*S. aucheri* subsp *canescens*	43.47±2.15	48.39±1.77	35.98±1.62	3.89±0.25	0.81±0.08	0.67±0.039
FC 1048	*S. fruticosa*	39.98±2.89	41.55±3.7	34.15±2.47	6.58±0.96	1.4±0.21	0.85±0.07
SB375	*S. tomentosa*	38.62±3.29	44.73±3.61	32.63±3.80	4.72±0.43	1.16±0.14	0.72±0.10
FC 1025	*S. aramiensis*	44.1±3.74	45.98±4.15	36.5±1.56	7.3±1.85	1.68±0.21	0.82±0.21
SB154	*S. recognita*	46.85±4.14	50.22±6.09	41.48±4.18	5.37±0.61	1.23±0.20	0.65±0.12
FC 1018	*S. pilifera*	42.40±3.88	47.98±3.87	36.38±3.26	3.7±0.33	0.81±0.09	0.63±0.07
FC 1021	*S. pinnata*	43.54±3.02	44.87±4.17	36.68±3.33	5.11±0.85	1.66±0.21	0.81±0.17
AK1386	*S. bracteata*	41.73±1.72	47.77±5.9	34.92±2.2	5.81±2.30	1.42±0.2	0.65±0.12
FC 1290	*S. cedronella*	41.34±2.78	49.55±3.23	33.98±3.24	4.96±0.55	0.88±0.09	0.72±0.05
FC 1338	*S. adenophylla*	45.15±2.25	49.67±3.33	36.6±3.3	5.70±1.42	0.74±0.26	0.72±0.13
SB114	*S. wiedemannii*	43.81±5.84	42.21±3.76	37.29±5.92	4.37±0.72	1.19±0.26	0.63±0.13
FC 1156	*S. pisidica*	37.23±2.0	45.72±2.30	30.06±1.8	5.58±1.40	0.92±0.2	0.82±0.15
FC 1414	*S. marashica*	45.58±295	47.82±3.17	39.29±2.64	5.58±0.67	1.10±0.12	0.89±0.16
FC 1262	*S. potentillifolia*	41.72±1.67	47.1±3.39	34.08±2.3	6.94±1.24	0.92±0.16	0.8±0.22
FC 1264	*S. nydeggeri*	47.68±2.88	51.19±3.53	40.62±2.61	5.74±0.99	1.51±0.27	1.1±0.2
FC 1249	*S. albimaculata*	50.97±2.06	57.19±4.3	42.8±1.8	4.73±0.34	0.84±0.14	0.7±0.12

Table 9 (continue)

SB400	*S. tchihatcheffii*	41.56 ±7.11	40.55±6.89	36.57±5.18	3.39±0.76	1.21±0.20	0.73±0.17
FC 1108	*S. heldreichiana*	49.61±1.83	52.39±4.74	41.16±1.74	4.08±0.52	0.81±0.08	0.68±0.08
FC 1253	*S. caespitosa*	48.13±4.2	53.97±1.64	39.65±2.66	5.56±1.14	0.89±0.12	0.7±0.23
B360	*S. caespitosa*	43.95±3.92	49.85±5.40	38.59±3.35	5.27±0.82	1.33±0.15	0.83±0.15
AK1119	*S. suffruticosa*	45.76±4.78	44.01±4.21	38.79±5.21	4.56±1.11	1.22±0.19	0.79±0.17
SB398	*S. cadmica*	49.36±3.99	51.44±3.82	44.14±3.92	8.20±0.64	1.34±.12	0.62±0.01
FC 1053	*S. smyrnaea*	56.96±3.56	57.51±3.41	49.39±3.27	4.5±0.58	0.87±0.08	0.73±0.08
AK1237	*S. blepharochlaena*	55.71±7.35	58.37±3.88	47.33±6.78	5.98±2.32	1.37±0.13	0.73±0.10
FC 1050	*S pomifera*	47.99±3.93	56.48±2.19	39.05±3.85	3.37±0.48	0.88±0.05	0.7±0.08
FC 1232	*S. sericeo-tomentosa*	43.25±4.74	52.03±4.37	35.27±3.5	3.93±0.3	0.86±0.11	0.73±0.08
SB297	*S. multicaulis*	41.34±7.81	39.53±5.41	36.00±6.90	4.58±1.15	1.1 ±0.15	0.68±0.13
SB290	*S. cryptantha*	38.27±3.38	45.09 3.49	32.09±4.22	8.06±0.86	1.43±0.16	0.68±0.12
SB245	*S. syriaca*	39.23±6.48	44.88±8.48	32.85±5.63	7.06±0.52	1.61±0.20	051±0.06
SB388	*S. viridis*	39.34±3.00	38.34±5.73	33.82±2.52	5.13±0.85	1.14±0.13	0.58±0.07
AK1173	*S. hypargeia*	51.50±4.05	52.42±4.47	43.64±3.91	3.57±0.96	1.16±0.15	0.54±0.06
AK1132	*S. palaestina*	47.72±3.85	45.40±3.73	42.07±4.01	3.79±0.72	1.37±0.21	0.75±0.03
FC 1109	*S. sclarea*	32.64±1.22	34.58±1.87	26.8±1.84	5.37±0.56	1.12±0.17	0.67±0.13
FC 1330	*S. chrysophylla*	46.11±2.2	50.46±2.6	37.9±1.8	4.16±0.9	0.78±0.2	0.2±0.15
SB240	*S. aethiopis*	39.29±1.42	44.10±2.31	33.71±1.00	7.21±0.63	1.27±0.15	0.65±0.08
SB261	*S. ceratophylla*	40.33±3.17	45.77±4.38	34.65±3.35	4.00±0.58	1.25±0.14	0.76±0.08
FC 1258	*S. chionantha*	52.21±3.92	58.87±3.28	44.06±4.20	4.18±0.36	0.91±0.06	0.73±0.07
FC 1315	*S. argentea*	47.77±2.59	45.44±3.85	39.85±2.27	4.2±0.59	0.75±0.1	0.63±0.11

Table 9 (continue)

FC 965	*S. microstegia*	46.96±1.34	52.49±2.88	37.05±1.76	4.56±0.8	0.69±0.07	0,63±0,13
SB284	*S. frigida*	37.86±4.10	40.59±3.65	33.10±3.93	5.06±0.50	1.15±0.13	0.70±0.11
SB265	*S. yosgadensis*	35.61±1.71	39.13±1.77	29.60±1.38	5.57±0.36	1.29±0.07	0.70±0.07
FC 1072	*S. modesta*	43.47±2.24	47.81±2.8	36.43±2.76	5.42±0.31	1.24±0.33	1.06±0.18
SB343	*S. candidissima* ssp. *candidissima*	46.73±1.49	46.81±2.07	41.55±1.52	7.57±0.74	1.45±0.24	0.72±0.08
FC 1263	*S. candidissima* ssp. *occidentalis*	54.56±3.9	50.69±4.12	43.58±4.36	4.91±0.75	1.04±0.1	0.72±0.12
SB129	*S. cyanescens*	49.45±2.36	55.67±3.39	42.18±1.85	8.51±0.54	1.80±0.10	0.62±0.11
FC 1199	*S. cilicica*	45.59±3.04	49.37±3.2	36.57±3.69	4.36±0.47	0.86±0.15	0.66±0.11
FC 1411	*S. cassia*	45.90±3.8	51.95±1.5	39.86±3.96	5.61±0.76	1.11±0.32	0.93±0.22
AK1539	*S. indica*	44.98±4.22	52.24±4.41	39.02±3.49	8.64±1.17	1.49±0.10	0.52±0.05
SB402	*S. glutinosa*	38.84±2.85	48.78±3.28	33.34±2.86	5.54±0.71	1.08±0.11	0.64±0.13
SB346	*S. virgata*	36.20±1.51	42.30±3.58	29.75±1.08	3.71±0.33	1.28±0.31	0.62±0.06
FC 1147	*S. adenocaulon*	40.45±3.1	41.42±2.8	33.71±3.42	3.53±0.44	0.82±0.076	0.74±0.075
AK1487	*S. dichroantha*	41.30±2.89	39.06±2.04	34.33±3.31	4.33±0.50	1.36±0.14	0.70±0.08
FC 1045	*S. verbenaca*	53.17±4.7	49.94±3.45	46.9±5.51	4.7±0.41	0.81±0.15	0.76±0.08
SB341	*S. verticillata* ssp. *amasiaca*	32.13±0.98	33.28±1.60	26.32±1.46	6.48±1.06	1.22±0.24	0.55±0.16
AK1451	*S. russellii*	28.42±0.87	30.72±1.00	23.95±0.99	3.67±0.80	1.03±0.11	0.59±0.08
FC 1110	*S. napifolia*	38.05±7.59	48.86±10.1	32.32±7.2	5.99±1.4	1.04±0.05	0.87±0.16

Variation in pollen micromorphological characteristics appears to have particular taxonomic value in separating different species. Pollen size, surface sculpturing (exine ornamentation), reticulation (reticulate or bireticulate), thickness of muri, size and number of lumina are one of the important characters for separating species. However, the similarity in exine structure and ornamentation, as well as the variability of the various parameters analyzed at interspecific and intraspecific level makes it hard to establish taxonomical boundaries. The palynologic results are not support or correlate with sectional grouping of Bentham. In conclusion, the results have demonstrated that pollen morphology of studied *Salvia* taxa is of very limited taxonomic value.

3.3.3. Nutlet Micromorphology

Studies on nutlet micromorphology, anatomy and pericarp structure in the Lamiaceae have proved to be useful in varying degrees at different taxonomic levels (Wojciechowska, 1966; Hedge, 1970; Husain *et al.*, 1990; Ryding, 1992a; b; Marin *et al.*, 1994; 1996; Oran, 1996; Guerin, 2005; Moon and Hong, 2006; Moon *et al.* 2009, Salmaki *et al.*, 2008; Kaya and Dirmenci, 2008). Wojciechowska (1966) presented an informal sub-division of Lamiaceae based on pericarp anatomical characteristics. Marin *et al.* (1994) studied nutlet characters of *Teucrium* and classified them by the presence and density of oil glands. According to their study, nutlet characters were potentially useful within the family at the level of section, genus and species. Guerin (2005) proved that nutlet morphology has phylogenetic value in *Hemigenia* R.Br. and *Microcorys* R.Br. Moon and Hong (2006) investigated nutlet morphology and anatomy of the genus *Lycopus*. They concluded that morphological and anatomical data useful as diagnostic characters at the specific and interspecific levels. Nutlet properties of Iranian *Stachys* were studied by Salmaki *et al.* (2008). The study showed that nutlet characteristics are potentially useful for separating species within the sections. Moon *et al.* (2009) analysed nutlet characters cladistically across genera of tribe Mentheae and found characters useful at the generic level, although nutlets were variable within *Salvia*. According to all these studies, nutlet surface sculpturing, type of exocarp cells, pericarp anatomy and indumentum are important diagnostic characters in the family Lamiaceae.

Marin *et al.* (1996) and Oran (1996) found that nutlet morphology and surface sculpturing in species of *Salvia* was variable and taxonomically useful. However, colour, size and shape of nutlets were considered not to be important in accordance with Oran (1996). Hedge (1970) also studied on mucilage production (myxocarpy) and its taxonomic significance in some *Salvia* species. He concluded that mucilage features were occasionally valuable for separating species. Özkan *et al.* (2009) provided a preliminary survey of nutlet morphology and surface sculpturing for *Salvia* in Turkey. They concluded there was useful variation which appeared to correlate with stamen types which suggests nutlet characters in *Salvia* show phylogenetic signal.

The results obtained from macro and micro-morphological studies are given in Table 10. Selected SEM micrographs of nutlets are presented in Figs. 62-76. According to nutlet length/with ratio, four basic nutlet shapes were distinguished: prolate-spheroidal (PS) (nutlet length/width ratio: 1.00-1.14), subprolate (S) (1.14-1.33), prolate (Pr) (1.33-2.00) and perprolate (Pe) (>2). The subprolate shape was the most common shape. Transverse sections of the nutlets were rounded, rounded-trigonous (the most common type) or trigonous. Nutlet colour is light brown to black.

Regarding sculpturing of nutlet surface five basic types was divided: **colliculate type** (having small hill-like eminences, rounded or pentangular-hexangular elevations, spaced, covering throughout the nutlet surface), **reticulate type** (with a reticulum or net and interspaces characterized with raised walls. The interspaces can be distinct and relatively large or more or less indistinct and small), **verrucate type** (irregular projections or knobs), **foveate type** (pitted or having depressions marked with little pits) and **rugose type** (wrinkled, the irregular elevations making up the wrinkles and running mostly in one directions) (Stearn, 2004). The majority of the studied taxa are of the colliculate type, followed by reticulate and verrucate. According to shape of exocarp cells, the colliculate type was subdivided into three subgroups: rounded, pentangular-hexangular or hill-like eminence exocarp cells.

The size of nutlet ranges from 1.74 mm (*S. adenocaulon*) to 8.44 mm (*S. albimaculata*) in length and 1.14 mm (*S. russellii*) to 3.71 mm (*S. suffruticosa*) in width. Among the examined taxa, four descriptive seed types were recognized in accordance with shape:

Type 1 nutlets are usually prolate-spheroidal (PS) according to average length/width ratio. However, subprolate (S) seeds can be rarely seen in the examined specimens. The transverse sections are rounded, rounded-trigonous or trigonous. The surface sculpturing is reticulate with rounded to angular lacunae, verrucate or colliculate. The exocarp cells are rounded or pentangular-hegzangular. *S. pinnata*, *S. recognita*, *S. bracteata*, *S. suffruticosa*, *S. smyrnaea, S. palaestina* and *S. indica* are evaluated as being of this type.

Type 1 can be subdivided into three subtypes according to sculpturing type.

Type 1a, the surface sculpturing is reticulate. Transverse sections are rounded. *S. pinnata* is evaluated in this type (Figure 62).

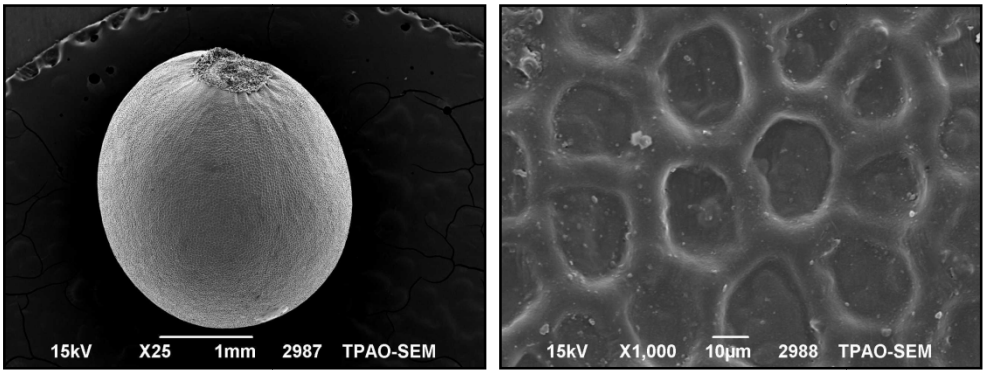

Figure 62. SEM micrographs of nutlet of *S. pinnata*

Type 1b, the surface sculpturing is verrucate. Transverse sections are rounded-trigonous. *S. recognita* is evaluated in this type (Figure 63).

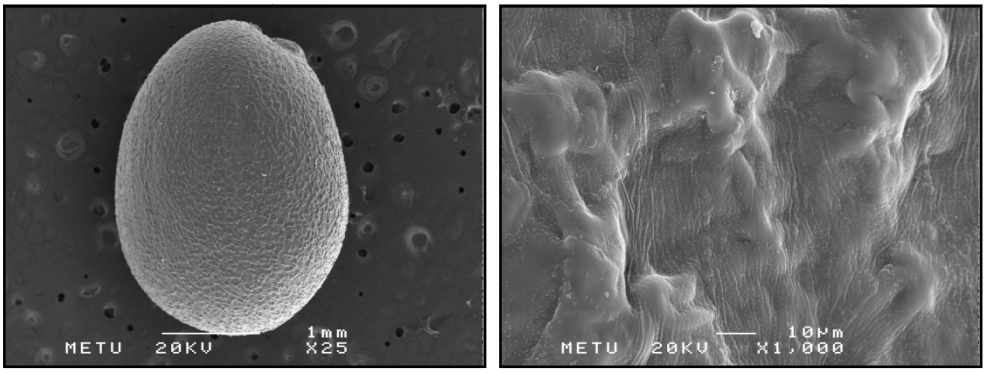

Figure 63. SEM micrographs of nutlet of *S. recognita*

Type 1c, the surface sculpturing is colliculate. *S. suffruticosa*, *S. bracteata*, *S. smyrnaea, S. palaestina* and *S. indica* are evaluated in this type (Figure 64).

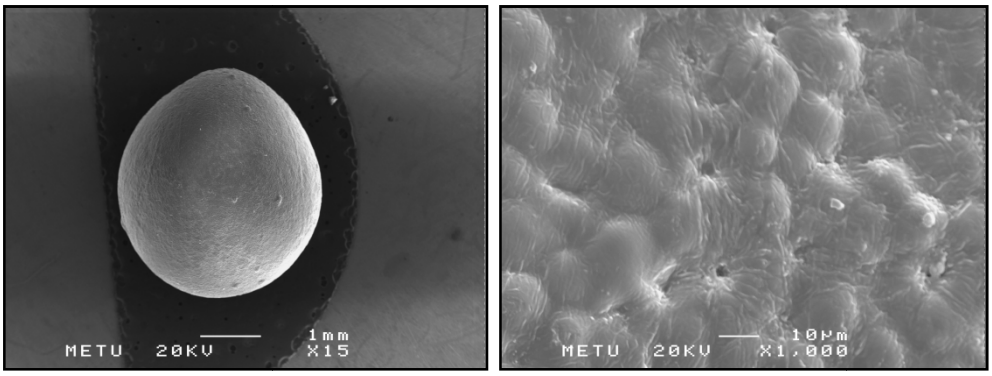

Figure 64. SEM micrographs of nutlet of *S. suffruticosa*

Type 2 nutlets are subprolate (S) in accordance with average length/width ratio. However, prolate-spheroidal (PS) or prolate (Pr) seeds can be rarely seen in the examined specimens. The transverse sections are rounded or rounded-trigonous. The surface sculpturing is colliculate or rarely reticulates. The exocarp cells are rounded or pentangular-hegzangular. *S. aramiensis, S. marashica, S. aucheri* subsp. *aucheri*, *S. aucheri* subsp. *canescens*, *S. fruticosa*, *S. caespitosa*, *S. cedronella*, *S. adenophylla, S. heldreichiana, S. pilifera, S. cadmica, S. blepharochleana, S. sericeo-tomentosa* var. *sericeo-tomentosa, S. sericeo-tomentosa* var. *hatayica, S. multicaulis, S. cryptantha, S. syriaca, S. sclarea, S. ceratophylla, S. argentea, S. microstegia, S. frigida, S. yosgadensis, S. modesta, S. virgata, S. verbenaca, S. adenocaulon* and *S. dichroantha* are evaluated as being of this type.

Type 2 can be subdivided into five subtypes according to sculpturing type.

Type 2a, the surface sculpturing is reticulate. *S. marashica, S. aramiensis, S. sericeo-tomentosa* are evaluated in this group (Figure 65). According to size of the nutlets, *S. marashica* (3.44-4.02 x 2.75-3.38 mm) is bigger than *S. aramiensis* (2.79-3.05 x 2.23- 2.7 mm). From taxonomical point of view, they are clearly distinct species. *S. marashica* has pinnate leaves but *S. aramiensis* has simple leaves. As well as, *S. sericeo-tomentosa* clearly differs from *S. marashica* and *S. aramiensis* on its membranous calyces.

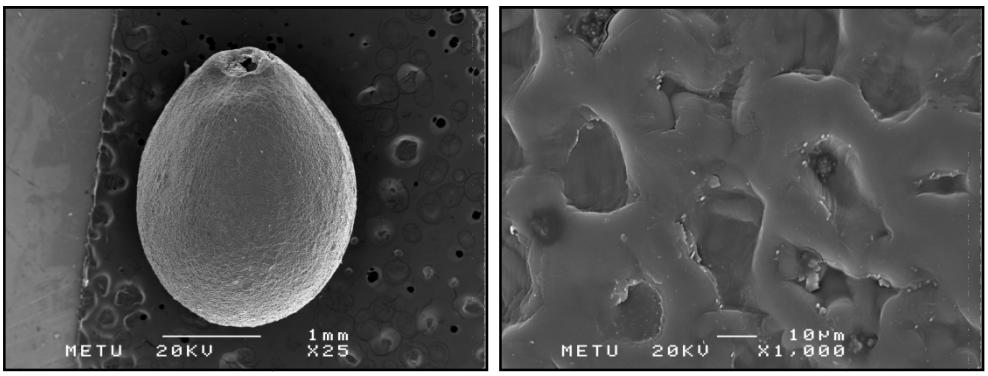

Figure 65. SEM micrographs of nutlet of *S. aramiensis*

Type 2b, the surface sculpturing is colliculate. Type 2b is the most common type. The group can be divided into further two subgroups according to the shape of exocarp cells.

Type 2b-1, exocarp cells are pentangular-hexangular. *S. aucheri* subsp. *aucheri*, *S. aucheri* subsp. *canescens*, *S. fruticosa*, *S. caespitosa*, *S. heldreichiana, S. pilifera, S. blepharochlaena, S. multicaulis*, *S. syriaca, S. argentea* and *S. cyanescens* are evaluated in this group (Figure 66).

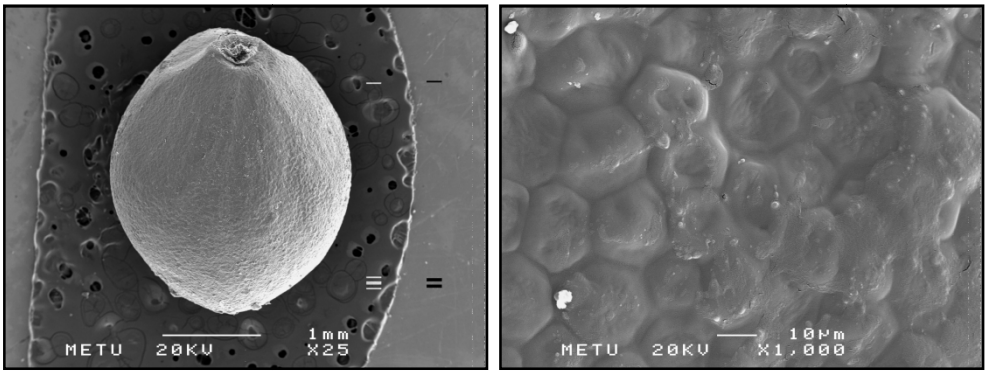

Figure 66. SEM micrographs of nutlet of *S. aucheri* subsp. *canescens*

Type 2b-2, exocarp cells are rounded. *S. cedronella*, *S. adenophylla, S. cryptantha, S. sclarea, S. microstegia, S. frigida, S. yosgadensis, S. modesta, S. virgata, S. verbenaca* and *S. dichroantha* are evaluated in this group (Figure 67).

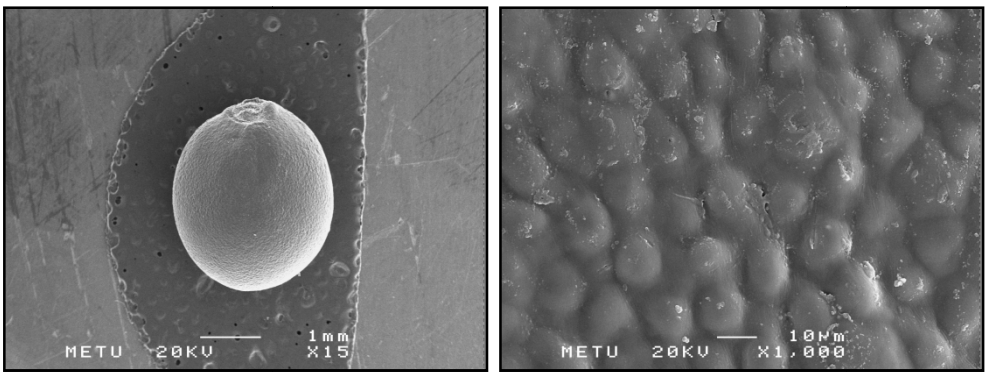

Figure 67. SEM micrographs of nutlet of *S. adenophylla*

Type 2c, the surface sculpturing is foveate. *S. cadmica* is evaluated in this group (Figure 68).

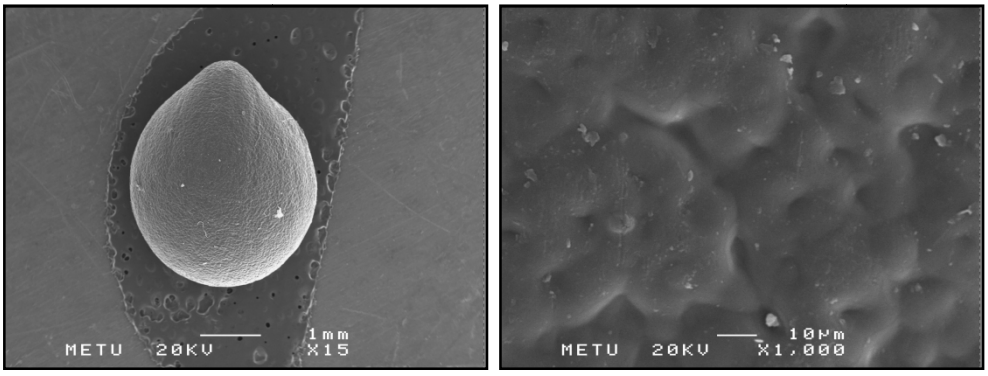

Figure 68. SEM micrographs of nutlet of *S. cadmica*

Type 2d, the surface sculpturing is rugose. *S. ceratophylla* is evaluated in this group (Figure 69).

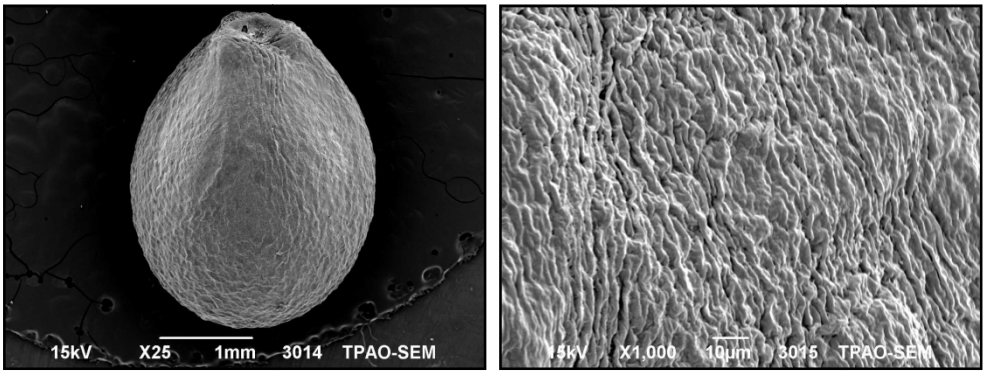

Figure 69. SEM micrographs of nutlet of *S. ceratophylla*

Type 2e, the surface sculpturing is verrucate with striate ornamentation. *S. adenocaulon* is evaluated in this group (Figure 70).

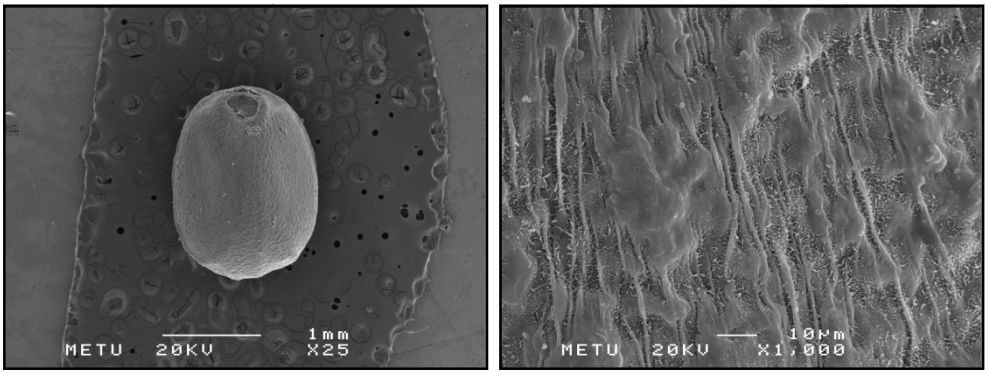

Figure 70. SEM micrographs of nutlet of *S. adenocaulon*

Type 3 nutlets are prolate (Pr) according to average length/width ratio. However, subprolate (S) or perprolate (Pe) seeds can be rarely seen in the examined specimens. The transverse sections are rounded-trigonous or trigonous. The surface sculpturing is colliculate, verrucate, reticulate or foveate.

Type 3 can be subdivided into four subtypes according to sculpturing type

Type 3a, the surface sculpturing is colliculate. Exocarp cells are pentangular-hexangular in *S. tomentosa, S. candidissima* subsp. *candidissima* (Figure 71) and exocarp cells are rounded or irregular in *S. potentillifolia*, *S. hypargeia, S. chrysophylla, S. aethiopis, S. verticillata* subsp. *amasiaca*, *S. russellii* and *S. napifolia* (Figure 71).

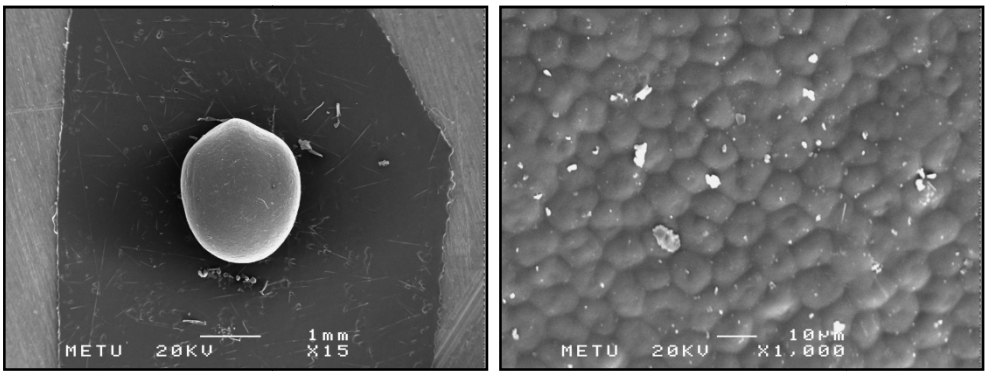

Figure 71. SEM micrographs of nutlet of *S. candidissima* subsp. *candidissima*

Type 3b, the surface sculpturing is foveate. *S.viridis* is evaluated in this group (Figure 72).

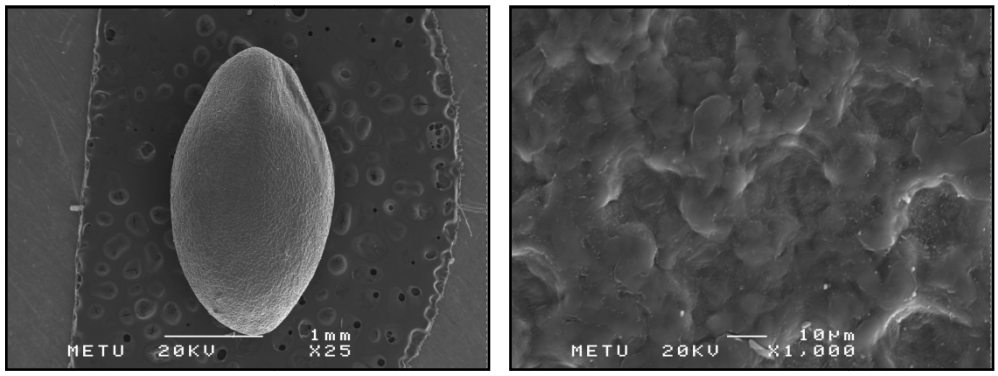

Figure 72. SEM micrographs of nutlet of *S. viridis*

Type 3c, the surface sculpturing is reticulate. *S.pomifera* is evaluated in this group (Figure 73).

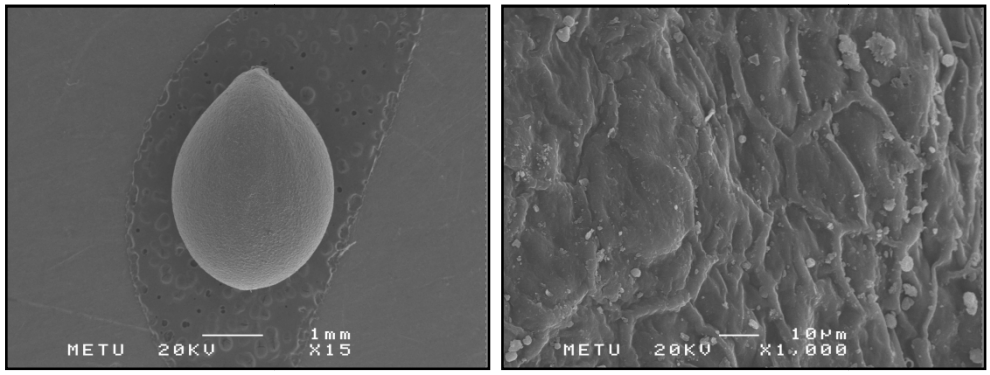

Figure 73. SEM micrographs of nutlet of *S. pomifera*

Type 3d, the surface sculpturing is verrucate. *S. nydeggeri* and *S. pisidica* are evaluated in this group (Figure 74). The spoon shaped nutlets are characteristic for *S. pisidica* in this group (Figure 75). As well as, their transverse sections are trigonous.

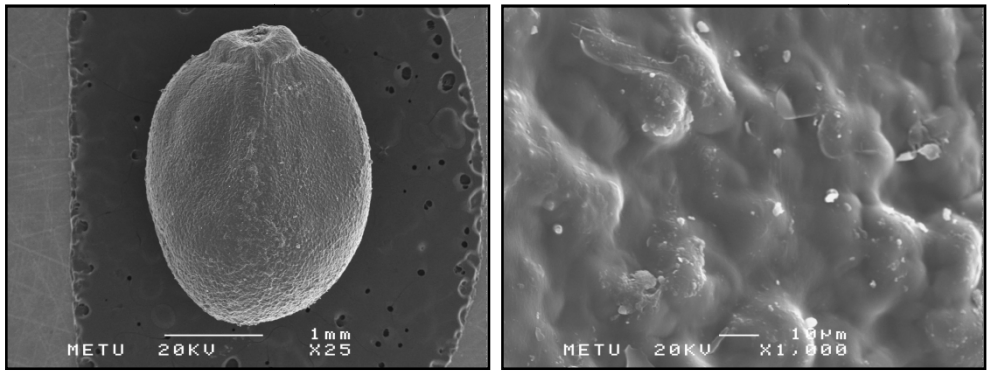

Figure 74. SEM micrographs of nutlet of *S. nydeggeri*

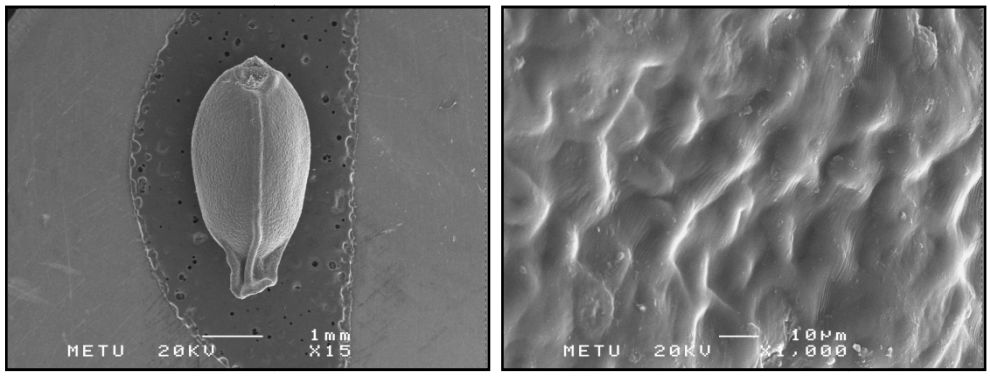

Figure 75. SEM micrographs of nutlet of *S. pisidica*

Type 4 nutlets are perprolate (Pe) according to average length/width ratio. The transverse sections are trigonous. The surface sculpturing is verrucate. The general appearance of the nutlets is similar to spoon in shape. The longest nutlets are placed in this group. *S. albimaculata* is only evaluated as being of this type (Figure 76).

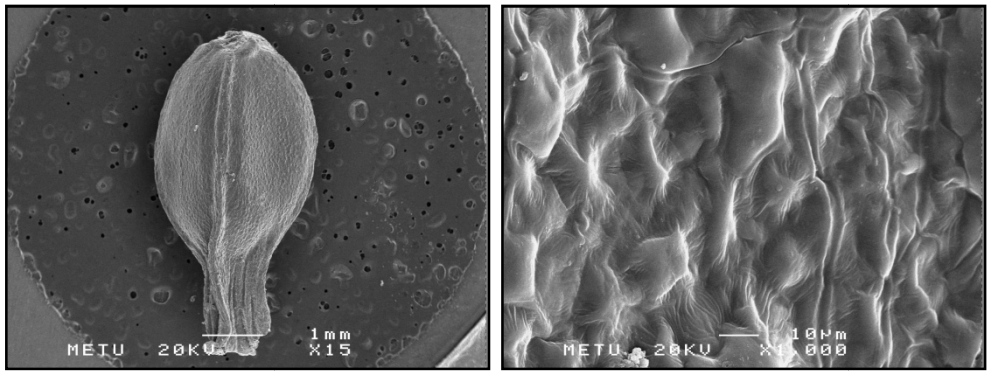

Figure 76. SEM micrographs of nutlet of *S. albimaculata*

Variation in nutlet characters appears to have particular taxonomic value in separating different species. These characters can be also used to distinguish the closely related species. According to *the Flora of Turkey* (Hedge, 1982a) and our revision studies, species can be divided into several groups in accordance with their taxonomic relationships.

Group 1 (*S. fruticosa*, *S. tomentosa* and *S. aramiensis*)

All species of this group are used as herbal tea. *S. aramiensis* is only restricted to Amanos mountain in the eastern part of the Mediterrranean region of Turkey, *S. fruticosa* is confined to the western and southern part of Turkey and *S. tomentosa* is distributed in all regions of Turkey except for the eastern Anatolia. These closely related species can be easily separated from each other using nutlet characteristics such as nutlet shape and sculpturing. The diagnostic key is presented below.

1a Nutlets mainly prolate……..……..……*S. tomentosa*
1b Nutlets mainly subprolate……..……..……2
2a Nutlet sculpturing reticulate and transverse section rounded-trigonous ……..…..…*S. aramiensis*
2b Nutlet sculpturing colliculate and transverse section rounded….....*S. fruticosa*

Group 2 (*S. recognita*, *S. pilifera* and *S. pinnata*)

In this group, *S. recognita* and *S. pilifera* are endemic to Turkey. *S. pilifera* differs from *S. recognita* and *S. pinnata* on its glabrous stems below and blue-purple corollas. Similarly, *S. recognita* differs from *S. pinnata* on its longer corolla (35-40 mm, not 25-30 mm) and ovate calyx (not urseolate). From nutlet micromorphological point of view, the species can be distinguished based on the type of sculpturing, size and shape.

1a Nutlet sculpturing reticulate, transverse sections rounded…….....*S. pinnata*

1b Nutlet sculpturing verrucate or colliculate, transverse sections rounded-trigonous……2

2a Nutlet sculpturing verrucate, prolate-spheroidal in shape, 3.17-3.87 x 2.86-3.31 mm in size…….....*S. recognita*

2b Nutlet sculpturing colliculate, subprolate in shape, 4.08-4.11 x 2.97-3.29 mm in size (Type 2b-1)……..…… ……...……..*S. pilifera*

Group 3 (*S. potentillifolia*, *S. nydeggeri*, *S. cedronella* and *S. adenophylla*)

All species of this group endemic to Turkey are pinnatisect and yellow-flowered. The species are mainly confined to the western part of the Mediterranenan region of Turkey. Among the species of this group, *S. cedronella* and *S. adenophylla* are very closely related to each other, and in the field several intermediate forms were recognized between them. As well as, the same is true about *S. potentillifolia* and *S. nydeggeri*. The possible conspecifity in each of these pairs should be tested in future. From nutlet micromorphological point of view, it is impossible to find any significant differences between *S. cedronella* and *S. adenophylla*, however *S. potentillifolia* differs from *S. nydeggeri* in terms of its colliculate sculpturing. Therefore, in the diagnostic key given below, *S. cedronella* and *S. adenophylla* are presented in one branch of the key.

1a Nutlets subprolate in shape…….....……*S. cedronella* & *S. adenophylla*

1b Nutlets prolate in shape……..……..……..……2

2a Type of sculpturing colliculate.……...……...*S. potentillifolia*

2b Type of sculpturing verrucate.……...…….…….....*S. nydeggeri*

Group 4 (*S. pisidica* and *S. albimaculata*)

Both species are endemic to Turkey. *S. albimaculata* is restricted to Ermenek in central part of the Mediterranean region of Turkey; however *S. pisidica* is confined to western part of the Mediterranean region of Turkey and southern part of the Aegean region of Turkey. Both species have blue corolla and pinnatisect leaves.

However, *S. albimaculata* differs from *S. pisidica* on its longer corolla and calyx. From nutlet micromorphological point of view, their nutlets similar to each other and look like a spoon in shape; however the nutlets of *S. albimaculata* are clearly bigger than those of *S. pisidica*. As well as, the longest nutlets are observed in *S. albimaculata*. The nutlet size of *S. albimaculata* is 7.05-8.44 x 2.42-3.04 mm, but in *S. pisidica* 3.36-4.07 x 2.00-2.41 mm.

Group 5 (*S. suffruticosa* & *S. bracteata*)

According to size of the nutlets, *S. suffruticosa* (3.71-4.25 x 3.00-3.71 mm) obviously bigger than *S. bracteata* (3.07-3.45 x 2.68-3.09 mm). In transverse sections, *S. suffruticosa* is rounded to rounded-trigonous but *S. bracteata* is always rounded-trigonous. In the field, these two species can be easily separated from each other since *S. suffruticosa* has yellow flowers and *S. bracteata* has pink flowers. In the East Anatolia, hybridization also occurs between them.

Group 6 (*S. cadmica* & *S. smyrnaea*)

Both species are endemic to Turkey. *S. smyrnaea* is only found to İzmir and Aydın in western part of the Aegion region of Turkey; however *S. cadmica* is confined to western part of the Mediterranean region and southern & eastern part of the Aegean region in the study area. Both species have white to light pink corolla and simple or trisect leaves. However, *S. smyrnaea* differs from *S.cadmica* on its thick, purple and scarcely expanding calyx. These closely related species can be easily separated from each other using nutlet characteristics such as nutlet shape and sculpturing. The diagnostic key is presented below.

1a Nutlet shape prolate spheroidal, sculpturing colliculate…..…..*S. smyrnaea*
1b Nutlet shape spheroidal, sculpturing foveate…….*S. cadmica*

Group 7 (*S. multicaulis* & *S. cryptantha*)

S. multicaulis and *S. cryptantha* are very closely related to each other and in the field several intermediate forms were recognized between them. From nutlet micromorphological point of view, it is impossible to find any significant differences between them. However, *S. multicaulis* has pentan-hexangular exocarp cells and *S. cryptantha* has rounded exocarp cells.

Group 8 (*S. argentea* & *S. microstegia*)

S. argentea and *S. microstegia* are very closely related to each other. *S. argentea* is restricted to western and central part of the Mediterrranean region and Aegean region in the study area; however *S. microstegia* is confined to the eastern part of the study area. From nutlet micromorphological point of view, it is impossible to find any significant differences between them. However, *S. argentea* has pentan-hexangular exocarp cells and *S. microstegia* has rounded exocarp cells.

Group 9 (*S. candidissima, S. cyanescens, S. cilicica* & *S. cassia*)

In this group, *S. cyanescens* and *S.cilicica* are endemic to Turkey. *S. cyanescens* has subprolate nutlets, but remaining species have prolate nutlets. From nutlet micromorphological point of view it is impossible to find any significant differences between *S. candidissima*, *S.cilicica* and *S. cassia*.

Group 10 (*S. virgata, S. adenocaulon* & *S. dichroantha*)

In this group, *S. adenocaulon* and *S. dichroantha* are endemic to Turkey. All species in this group have suboblate in shape. From nutlet micromorphological point of view, the species can be distinguished based on the type of sculpturing, size and shape.

1a Sculpturing verrucate…….*S. adenocaulon*

1b Sculpturing colliculate……..…2

2a Nutlet length 2.12 (2.24) 2.36 mm.....*S. virgata*
2b Nutlet length 1.77 (1.85) 1.98 mm.....*S. dichroantha*

Group 11 (*S. verticillata* subsp. *amasiaca*, *S. russellii* & *S. napifolia*)

From nutlet micromorphological point of view, it is impossible to find any significant differences among the species.

Remaining species are not constituted a group and are not placed in the other groups. They are taxonomically distant species.

Nutlet shape was useful for description and somewhat useful for distinguishing taxa. However, there was some infraspecific variation and length to width ratios were somewhat continuous, making the application of shapes to phylogenetic questions less useful. The shape of transverse sections, the nature of the surface sculpturing and the presence of trichomes were more useful characters, although in some cases the surface sculpturing pattern was obscure.

Özkan *et al.* (2009) found that nutlet shape to some extent correlated with stamen types. However, we found that qualitative shape of nutlets varied little between taxa while the length to width ratio varied more or less continuously, so that assigning different terms for shapes (such as spherical for shapes with length to width ratio closer to 1) artificially enhances the apparent utility of this character.

We detected to no consistent patterns of reticulate or colliculate surfaces correlating with other characters including stamen type, although the character variation appears useful. Verrucate sculpturing and the presence of trichomes correlated well with stamen types and sections currently applied to the species possessing these characters. Sections *Hemisphace* and *Plethiosphace* typically had verrucate sculpturing and sect. *Plethiosphace* (always) and sect. *Aethiopis* (rarely) had trichomes, indicating support for the continued recognition of these sections. Section *Hemisphace* had stamen type C (the only taxa sampled to do so) whereas sect.

Plethiosphace had type B stamens (a character shared with members of sects *Aethiopis* and *Horminum*). *Salvia pisidica* and *S. albimaculata* shared the characters of an abruptly attenuate apex anda mid-ridge and and appear to be closely related.

Our data agree with previous studies which suggest nutlet characters have taxonomic and phylogenetic utility in Lamiaceae. Nutlet micromorphology provides valuable data for delimitation of closely related species as well as characters that may be useful for phylogeny and classification at some level. Our findings showed that the nutlet surface sculpturing is the most important character. In order to resolve the problems among taxonomically difficult groups using nutlet characteristics, the data must be combined with a wider range of morphological characters. Anatomical studies of the pericarp structure in taxa with various cellular sculpturing may also be advantageous to determine the associated structures and homologies and this is particularly needed for more obscure surface patterns (Celep *et al.*, 2010c; Kahraman *et al*., 2010b).

Table 10. Details of nutlet characteristics of the studied taxa

Taxa names	Nutlet length (mm) Min (mean) max.	Nutlet width (mm) Min (mean) max.	L/W ratio Min (mean) max.	Nutlet shape	Trichome	Surface sculpturing
S. aucheri subsp. *aucheri*	2.84 (2.96) 3.17	2.24 (2.38) 2.65	1.09 (1.25) 1.32	S (PS)	Absent	Colliculate
S. aucheri subsp. *canescens*	2.74 (2.90) 3.11	2.30 (2.47) 2.61	1.11 (1.17) 1.22	S (PS)	Absent	Colliculate
S. fruticosa	2.42 (2.61) 2.83	2.06 (2.25) 2.45	1.07 (1.16) 1.22	S (PS)	Absent	Colliculate
S. tomentosa	2.95 (3.20) 3.32	2.2 (2.40) (2.57)	1.26 (1.33) 1.36	Pr (S)	Absent	Colliculate
S. aramiensis	2.79 (2.91) 3.05	2.23 (2.46) 2.70	1.09 (1.18) 1.31	S (PS)	Absent	Reticulate
S. recognita	3.17 (3.46) 3.87	2.86 (3.03) 3.31	1.05 (1.13) 1.18	PS (S)	Absent	Verrucate
S. pilifera	4.08 (4.09) 4.11	2.97 (3.14) 3.29	1.24 (1.30) 1.38	S (Pr)	Absent	Colliculate
S. pinnata	2.88 (3.00) 3.13	2.55 (2.71) 2.86	1.07 (1.10) 1.14	PS	Absent	Reticulate
S. bracteata	3.07 (3.24) 3.45	2.68 (2.88) 3.09	1.01 (1.12) 1.18	PS (S)	Absent	Colliculate
S. cedronella	2.79 (3.15) 3.42	2.33 (2.60) 2.95	1.13 (1.21) 1.33	S (PS)	Absent	Colliculate
S. adenophylla	3.04 (3.40) 3.76	2.30 (2.69) 2.95	1.13 (1.26) 1.40	S (Pr)	Absent	Colliculate
S. potentillifolia	3.27 (3.46) 3.70	2.20 (2.32) 2.44	1.32 (1.49) 1.62	Pr (S)	Absent	Colliculate
S. nydeggeri	2.92 (3.34) 3.90	2.00 (2.34) 2.74	1.16 (1.43) 1.59	Pr (S)	Absent	Verrucate
S. pisidica	3.36 (3.70) 4.07	2.00 (2.19) 2.41	1.49 (1.69) 1.80	Pr-Spoon	Absent	Colliculate-Verrucate
S. albimaculata	7.05 (7.64) 8.44	2.42 (2.73) 3.04	2.57 (2.79) 3.06	Pe-Spoon	Absent	Verrucate
S. heldreichiana	3.14 (3.60) 3.98	2.64 (3.03) 3.24	1.08 (1.18) 1.30	S (PS)	Absent	Colliculate
S. marashica	3.44 (3.72) 4.02	2.75 (3.06) 3.38	1.12 (1.21) 1.29	S (PS)	Absent	Reticulate
S. caespitosa	2.99 (3.12) 3.38	2.49 (2.68) 2.89	1.09 (1.16) 1.22	S (PS)	Absent	Colliculate

Table 10 (continue)

S. suffruticosa	3.71 (3.95) 4.25	3.00 (3.47) 3.71	1.09 (1.13) 1.22	PS (S)	Absent	Colliculate
S. cadmica	3.08 (3.42) 3.78	2.45 (2.92) 3.15	1.07 (1.18) 1.26	S (PS)	Absent	Foveate
S. smyrnaea	3.02 (3.33) 3.64	2.70 (3.05) 3.53	1.02 (1.09) 1.15	PS	Absent	Colliculate
S. blepharochlaena	3.05 (3.44) 3.92	2.40 (2.72) 3.09	1.15 (1.27) 1.40	S (Pr)	Absent	Colliculate
S. pomifera	3.14 (3.59) 3.91	2.45 (2.69) 2.90	1.28 (1.33) 1.36	Pr (S)	Absent	Reticulate
S. sericeo-tomentosa var. *sericeo-tomentosa*	2.77 (3.03) 3.23	2.45 (2.56) 2.74	1.14 (1.19) 1.23	S (PS)	Absent	Reticulate
S. sericeo-tomentosa var. *hatayica*	2.96 (3.35) 3.85	2.50 (2.83) 3.24	1.13 (1.18) 1.23	S (PS)	Absent	Reticulate
S. multicaulis	3.25 (3.62) 3.93	2.75 (3.05) 3.45	1.12 (1.21) 1.31	S (PS)	Absent	Colliculate
S. cryptantha	2.77 (3.06) 3.48	2.04 (2.58) 2.95	1.11 (1.20) 1.31	S (PS)	Absent	Colliculate
S. viridis	2.85 (3.05) 3.34	1.55 (1.63) 1.77	1.70 (1.86) 2.04	Pr (Pe)	Absent	Foveate
S. syriaca	2.18 (2.32) 2.53	1.68 (1.82) 1.96	1.22 (1.27) 1.32	S	Absent	Colliculate
S. hypargeia	2.75 (3.17) 3.47	1.85 (2.25) 2.55	1.30 (1.41) 1.57	Pr (S)	Absent	Colliculate?
S. palaestina	2.40 (2.44) 2.80	2.16 (2.22) 2.57	1.09 (1.14) 1.20	PS (S)	Absent	Colliculate
S. sclarea	2.48 (2.64) 2.90	1.89 (2.04) 2.23	1.17 (1.30) 1.40	S (Pr)	Absent	Colliculate ?
S. indica	3.15 () 4.50	3.00 () 3.50	1.02 () 1.21	PS (S)	Absent	Colliculate
S. chrysophylla	2.41 (2.62) 2.74	1.67 (1.80) 1.95	1.35 (1.46) 1.63	Pr (S)	Absent	Colliculate
S. ceratophylla	3.00 (3.28) 3.56	2.49 (2.66) 2.92	1.15 (1.23) 1.27	S	Absent	Rugose
S. argentea	2.62 (2.87) 3.01	2.19 (2.39) 2.64	1.13 (1.20) 1.26	S (PS)	Absent	Colliculate
S. microstegia	2.96 (3.13) 3.25	2.45 (2.50) 2.61	1.20 (1.26) 1.32	S	Absent	Colliculate

Table 10 (continue)

S. frigida	2.93 (3.08) 3.18	2.30 (2.44) 2.54	1.22 (1.26) 1.31	S	Absent	Colliculate
S. yosgadensis	2.67 (2.90) 3.24	2.10 (2.31) 2.57	1.19 (1.26) 1.32	S	Absent	Colliculate
S. modesta	2.70 (3.07) 3.29	2.25 (2.54) 2.69	1.18 (1.21) 1.25	S	Absent	Colliculate
S. aethiopis	2.67 (2.78) 2.94	1.91 (2.06) 2.28	1.23 (1.35) 1.46	Pr (S)	Absent	Colliculate
S. candidissima subsp. *candidissima*	2.96 (3.04) 3.16	2.09 (2.24) 2.40	1.27 (1.37) 1.45	Pr (S)	Absent	Colliculate
S. candidissima subsp. *occidentalis*	2.80 (2.97) 3.19	2.00 (2.10) 2.20	1.31 (1.41) 1.56	Pr (S)	Absent	Colliculate
S. cyanescens	2.50 (2.61) 2.76	1.80 (2.02) 2.18	1.19 (1.30) 1.40	S (Pr)	Absent	Colliculate
S. chionantha	4.04 (4.41) 4.74	2.68 (2.89) 3.21	1.36 (1.53) 1.64	Pr	?	Colliculate
S. cilicica	2.40 (2.70) 3.10	1.70 (1.89) 2.10	1.27 (1.43) 1.60	Pr (S)	Absent	Colliculate
S. cassia	-	-	-	-	Absent	Verrucate ? or rugose
S. virgata	2.12 (2.24) 2.36	1.61 (1.71) 1.85	1.25 (1.31) 1.40	S (Pr)	Present	Colliculate
S. verbenaca	2.01 (2.22) 2.32	1.50 (1.68) 1.75	1.24 (1.32) 1.40	S (Pr)	Present	Colliculate
S. adenocaulon	1.74 (1.91) 2.10	1.40 (1.53) 1.66	1.18 (1.25) 1.39	S (Pr)	Present	Verrucate
S. dichroantha	1.77 (1.85) 1.98	1.47 (1.59) 1.73	1.07 (1.16) 1.22	S (PS)	Present	Colliculate
S. verticilata subsp. amasiaca	2.06 (2.28) 2.45	1.46 (1.70) 1.97	1.19 (1.35) 1.55	Pr (S)		Colliculate
S. russellii	2.08 (2.19) 2.29	1.14 (1.28) 1.45	1.53 (1.70) 1.88	Pr		Colliculate
S. napifolia	1.90 (2.04) 2.21	1.37 (1.50) 1.74	1.23 (1.36) 1.	Pr (S)		Colliculate

3.4. Ecology, Endemism, Phytogeography, Distribution and Conservation Status of the Species

3.4.1. Habitat, Phenology and Altidutional Range of the Species

The species dealt with in this account grow sea level up to c. 2800 m, in a very wide range of different habitats such as, *Quercus* and *Pinus* woodland, macchie or phrygana, limestone cliffs, igneous slopes, rocky places, steppe, cornfields and fallow fields, dry meadows, roadsides, calcareous rocks, serpentine slopes, chalky rocks, sandy dunes, moist places under *Pinus, Fagus, Alnus* and *Corylus* sp., alpine and subalpine meadows and cultivated fields. For example, *S. fruticosa* is common on near the sea in the south-west Mediterranean phytogeographical region of Turkey. *S. potentillifolia, S. cedronella, S. adenophylla* and *S. nydeggeri* grow open *Quercus* macchie. *S. caespitosa, S. cadmica* and *S. smyrnaea* grow on rocky limestone slopes; *S. albimaculata* grows in soft chalky hills. *S. viridis, S. sclarea, S. syriaca, S. virgata, S. verbenaca* and *S. bracteata* are common in the study area and grow different habitats such as roadsides, fallow fields and cultivated fields. *S. glutinosa* grows under *Fagus* forest. At the end of the species descriptions, habitat preferences of the species are also explained (Figures 77-83).

Figure 77. *S. caespitosa* on rocky

Figure 78. *S. adenophylla* in *Quercus* shrubs

Figure 79. *S. chionantha* in field

Figure 80. *S. frigida* in subalpine meadows

Figure 81. *S. albimaculata* on chalky rocks

Figure 82. *S. fruticosa* in *Quercus coccifera* and *Pinus brutia* forest

Figure 83. *S. pisidica* roadsides

Research findings shows that flowering periods and altidutional ranges of the some species reveal some additional information to those data reported in *the Flora of Turkey* (Hedge, 1982a). In the study area, flowering occurs is between at the beggining of the March and at the beginning of the October, however the best flowering time is between at the begging of the April and at the begging of the July (Figure 84). *S. fruticosa, S. marashica, S. pomifera, S. pinnata, S. verbenaca* and *S. pilifera* flowers early in April, however, *S. glutinosa, S. adenocaulon* and *S. chrysophylla* flowers late in July to October. According to *the Flora of Turkey*, endemic *S. quezelii* flowers in August, however our studies show that the species flowers at the end of the May. Similarly, flowering time of *S. cassia* and *S. sericeo-tomentosa* should be changed as May. In *the Flora of Turkey*, flowering period of the *S. haussknechtii,* known only from type gathering in 1865, was given in August. However, the type specimen of *S. haussknechtii*, photos obtained from Edinburgh and specimens seen in Geneva herbarium, has not flowers. As well as, I could not find it during field trips in August. Therefore, I do not suggest exact flowering period of it, but I can suggest its best flowering time probably in June to July. Exact flowering period of the each species is given after species description.

In the study area, the species grow between 1 and ca. 2800 m; however they are mainly concentrated between 600 m and 2000 m (Figure 85). Altidutional ranges of the endemic species are clearly less than non-endemic species. Research findings shows that altidutional ranges of the some species should be extend. For examples, *S. quezelii* grows between 750 and 1100 m, *S. cassia* grows between 10 and 650 m, *S. sericeo-tomentosa* grows between 10 and 100 m (1000 m), *S. argentea* grows between 150 and 2000 m. Altidutional range of the each species is given after its description in revision part.

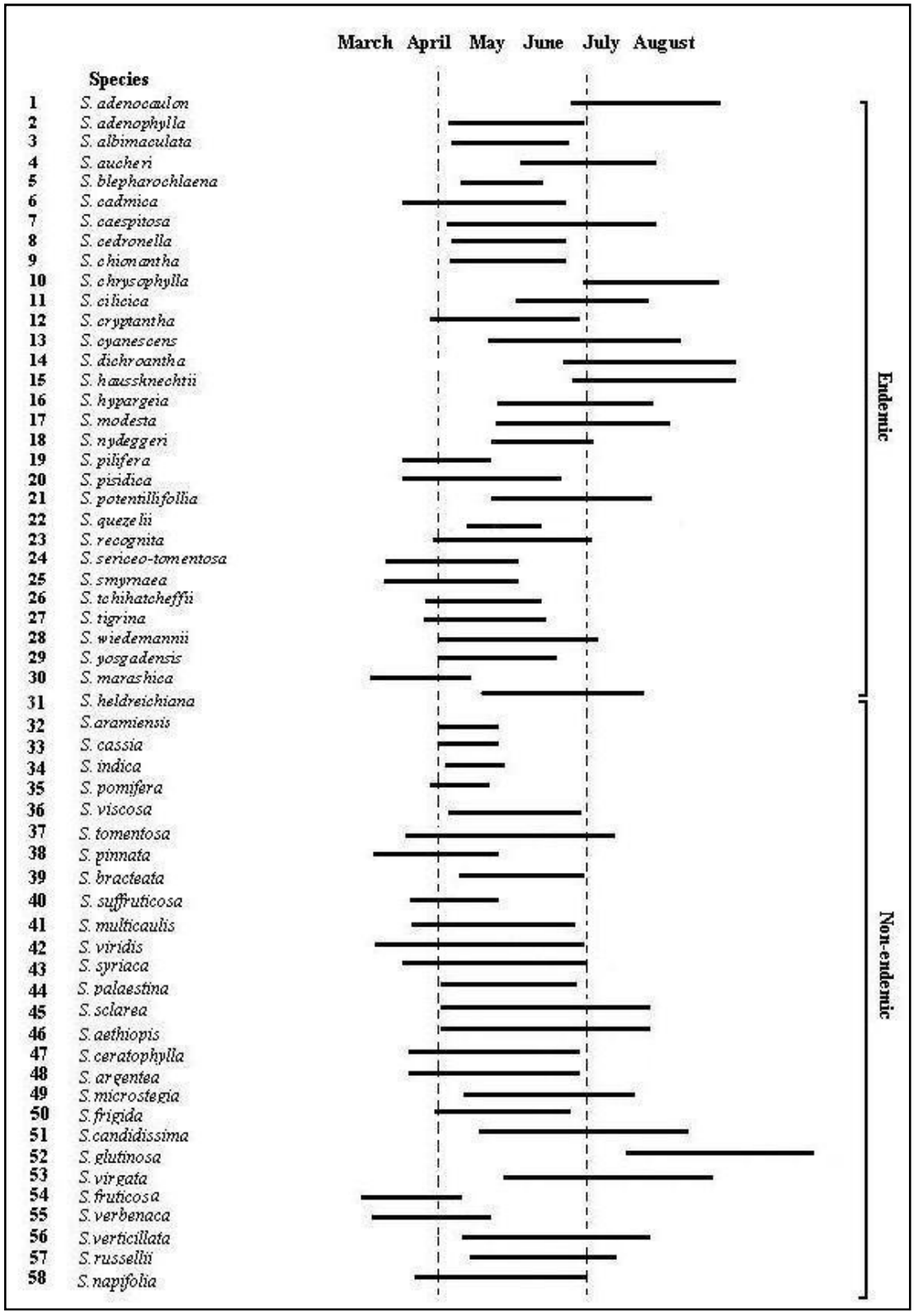

Figure 84. Flowering period of the species

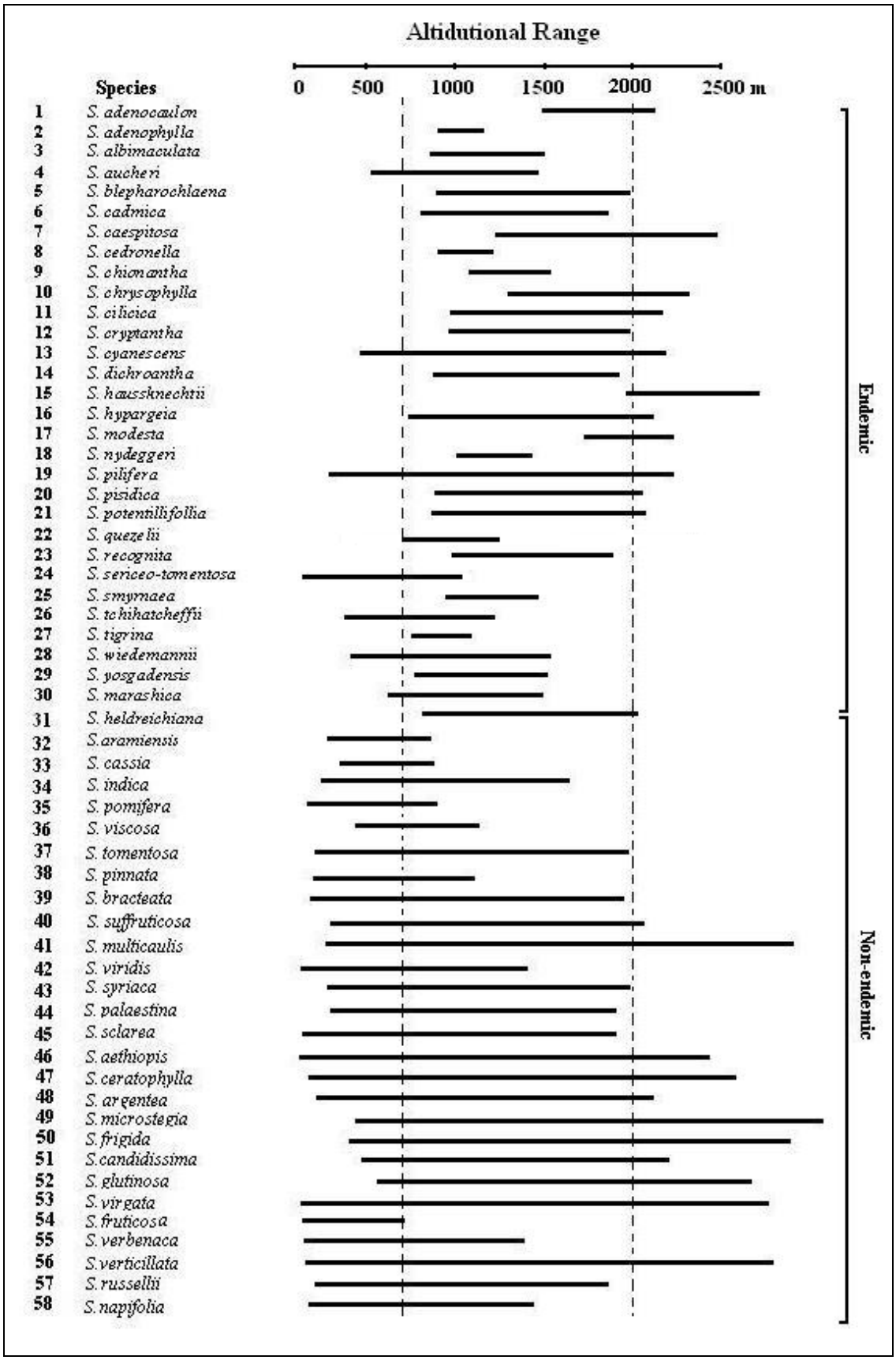

Figure 85. Altidutional range of the species

3.4.2. Soil Features of the Species

The soil samples collected from the suitable habitats. Their pH, $CaCO_3$, P, K, Organic content and texture were analyzed. The resuls are given in Table 11. According to results, *Salvia* species grow different soil types such as clayish, loamy and sandy in their habitats. The soil samples are slightly alkali between (pH 7.34-8.10) with well organic content between (0.16- 8.10 %). The $CaCO_3$ content of the soil are between 0.71 and 36.79. The amounts of P and K present are between 0.40-79.44 and between 32.06-828.35 ppm, respectively.

Table 11. C: Clay, L: Loam, Si: Silt, S: Sand, CL: Clay-Loam, SiCL: Silt-Clay-Loam, SiC: Silt-Clay, SiL: Silt-Loam, SL: Sand-Loam, LS: Loam-Sand, SCL: Sand-Clay-Loam

Number	Species	pH	$CaCO_3$	P (ppm)	K (ppm)	Organic Content %	Texture
1	*S. aucheri* subsp. *aucheri*	8,40	16,31	2,10	32,14	0,62	LS
	S. aucheri subsp. *canescens*	7,81	35,53	3,93	174,62	2,45	L
2	*S. fruticosa*	7,40	1,13	5,97	421,01	8,10	CL
3	*S. tomentosa*	7,56	1,31	4,21	120,62	5,72	CL
4	*S. aramiensis*	7,34	0,94	1,62	127,82	2,70	CL
5	*S. tigrina*	-	-	-	-	-	-
6	*S. recognita*	7,84	21,98	2,92	170,41	5,50	C
7	*S. pilifera*	7,90	22,92	7,90	71,31	0,66	L
8	*S. pinnata*	7,74	5,63	4,87	433,33	1,88	C
9	*S. bracteata*	7,77	4,81	37,41	361,86	2,70	SL
10	*S. cedronella*	7,83	36,79	1,62	191,52	2,04	C, LS
11	*S. adenophylla*	8,18	3,19	1,36	46,83	0,41	C, LS
12	*S. wiedemannii*	8,08	32,62	2,10	210,53	1,00	C
13	*S. pisidica*	7,88	5,92	12,47	445,84	0,60	SCL
14	*S. potentillifolia*	7,84	7,77	79,44	828,35	7,38	SiCL
15	*S. nydeggeri*	8,06	3,70	12,21	285,95	1,26	SL, C
16	*S. albimaculata*	7,81	35,53	3,93	174,62	2,45	SiCL, L
17	*S. tchihatcheffii*	8,19	15,53	4,47	285,95	0,25	C
18	*S. heldreichiana*	7,69	1,48	4,87	339,36	6,38	C
19	*S. caespitosa*	7,67	2,51	10,57	135,23	2,73	CL, L
20	*S. suffruticosa*	8,07	8,88	2,99	296,31	0,69	SL
21	*S. quezelii*	-	-	-	-	-	-
22	*S. haussknechtii*	-	-	-	-	-	-
23	*S. cadmica*	7,67	2,51	10,57	135,23	2,73	CL
24	*S. smyrnaea*	7,56	1,31	4,21	120,62	5,72	CL
25	*S. blepharochlaena*	7,60	1,11	2,03	174,62	2,83	L
26	*S. pomifera*	7,88	35,84	2,57	68,77	2,04	SCL
27	*S. sericeo-tomentosa*	8,21	0,74	0,40	32,06	0,19	C
28	*S. multicaulis*	7,77	6,85	8,54	471,30	3,93	SiCL, SL, CL
29	*S. cryptantha*	8,19	15,53	4,47	285,95	0,25	C

Table 11 (continue)

30	*S. syriaca*	7,75	10,92	1,76	306,83	0,19	CL
31	*S. viridis*	8,04	6,74	2,64	63,00	0,31	SL
32	*S. hypargeia*	7,76	68,70	5,55	135,23	1,26	C, CL
33	*S. palaestina*	7,82	3,89	21,01	445,84	2,04	CL, L
34	*S. sclarea*	7,92	25,10	3,93	218,14	0,63	C
35	*S. chrysophylla*	7,73	32,01	13,29	209,11	0,22	SCL
36	*S. aethiopis*	7,70	34,79	13,15	497,42	2,20	CL
37	*S. ceratophylla*	8,07	8,88	2,99	296,31	0,69	SL
38	*S. chionantha*	7,50	31,09	24,80	458,48	3,61	CL, SL
39	*S. argentea*	7,52	25,88	7,52	119,56	5,81	L, SL
40	*S. microstegia*	7,62	1,70	0,94	306,83	1,54	L, SCL
41	*S. frigida*	7,82	6,85	8,54	471,30	3,93	SiCL
42	*S. yosgadensis*	7,63	0,71	1,71	178,98	0,16	LS
43	*S. modesta*	7,62	1,70	0,94	306,83	1,54	SCL
44	*S. candidissima* ssp. *candidissima*	7,82	6,85	8,54	471,30	3,93	SiCL
	S. candidissima ssp. *occidentalis*	7,84	7,77	79,44	828,35	7,38	SiCL, L, CL
45	*S. cyanescens*	7,79	24,16	2,31	227,33	0,82	SCL
46	*S. cilicica*	7,77	1,30	2,45	142,76	0,53	SL, LS, CL
47	*S. cassia*	7,88	2,25	2,31	99,94	0,57	SCL
48	*S. indica*	7,44	1,06	7,44	215,23	2,62	SL
49	*S. glutinosa*	-	-	-	-	-	-
50	*S. virgata*	7,73	2,64	25,08	652,93	1,79	L, C
51	*S. viscosa*	-	-	-	-	-	-
52	*S. adenocaulon*	7,76	0,94	1,36	174,62	2,29	SiCL
53	*S. dichroantha*	7,59	8,68	2,57	32,06	0,44	L
54	*S. verbenaca*	7,90	19,85	4,42	47,71	3,09	SL
55	*S. verticillata* ssp. *amasiaca*	7,70	34,79	13,15	497,42	2,20	CL
56	*S. russellii*	7,74	17,17	4,47	285,95	2,10	C
57	*S. napifolia*	7,69	1,48	4,87	339,36	6,38	C
58	*S. marashica*	7,73	26,23	2,41	95,65	2,06	CL

3.4.3. Endemism, Phytogeography and IUCN Threat Categories of the Species

The rate of endemism of *Salvia* is ca. 53 % both in the area and Turkey. According to geographical distribution of the species, 26 taxa grow in the Aegean geographic region of Turkey, 10 of which are endemic and 55 taxa grow in the Mediterranean geographic region of Turkey, 28 of which are endemic. 6 endemic taxa are also common in both regions (Celep & Doğan, 2007; Celep *et al.*, 2010d)

In the Aegean region, endemic and non-endemic rare species are concentrated in mostly Uşak, Afyon and Eskişehir. In the Mediterranean region, endemic and non-endemic rare species are concentrated in mainly three regions. The first region covers Antalya, Elmalı, Korkuteli, Denizli and Burdur in the western Mediterranean region. The second region covers Karaman, Mut, Gülnar and Ermenek in the central Mediterranean region. The third region covers Pozantı, Göksun and Hatay in the eastern Mediterranean region. For examples, *S. potentillifolia, S. nydeggeri, S. cedronella, S. adenophylla, S. pisidica, S. chionantha* are confined to western Mediterranean region, *S. albimaculata, S. aucheri* and *S. quezelii* are confined to central Mediterranean region and *S. cilicica, S. tigrina, S. sericeo-tomentosa, S. pilifera* and *S. haussknechtii* are localized to eastern Mediterranean region. The richest areas in terms of the number of endemic species were indicated and their number was also given for each grid square (Figure 86) (Celep *et al.*, 2010d).

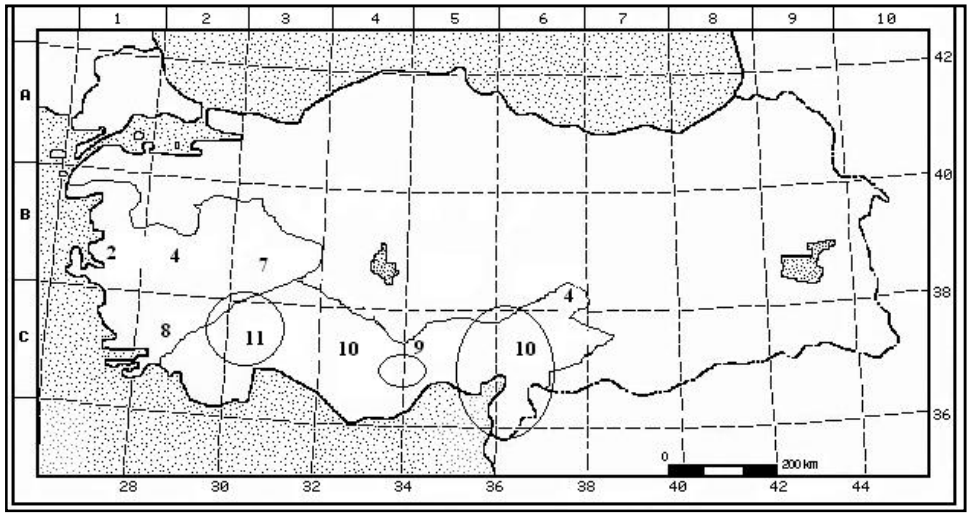

Figure 86. Location of the study area and distribution of the endemic species for each grid square, circulars indicated the richest areas in terms of endemic species number.

Previously, 31 taxa were evaluated under different threat categories in the Turkish Red Data Book (Ekim *et al.*, 2000). However, our studies and field observations show that the previous evaluations of the species were not properly made due to lack of field/herbarium studies and data.

Firstly, all published information was reviewed and the herbarium materials were studied in the following herbaria namely ANK, AEF, B, BM, E, G, GAZI, H, HUB, ISTE, ISTF, K, KNYA and LE. During the period 2005-2009, we visited the type and the other known localities, as well as a number of other sites where they might potentially occur. Between 2005 and 2009, 60 taxa were collected from about 400 different populations in the area. When the species was detected, we observed following criteria: the area of occupancy and distribution, populations and their size and the number of mature individuals. As well as, current distribution areas of the species and their estimated distributional range were determined using GPS data. Threat categories are proposed for all the taxa according to IUCN Red List Categories Version 3.1 (2001) and the Application of IUCN Red List Criteria at Regional Levels (Gardenfors *et al.*, 2001). Details of the threats are determined for each species and comments are made according to Broughton & McAdam (2002).

Threat categories are proposed for all the taxa according to IUCN Red List Categories Version 3.1 (2001). When the species was detected, we observed following criteria: their actual or potential levels of exploitation (in criteria A), the area of occupancy (in criteria B) and distributions (GPS locations), populations and their size (in criteria C) and the number of mature individuals (in criteria D). According to the results, we re-evaluated their current conservation status. The following categories established and defined by IUCN (2001) have been used in this study. Data deficient (DD): inadequate information available to make an direct assessment. Critically endangered (CR): the taxon has an extremely high risk of extinction in the wild. Endangered (EN): the taxon has a very high risk of extinction in the wild. Vulnerable (VU): the taxon has a high risk of extinction in the wild in the medium term future. Near threatened (NT): the taxon is none of the above, but it close to qualifying for or is likely to qualify for a threatened category in the near future. Least concern (LC): the taxon is none of the above. Widespread and abundant taxa are included in this category.

According to our recent taxonomic revision of Turkish *Salvia*, the Mediterranean and Aegean geographic regions of Turkey have 60 taxa (56 species, 2 subspecies and 2 varieties) 32 of which are endemic (mainly local endemics), 5 of which are non-endemic rare and remaining 23 taxa are widely distributed both in the regional and the global level.

The distribution of species according to phytogeographical regions is as follows: Mediterranean elements 29 (50%), Irano-Turanian elements 25 (43%), Euro-Siberian element 1 (2%), unknown or multiregional elements 3 (5%). Mediterranean elements distributed mainly in lower altitude than Irano-Turanian elements and they usually prefer south facing slopes of the Taurus Mountains. Irano-Turanian elements mostly distributed in the inner part of the Mediterranean and Aegean regions. In the area, there is only one species, *S. glutinosa,* Euro-Siberian element. It was found in humid shadowy areas under *Fagus orientalis* Lipsky forest in Amanos Mountains.

According to IUCN (2001) criteria at national level, *S. haussknechtii* Boiss., known only from type gathering, is evaluated as Data Deficient (DD). This taxon was not

found in a detailed floristic research conducted in the type locality between 1977 and 1981 by Yıldız (2001). As well as, we could not find any specimens of *S. haussknechtii* in spite of many expeditions to its type location and other potential areas. Therefore, we have not got inadequate information to make a direct or indirect assessment of its vulnerability. This might be due to extinction of the species in the area, or its known type locality wrong, or the species is distributed somewhere. *S. quezelii* Hedge & Afzal-Rafii is Critically Endangered [CR B1ab(i,ii,iv); C2a(ii): extent of occurrence less than 100 km^2; area of occupancy less than 10 km^2; known to exist at only a single location; all mature individuals placed in one population and estimated mature individuals fewer than 100]. *S. tigrina* Hedge & Hub.-Mor., *S. sericeo-tomentosa* Rech. fil., *S. smyrnaea* Boiss., *S. marashica* İlçim, F.Celep & Dogan, *S. nydeggeri* Hub.-Mor., *S. albimaculata* Hedge & Hub.-Mor., *S. adenocaulon* P.H. Davis, *S. chrysophylla* Staph, *S. cassia* Samuellss. ex Rech. fil., *S. pomifera* L., *S. viscosa* Jacq. are Endangered [EN B2ab(i,ii,iv): area of occupancy less than 500 km^2, known at no more than five locations]. 17 taxa are evaluated as Vulnerable [VU B2ab(i,ii,iv): area of occupancy less than 2000 km^2, known at no more than 10 locations; inferred decline in the area]. 7 taxa are evaluated as Near Threatened (NT)] since they are likely to qualify for a threatened category in the near future. Remaining 23 non-endemic taxa are evaluated as Least Concern (LC) since they are widespread or abundant (Table 12, Figure 87) (Celep *et al.*, 2010d).

The distribution of the threatened species according to regional (The Aegean and the Mediterranean geographic regions of Turkey), national and international level is as follows: In the regional level; 1 taxon DD, 1 taxon CR, 19 taxa EN, 18 taxa VU and 21 taxa LC. In the national level: 1 taxon DD, 1 taxon CR, 11 taxa EN, 17 taxa VU, 7 taxa NT and 23 taxa LC. In the international level, 1 taxon DD, 1 taxon CR, 8 taxa EN, 15 taxa VU, 7 taxa NT and 28 taxa LC (Table 12, Figure 87).

The distribution of the threatened species according to geographic regions is as follows at international level: In the Aegean region; 1 taxon EN, 6 taxa VU, 5 taxa NT and 14 taxa LC. In the Mediterranean region: 1 taxon DD, 1 taxon CR, 7 taxa EN, 12 taxa VU, 7 taxa NT and 27 taxa LC (Figure 87).

The distribution of species according to phytogeographical regions is as follows: 30 taxa (50%) Mediterranean elements (1 taxon DD, 1 taxon CR, 8 taxa EN, 8 taxa VU, 1 taxon NT and 11 taxa LC), 26 taxa (43%) Irano-Turanian elements (7 taxa VU, 5 taxa NT and 14 taxa LC), 1 taxon (2%) Euro-Siberian element (LC), 3 taxa (5%) unknown or multiregional elements (1 taxon NT and 2 taxa LC) (Figure 87). Mediterranean elements distributed mainly in lower altitude than Irano-Turanian elements and they usually prefer south facing slopes of the Taurus Mountains. Irano-Turanian elements are mostly distributed in the inner part of the regions. In the area, there is only one species, *S. glutinosa* L., Euro-Siberian element. It was found in humid shadowy areas under *Fagus orientalis* Lipsky forest in Amanos Mountains.

22 taxa (18 endemics and 4 non-endemics) grow only in the study area (Table 12). Between 2005 and 2009, the authors visited the type locality of these 18 endemic taxa. In spite of many expeditions, *S. potentillifolia* Boiss., *S. nydeggeri*, *S. adenocaulon*, *S. sericeo-tomentosa* and *S. quezelii* were not found in their type locality, but they were found at other locations. In Table 13, details of threats, endemism and important comments are given for the all examined taxa.

The principle threats in the study area are urbanization, cultivation, tourism activities, fire, overgrazing, pollution, road and dam constructions. In near future, plant diversity may decline and threatened species may disappear in the area if necessary conservation measures are not taken. The richest regions in terms of the endemic species number need to be legally protected with protection of the small population and vegetation (in-situ conservation), besides the areas are urgently modeled and managed by means of using the Geographical Information System (GIS) images. In addition, several other measures need to be considered such as rehabilitation or restoration of damaged habitats, transferring the species in surrounding protected areas such as national park and botanical gardens (ex-situ conservation) (Akhani & Ghorbani, 2003). As well as, public awareness and interest on the conservation of species should be increased.

Table 12. The species of the study area, their IUCN categories and criteria, and an estimated proportion (%) of the global population. (*) indicated that the species known only within the region in Turkey, (+) indicated that the species endemic, (ir-tur.) Irano-Turanian element, (med.) Mediterranean element, (eu.-sib.) Euro-Siberian element, (un. or mu.) Unknown or multiregional. 1: According to Turkish Red Data Book, 2: Recommended Threat Categories for Regional Level, 3: Recommended Threat Categories for National Level, 4: Recommended Threat Categories for International Level, 5: An estimate of the proportion (%) of the global population occurring within the region, 6: IUCN Red List Criterias (2001).

	Species	1	2	3	4	5	6
1	+,*, med. *Salvia haussknechtii*	DD	DD	DD	DD	100, ?	?
2	+,*, med. *S. quezelii*	EN	CR	CR	CR	100	B1ab(i,ii,iv); C2a(ii)
3	+,*, med. *S. tigrina*	EN	EN	EN	EN	80-100	B2ab(i,ii,iv)
4	+,*, med. *S. sericeo-tomentosa*	EN	EN	EN	EN	80-100	B2ab(i,ii,iv)
5	+,*, med. *S. smyrnaea*	EN	EN	EN	EN	100	B2ab(i,ii,iv)
6	+,*, med. *S. marashica*	-	EN	EN	EN	100	B2ab(i,ii,iv)
7	+,*, med. *S. nydeggeri*	EN	EN	EN	EN	100	B2ab(i,ii,iv)
8	+,*,med. *S. albimaculata*	VU	EN	EN	EN	100	B2ab(i,ii,iv)
9	+,*, med. *S. adenocaulon*	EN	EN	EN	EN	80-90	B2ab(i,ii,iv)
10	+,*, med. *S. chrysophylla*	NT	EN	EN	EN	100	B2ab(i,ii,iv)
11	+,*, med. *S. adenophylla*	VU	VU	VU	VU	100	B2ab(i,ii,iv)
12	+,*, med. *S. cedronella*	VU	VU	VU	VU	100	B2ab(i,ii,iv)
13	+,*, med. *S. aucheri* var. *aucheri*	VU	VU	VU	VU	100	B2ab(i,ii,iv)
	+,*, med. *S. aucheri* var. *canescens*	VU	VU	VU	VU	100	B2ab(i,ii,iv)
14	+,*, med. *S. cilicica*	VU	VU	VU	VU	90	B2ab(i,ii,iv)
15	+, ir-tur. *S. modesta*	VU	EN	VU	VU	30-40	B2ab(i,ii,iv)
16	+,*, med. *S. chionantha*	NT	VU	VU	VU	100	B2ab(i,ii,iv)
17	+,ir-tur. *S. blepharochlaena*	NT	EN	VU	VU	10-20	B2ab(i,ii,iv)
18	+,*,med. *S.potentillifolia*	NT	VU	VU	VU	100	B2ab(i,ii,iv)
19	+, ir-tur. *S. tchihatcheffii*	NT	EN	VU	VU	10-20	B2ab(i,ii,iv)
20	+, ir-tur. *S. pilifera*	LC	EN	VU	VU	20-30	B2ab(i,ii,iv)
21	+,*, med. *S. pisidica*	LC	VU	VU	VU	90-100	B2ab(i,ii,iv)

Table 12 (continue)

22	+, ir-tur. *S. recognita*	LC	EN	VU	VU	10-20	B2ab(i,ii,iv)
23	+, ir-tur. *S. wiedemannii*	LC	EN	VU	VU	10-15	B2ab(i,ii,iv)
24	+, ir-tur. *S. yosgadensis*	LC	EN	VU	VU	10-15	B2ab(i,ii,iv)
25	+, un. or mu. *S. cadmica*	LC	VU	NT	NT	40-50	-
26	+, ir-tur. *S. caespitosa*	LC	VU	NT	NT	10-20	-
27	+, ir-tur. *S. cryptantha*	LC	VU	NT	NT	10-15	-
28	+, ir-tur. *S. cyanescens*	LC	VU	NT	NT	10-15	-
29	+, ir-tur. *S. dichroantha*	LC	VU	NT	NT	10-20	-
30	+, med. *S. heldreichiana*	LC	VU	NT	NT	60-70	-
31	+, ir-tur. *S. hypargeia*	LC	VU	NT	NT	10-20	-
32	*, med. *S. aramiensis*	-	VU	VU	LC	20-30	B2ab(i,ii,iv)
33	*, med. *S. cassia*	-	EN	EN	LC	20-30	B2ab(i,ii,iv)
34	ir-tur. *S. indica*	-	EN	VU	LC	?	B2ab(i,ii,iv)
35	*, med. *S. pomifera*	-	EN	EN	LC	10-20	B2ab(i,ii,iv)
36	*, med. *S. viscosa*	-	EN	EN	LC	10-20	B2ab(i,ii,iv)
37	med. *S. tomentosa*	-	LC	LC	LC	?	Widely distributed
38	med. *S. pinnata*	-	LC	LC	LC	?	Widely distributed
39	ir-tur. *S. bracteata*	-	LC	LC	LC	?	Widely distributed
40	ir-tur. *S. suffruticosa*	-	LC	LC	LC	?	Widely distributed
41	ir-tur. *S. multicaulis*	-	LC	LC	LC	?	Widely distributed
42	med. *S. viridis*	-	LC	LC	LC	?	Widely distributed
43	ir-tur. *S. syriaca*	-	LC	LC	LC	?	Widely distributed
44	ir-tur. *S. palaestina*	-	LC	LC	LC	?	Widely distributed
45	un. or mu. *S. sclarea*	-	LC	LC	LC	?	Widely distributed
46	un. or mu. *S. aethiopis*	-	LC	LC	LC	?	Widely distributed
47	ir-tur. *S. ceratophylla*	-	LC	LC	LC	?	Widely distributed
48	med. *S. argentea*	-	LC	LC	LC	?	Widely distributed
49	ir-tur. *S. microstegia*	-	LC	LC	LC	?	Widely distributed
50	ir-tur. *S. frigida*	-	LC	LC	LC	?	Widely distributed
51	ir-tur. *S. candidissima* ssp. *candidissima*	-	LC	LC	LC	?	Widely distributed
	ir-tur. *S. candidissima* ssp.	-	LC	LC	LC	?	Widely distributed

Table 12 (continue)

	occidentalis						
52	eu.-sib. *S. glutinosa*	-	VU	LC	LC	?	Widely distributed
53	ir-tur. *S. virgata*	-	LC	LC	LC	?	Widely distributed
54	med. *S. fruticosa*	-	LC	LC	LC	5-10	Widely distributed
55	med. *S. verbenaca*	-	LC	LC	LC	?	Widely distributed
56	ir-tur. *S. verticillata* ssp. *amasiaca*	-	LC	LC	LC	?	Widely distributed
57	ir-tur. *S. russellii*	-	VU	LC	LC	?	Widely distributed
58	med. *S. napifolia*	-	LC	LC	LC	?	Widely distributed

Table 13. The principle threats and comments on the taxa. (*) indicated that the species known only within the region in Turkey, ($^{+}$) indicated that the species endemic. 1: Urbanization & Tourism activities, 2: Constructions (Road, Dam and others.), 3: Overgrazing, 4: Land Clearing & Fire.

	Species	1	2	3	4	Comments
1	$^{+,*}$*Salvia haussknechtii*			+		The species is only known from type gathering. Despite many expeditions, the species did not find. Overgrazing likely to be a major factor limiting distribution. More information is required before reaching any conclusion.
2	$^{+,*}$*S. quezelii*		+		+	The species did not find in its known localities. Recently, we have found it from one another location as a small population.
3	$^{+,*}$*S. tigrina*			+	+	Only known from type gathering. Despite many expeditions, the species did not find in its type location; however another herbarium specimen of the species has been seen in BM from Syria borealis.
4	$^{+,*}$*S. sericeo-tomentosa*	+	+			The species did not find in its type location. But another population was found in Samandağ-Hatay.
5	$^{+,*}$*S. smyrnaea*		+	+		Restricted to the western Anatolia and only three populations are currently known.
6	$^{+,*}$*S. marashica*	+	+			The species has been recently described from Kahramanmaraş. Urbanization, road and dam constructions are the major threats on the species.
7	$^{+,*}$*S. nydeggeri*		+		+	Restricted to the western Mediterranean region of Turkey.
8	$^{+,*}$*S. albimaculata*		+		+	Restricted to around Ermenek-Karaman. Road-

Table 13 (continue)

						Dam constructions and land clearing are the major threats.
9	[+,*]*S. adenocaulon*			+		Restricted to the central Mediterranean region of Turkey. Likely to be a threatened as a result of overgrazing.
10	[+,*]*S. chrysophylla*		+	+	+	Recorded only 5 times. Road construction, overgrazing and land clearing are the major threats.
11	[+,*]*S. adenophylla*		+		+	Restricted to the western Mediterranean region and southern Aegean region of Turkey.
12	[+,*]*S. cedronella*		+		+	Restricted to the western Mediterranean region and southern Aegean region of Turkey.
13	[+,*]*S. aucheri* subsp. *aucheri*		+		+	Restricted to the eastern Mediterranean region of Turkey. Its leaves are used as herbal tea.
	[+,*]*S. aucheri* subsp. *canescens*		+		+	Restricted to around Ermenek, Mut,Gülnar,Karaman. Road-Dam constructions and land clearing are the major threats.
14	[+,*]*S. cilicica*		+	+	+	Restricted to the eastern Mediterranean region of Turkey.
15	[+]*S. modesta*		+	+		In the area, the species is very rare. Only known from two small isolated populations at high altitude.
16	[+,*]*S. chionantha*		+		+	Restricted to the western Mediterranean region of Turkey. Only known from small isolated populations.
17	[+]*S. blepharochlaena*		+	+		In the area, only known from a few small isolated populations.
18	[+,*]*S. potentillifolia*		+		+	Restricted to the western Mediterranean region

Table 13 (continue)

						of Turkey. A major population occurs in Cedar Research Forest (Elmalı-Antalya).
19	[+]*S. tchihatcheffii*		+	+		In the study area, the species is known from the eastern Aegean region as small populations.
20	[+]*S. pilifera*		+			In the study area, restricted to the eastern Mediterranean region of Turkey.
21	[+,*]*S. pisidica*	+	+			Restricted to the western Mediterranean region of Turkey.
22	[+]*S. recognita*		+	+		In the area, only known from a few small isolated populations.
23	[+]*S. wiedemannii*		+			In the area, the species is known from the eastern Aegean region of Turkey as small populations.
24	[+]*S. yosgadensis*		+	+		In the area, only known from one population. However, it is distributed mainly in the central Anatolia.
25	[+]*S. cadmica*			+		Frequently in rocky places in the central Anatolia and the western part of the study area.
26	[+]*S. caespitosa*		+	+		In the study area, frequent in rocky places in eastern Mediterranean region. However, one extant population occurs in Antalya.
27	[+]*S. cryptantha*		+			The endemic species is mainly distributed in the central Anatolia and the northern Mediterranean region of Turkey. Its leaves are used as herbal tea.
28	[+]*S. cyanescens*		+	+		The endemic species is mainly distributed in the central Anatolia and the northern

Table 13 (continue)

						Mediterranean region of Turkey.
29	+*S. dichroantha*		+			The endemic species is mainly distributed in the central Anatolia and the northern Mediterranenan region of Turkey.
30	+*S. heldreichiana*		+			The species is mainly distributed in the Mediterranean region of Turkey and it can be seen in the central Anatolia.
31	+*S. hypargeia*					This endemic species is mainly distributed in the central Anatolia and the northern Mediterranenan region of Turkey.
32	**S. aramiensis*		+		+	Only known from Amanos Mountains. Its leaves are used as herbal tea in Hatay.
33	**S. cassia*		+		+	Restricted to Amanos Mountains and the eastern Mediterranean region of Turkey.
34	*S. indica*		+	+		Restricted to the eastern Mediterranean region of Turkey in the study area.
35	**S. pomifera*		+			Restricted to the western Mediterranean region of Turkey. Only known from small isolated populations around Aydın. Its leaves are used as a herbal tea.
36	**S. viscosa*		+			Restricted to Hatay-Yayladağ. Only two populations are known.
37	*S. tomentosa*		+	+		Widespread and common wherever suitable habitat exists.
38	*S. pinnata*		+			Widespread and common, although populations occur at a lower density.
39	*S. bracteata*		+			Widespread and common wherever suitable habitat exists.
40	*S. suffruticosa*		+			Although relatively widespread, it is known

Table 13 (continue)

						from only two records in the area.
41	*S. multicaulis*		+			Widespread and common in the eastern Mediterranean region of Turkey.
42	*S. viridis*		+			Widespread and common wherever suitable habitat exists.
43	*S. syriaca*		+		+	Widespread and common wherever suitable habitat exists.
44	*S. palaestina*		+			In the area, restricted to the eastern Mediterranean region of Turkey.
45	*S. sclarea*					Widespread and common wherever suitable habitat exists.
46	*S. aethiopis*					Widespread and common wherever suitable habitat exists.
47	*S. ceratophylla*					Widespread and common wherever suitable habitat exists.
48	*S. argentea*		+	+		In the area, the species is known from the western Mediterranean region of Turkey.
49	*S. microstegia*		+	+		In the area, the species is known from the eastern Mediterranean region of Turkey in the uplands.
50	*S. frigida*		+	+		Widespread and common wherever suitable habitat exists.
51	*S. candidissima* ssp. *candidissima*					Widespread and common wherever suitable habitat exists.
	S. candidissima ssp. *occidentalis*					Widespread and common wherever suitable habitat exists.
52	*S. glutinosa*		+		+	In the study area, the species is known only from Amanos Mountain.
53	*S. virgata*					Widespread and common wherever suitable

Table 13 (continue)

						habitat exists.
54	*S. fruticosa*		+		+	Restricted to the western Anatolia. Its leaves are used as a herbal tea.
55	*S. verbenaca*					Widespread and common wherever suitable habitat exists.
56	*S. verticillata* ssp. *amasiaca*					Widespread and common wherever suitable habitat exists.
57	*S. russellii*					Although widespread and common in central Anatolia, rarely recorded in the study area.
58	*S. napifolia*					Widespread and common wherever suitable habitat exists.

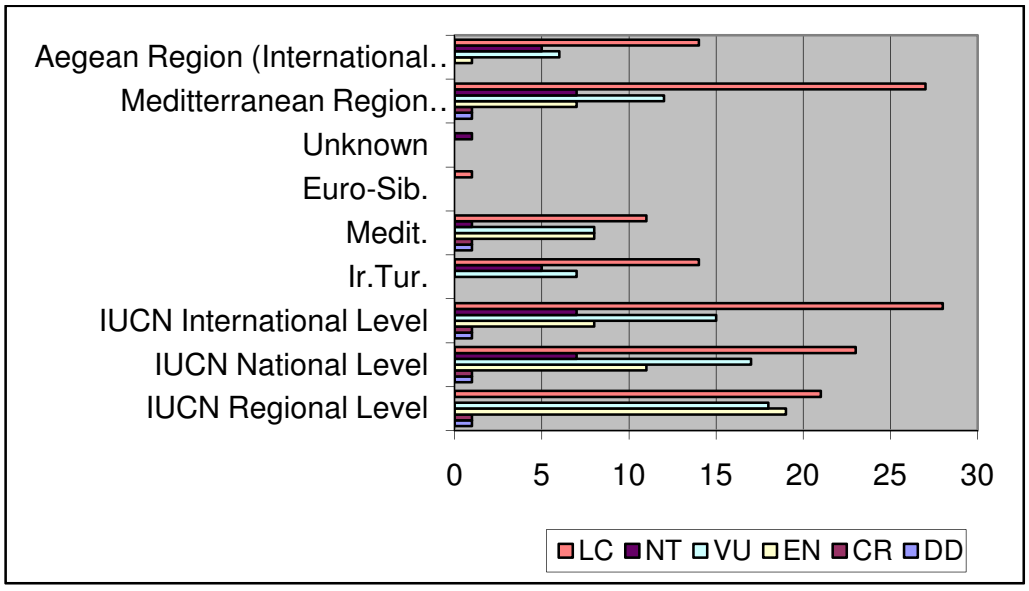

Figure 87. Distribution of the species according to IUCN Red List categories (regional, national and international level), phytogeographic elements and geographic distribution.

3.4.4. Geographical Disribution of the Species in the Research Area

Distributions maps (Figures 88-106) of the species or species-groups are given using Davis' grid squares. During the preparation of these maps, our own samples, herbarium materials (ANK, AEF, B, BM, E, G, GAZI, H, HUB, ISTE, ISTF, K and KNYA) and a number of floristic studies have been carefully investigated in order to assess species distribution throughout its entire range in the study area. As well as, I consulted both *Flora of Turkey* and *Flora Orientalis* (Celep & Doğan, 2008; Celep *et al.*, 2010d).

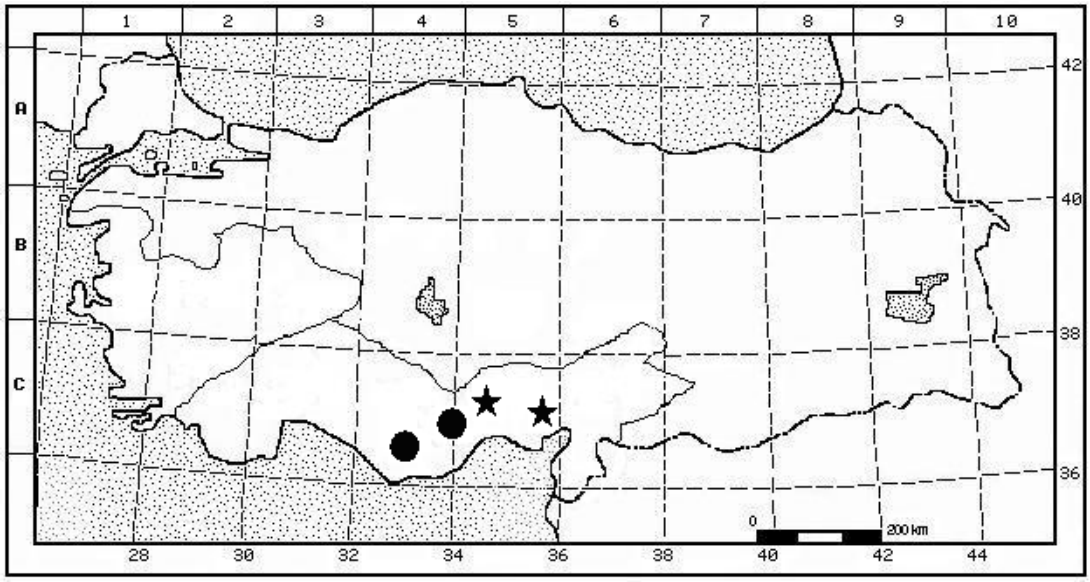

Figure 88. Distribution map of (★) *S. aucheri* subsp. *aucheri* and (●) subsp. *canascens*

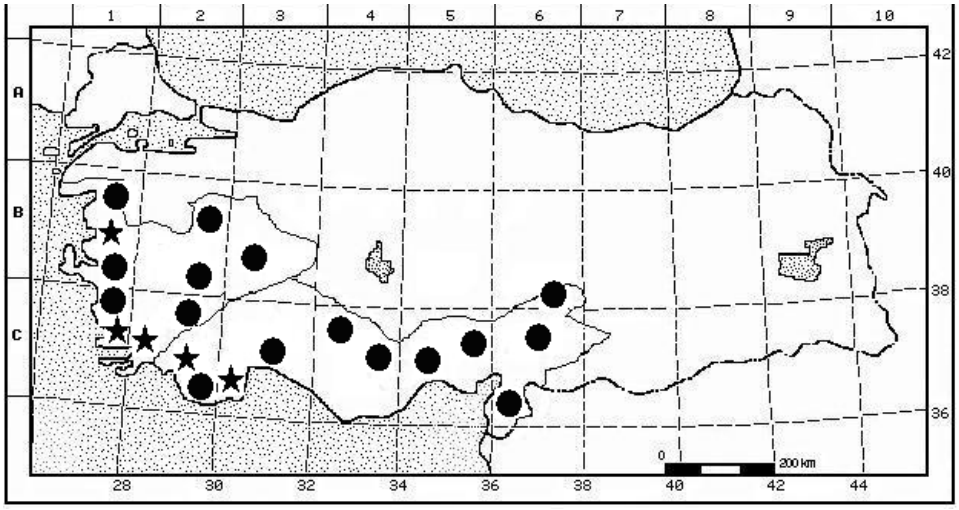

Figure 89. Distribution map of (★) *S. fruticosa* and (●) *S. tomentosa*

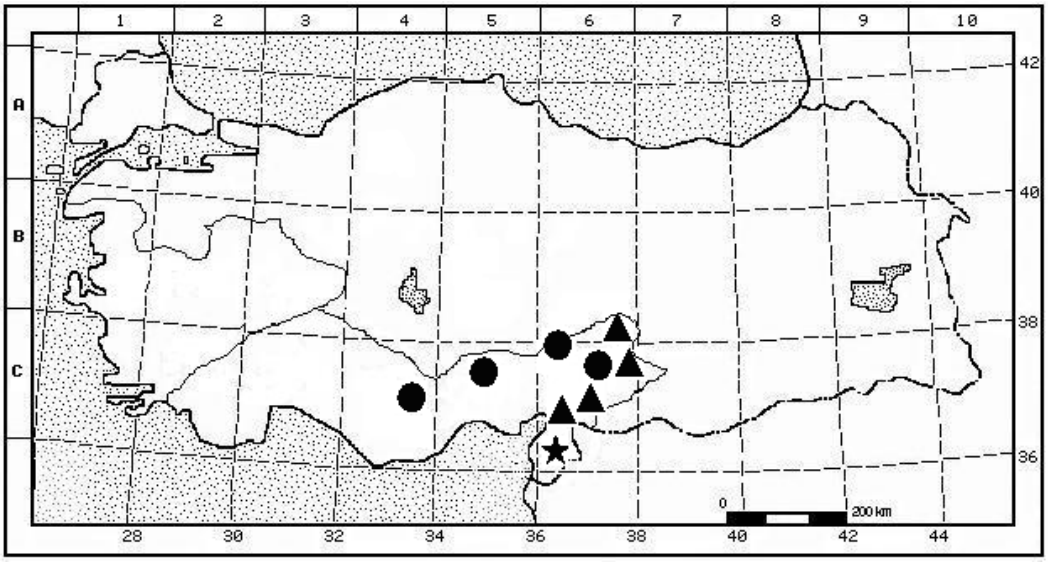

Figure 90. Distribution map of (★) *S. tigrina,* (●) *S. recognita* and (▲) *S. pilifera*

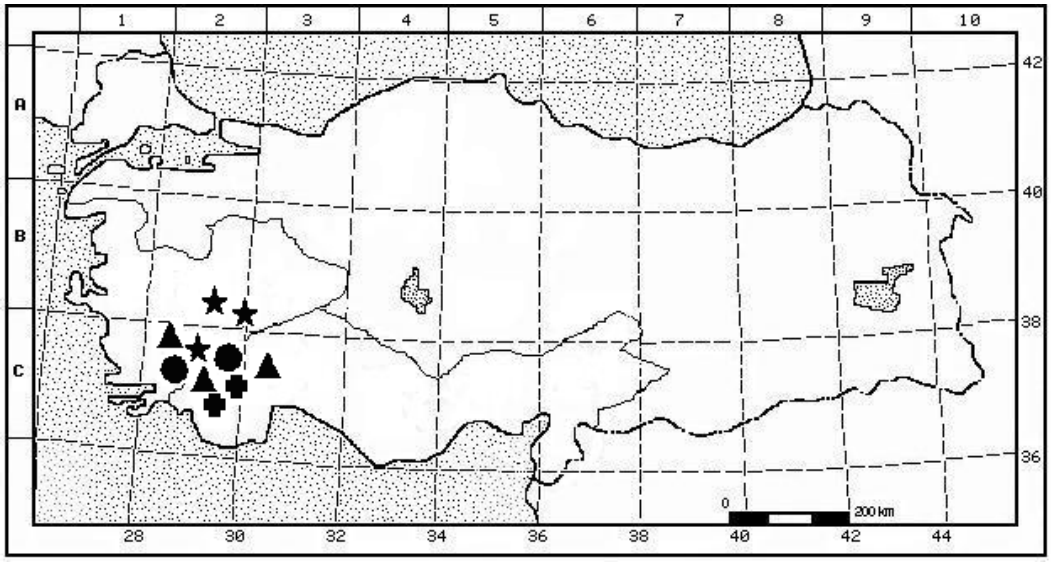

Figure 91. Distribution map of (★) *S. cedronella*, (●) *S. adenophylla*, (▲) *S. potentillifolia* and (✚) *S. nydeggeri*

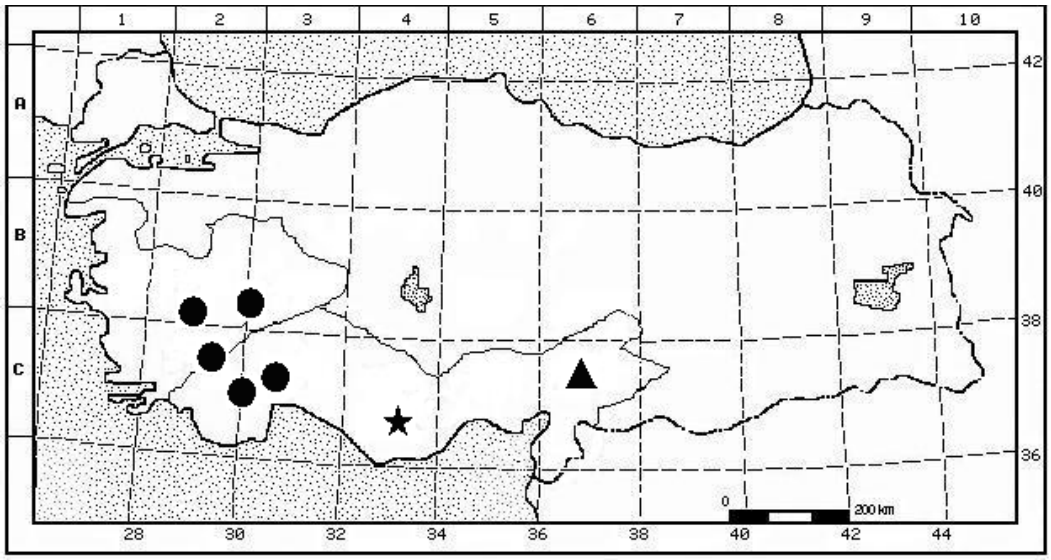

Figure 92. Distribution map of (★) *S. albimaculata*, (●) *S. pisidica* and (▲) *S. marashica*

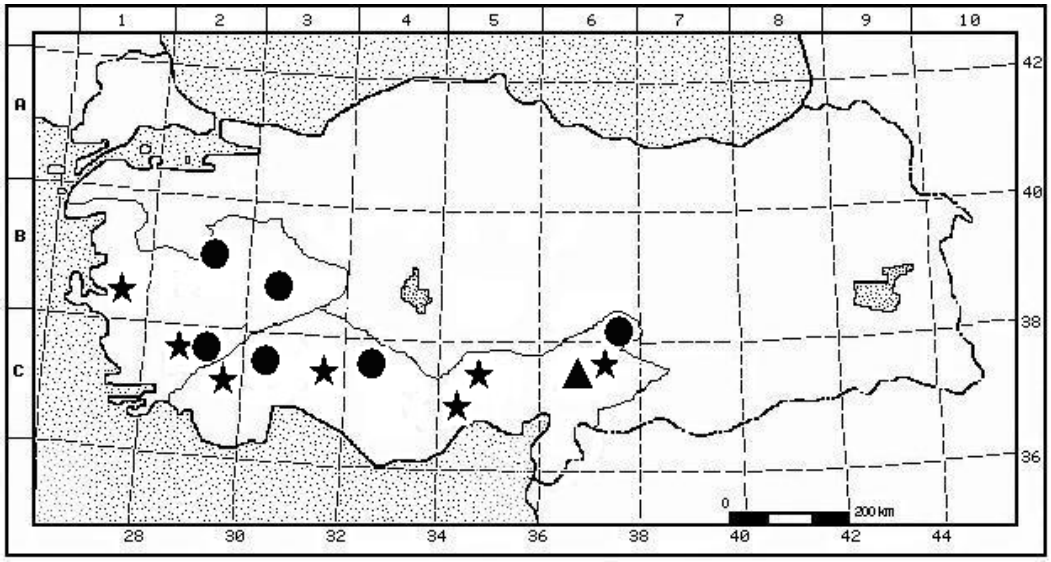

Figure 93. Distribution map of (★) *S. pinnata,* (●) *S. bracteata* and (▲) *S. suffruticosa*

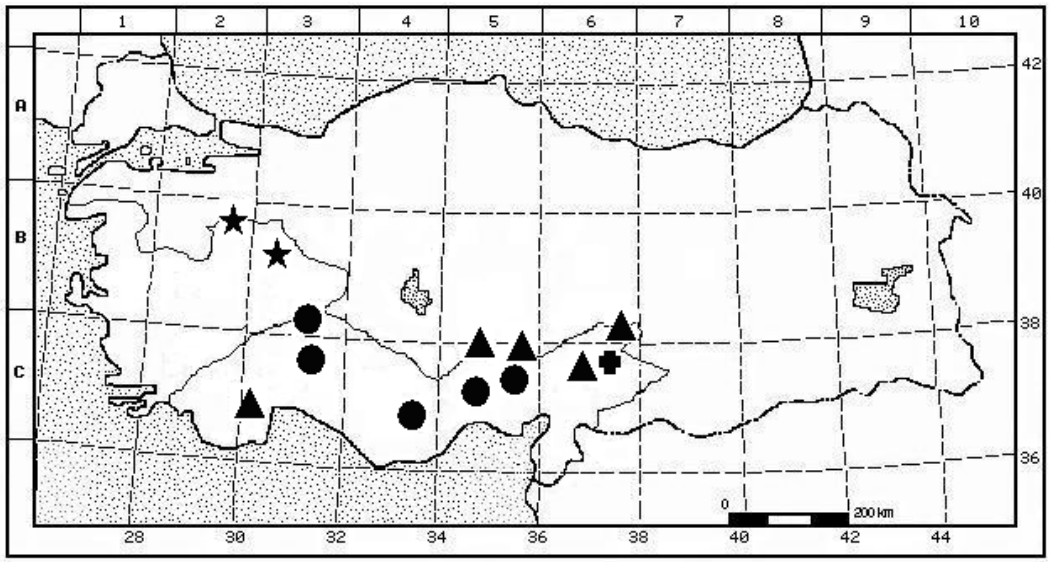

Figure 94. Distribution map of (★) *S. tchihatcheffi*, (●) *S. heldreichiana*, (▲) *S. caespitosa* and (✤) *S. haussknechtii*

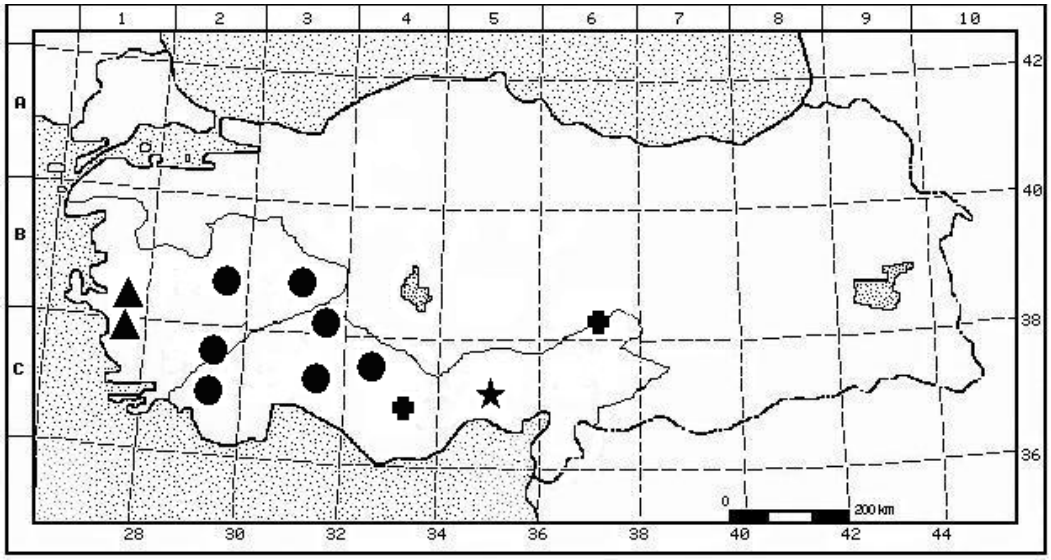

Figure 95. Distribution map of (★) *S. quezellii*, (●) *S. cadmica*, (▲) *S. smyrnaea* and (✚) *S. blepharochlaena*

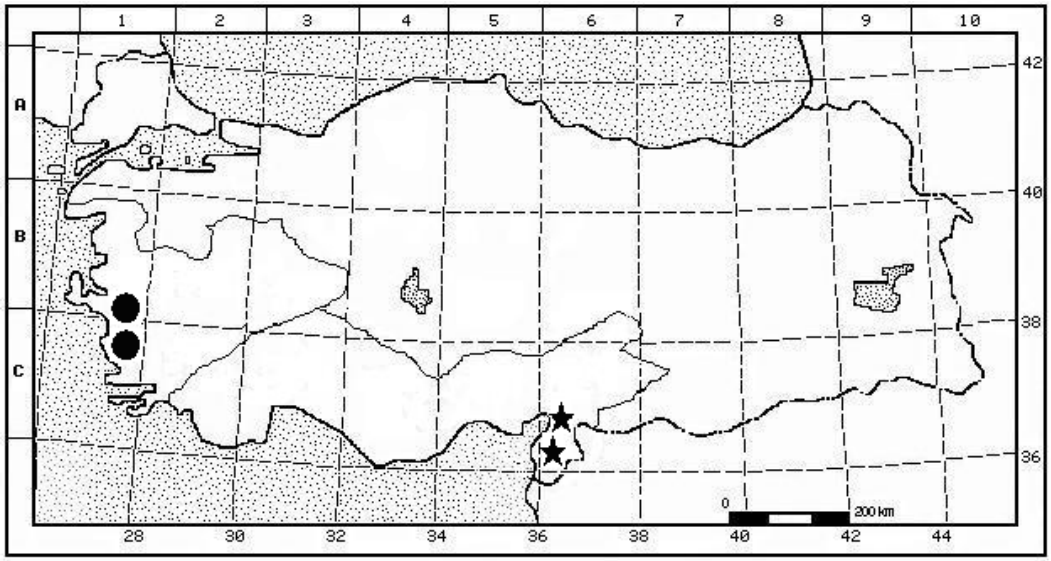

Figure 96. Distribution map of (★) *S. aramiensis* and (●) *S. pomifera*

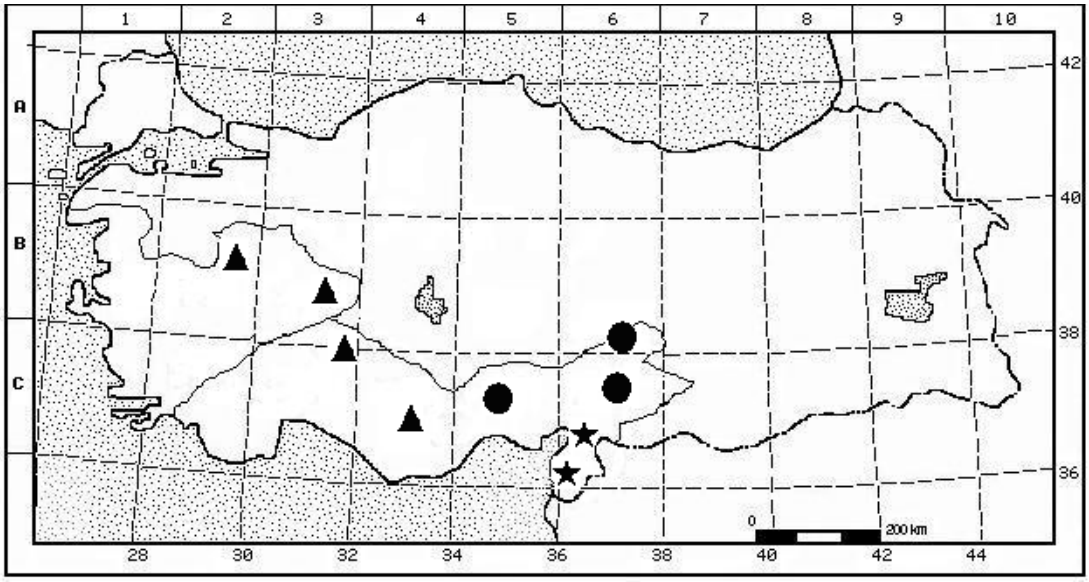

Figure 97. Distribution map of (★) *S. sericeo-tomentosa*, (●) *S. multicaulis* and (▲) *S cryptantha*

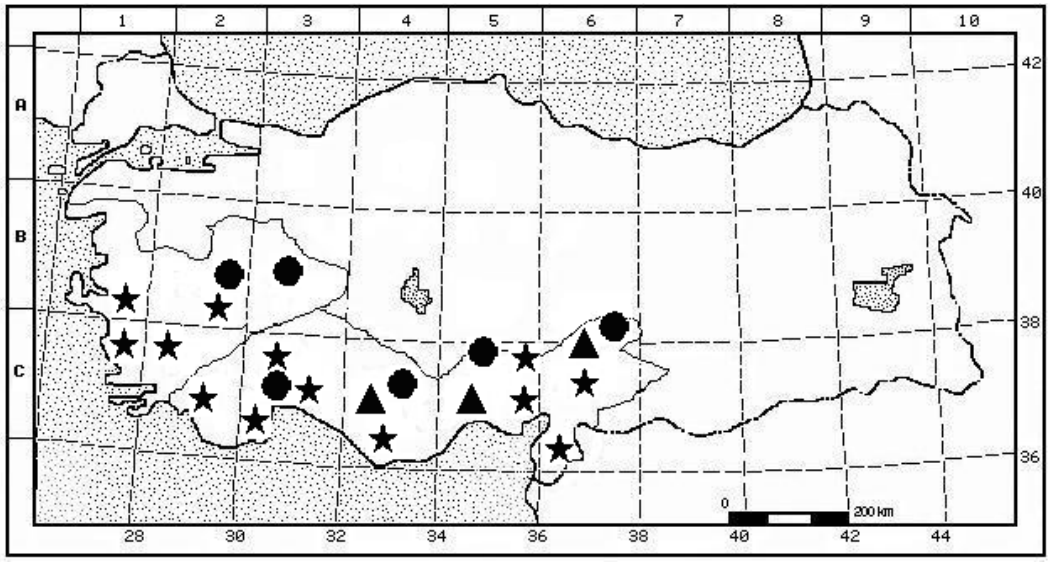

Figure 98. Distribution map of (★) *S. viridis*, (●) *S. syriaca* and (▲) *S. hypargeia*

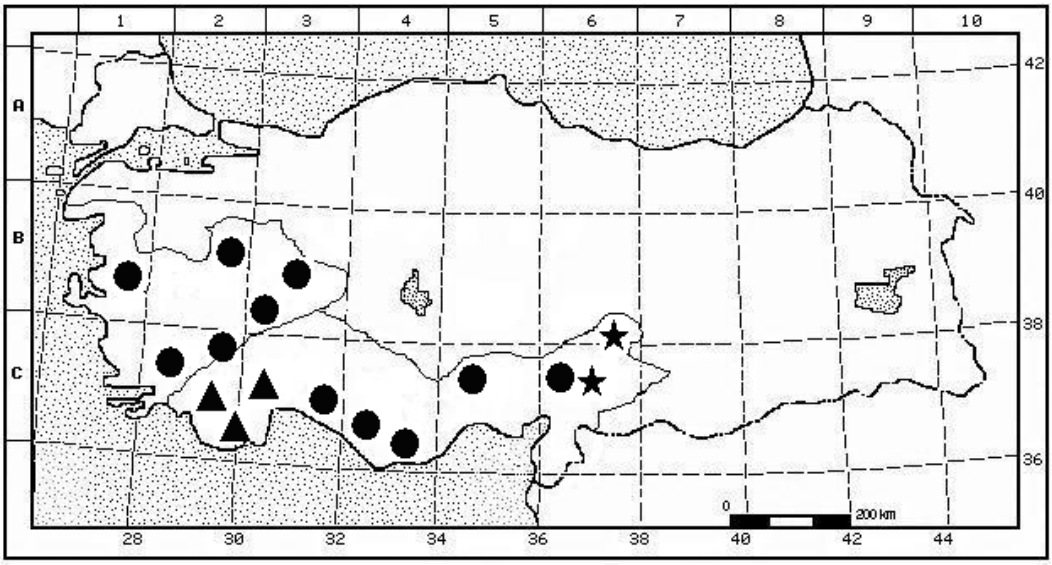

Figure 99. Distribution map of (★) *S. palaestina*, (●) *S. sclarea* and (▲) *S. chrysophylla*

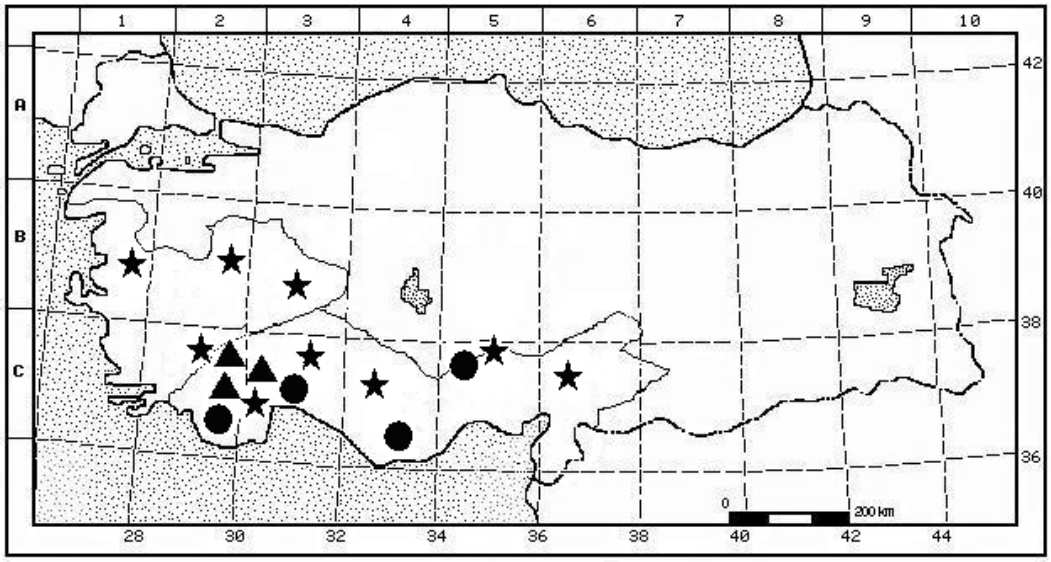

Figure 100. Distribution map of (★) *S. aethiopis*, (●) *S. ceratophylla* and (▲) *S. chionantha*

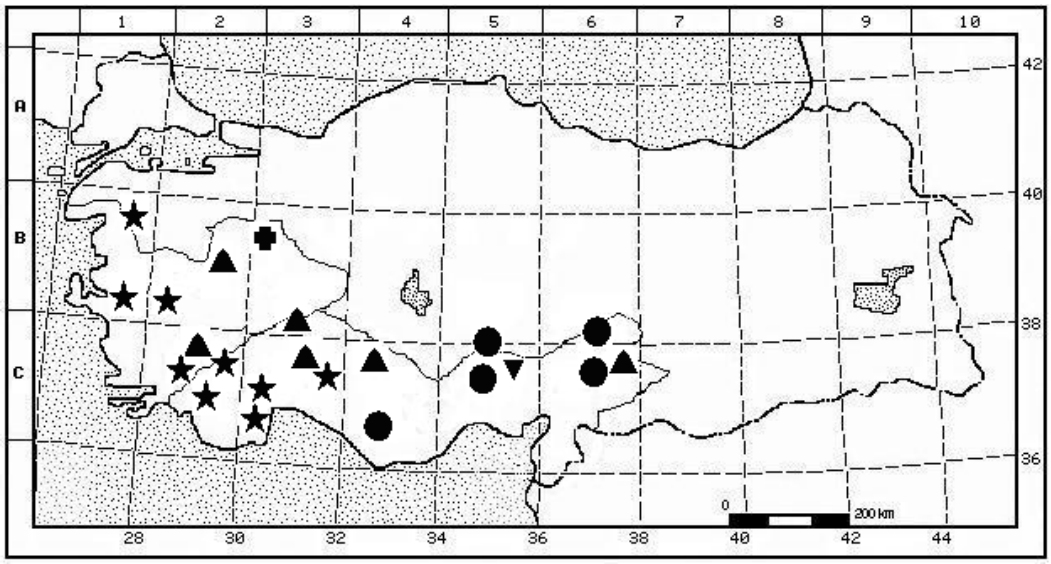

Figure 101. Distribution map of (★) *S. argentea*, (●) *S. microstegia*, (▲) *S. frigida*, (✚) *S. yosgadensis* and (▼) *S. modesta*.

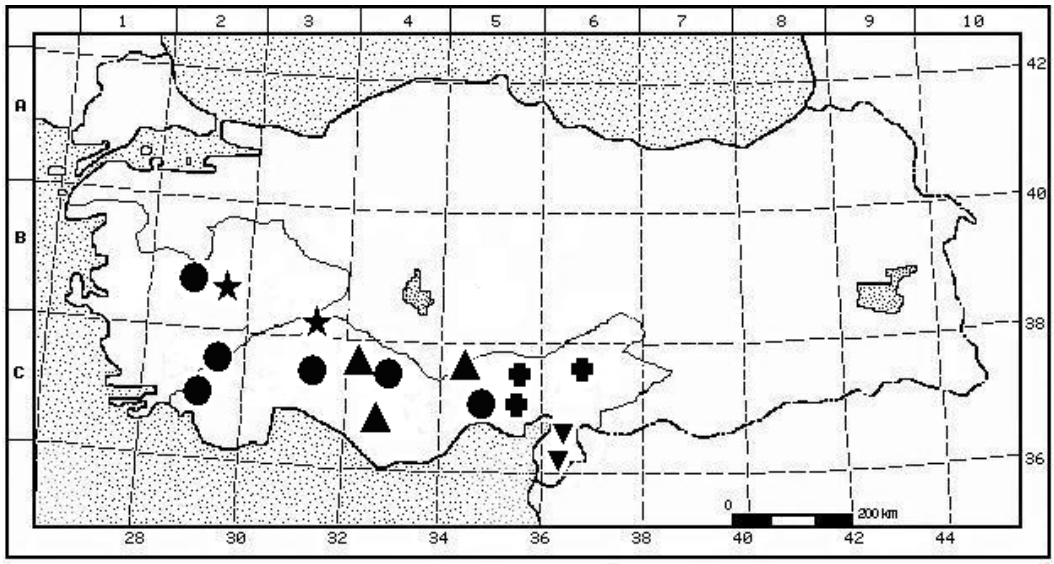

Figure 102. Distribution map of (★) *S. candidissima* ssp. *candidissima*, (●) ssp. *occidentalis*, (▲) *S. cyanescens*, (✚) *S. cilicica* and (▼) *S. cassia*.

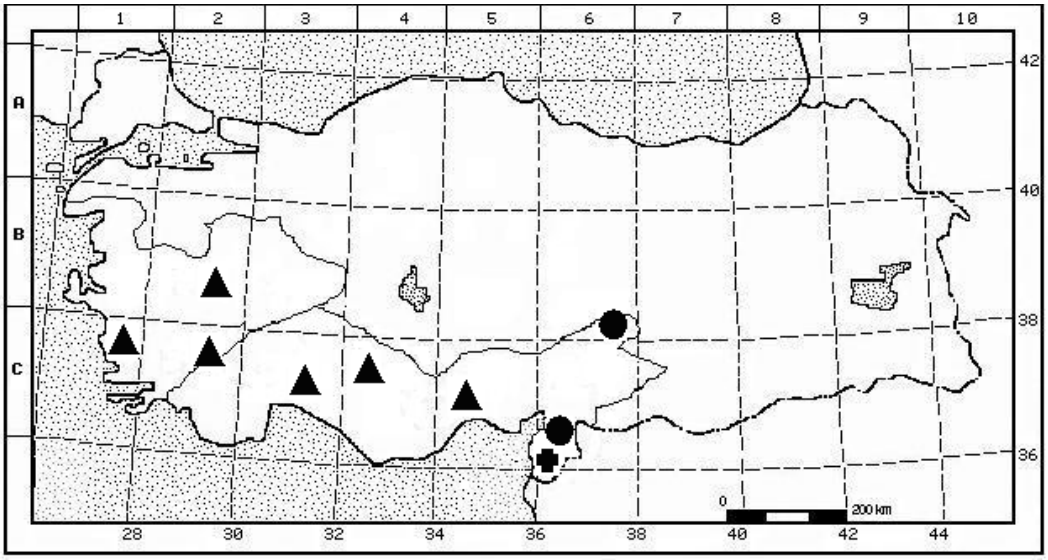

Figure 103. Distribution map of (●) *S. indica*, (▲) *S. virgata* and (✚) *S. glutinosa*.

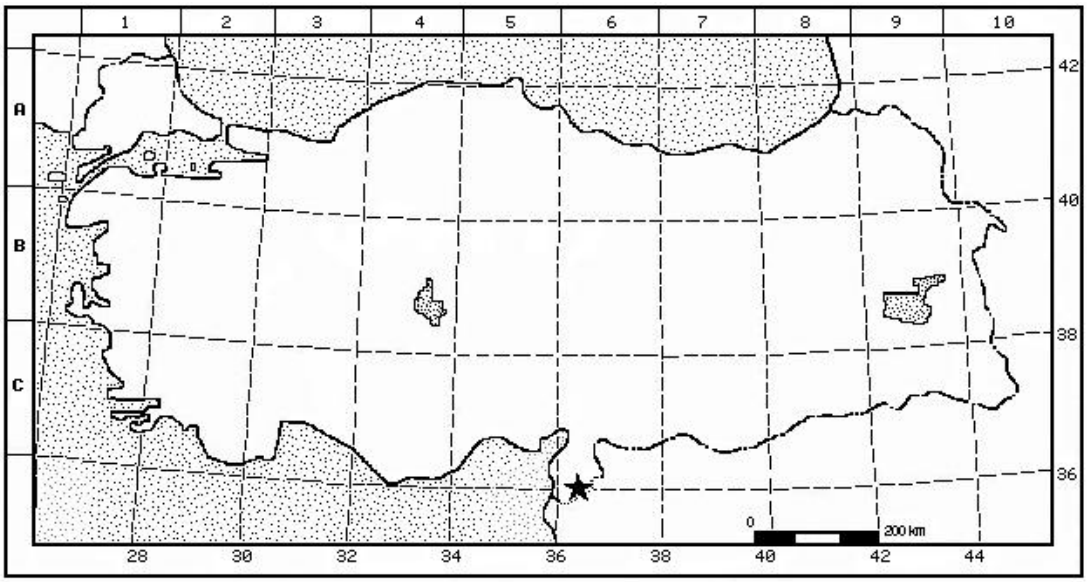

Figure 104. Distribution map of (★) *S. viscosa*

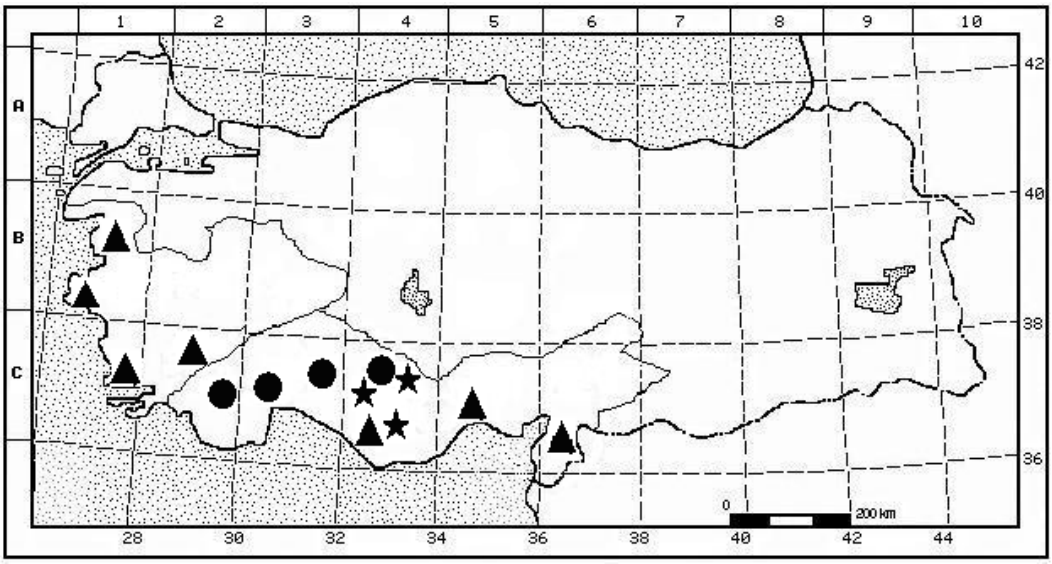

Figure 105. Distribution map of (★) *S. adenocaulon*, (●) *S. dicroantha* and (▲) *S. verbenaca*.

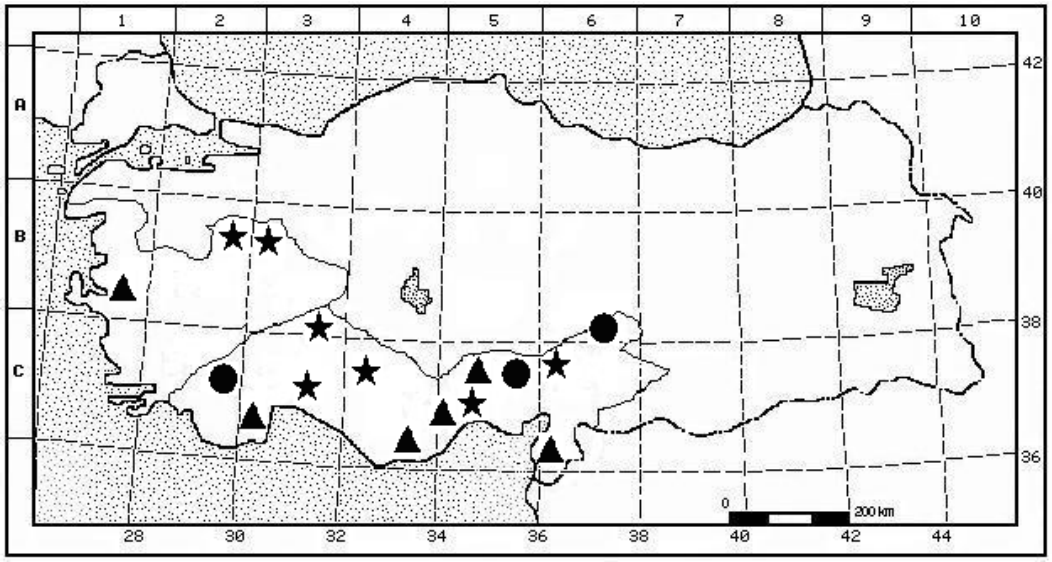

Figure 106. Distribution map of (★) *S. verticillata* ssp. *amasiaca*, (●) *S. russellii* and (▲) *S. napifolia*.

3.5. Infrageneric Delimitation

The species recognised in this thesis were grouped using Bentham's (1833) sectional delimitation. In 1895, Briquet recognised some subgenera and sections in *Salvia*, most of which correspond with those of Bentham. In *the Flora U.S.S.R*. (1972), Pobedimova grouped some of the species into few membred taxa and called them series (Hedge, 1974). When Hedge was revising European and African Salvia's, he also used Bentham's sections (Hedge, 1972; 1974).

The first time, Bentham (1833) recognized 22 species of *Salvia* from Turkey. He placed these species under six sections. These sections are as follows: *Eusphace* Benth., *Hymenosphace* Benth., *Aethiopis* Benth., *Plethiosphace* Benth., *Horminum* Benth. and *Hemisphace* Benth. Then, Boissier (1879), in his *Flora Orientalis,* recognized 75 species of *Salvia* from Turkey. According to Bentham's (1833) sectional delimitation, Boissier placed these species under seven sections. These sections are as follows: *Eusphace* Benth., *Hymenosphace* Benth., *Aethiopis* Benth., *Plethiosphace* Benth., *Horminum* Benth., *Hemisphace* Benth. and *Drymosphace* Benth. After that sect. *Euphace* was changed as sect. *Salvia* by Hedge (1972).

Although Hedge (1957; 1961) placed some Turkish species under Bentham's sections, the species were not referred to sections in the *Flora of Turkey* (Hedge, 1982a). Instead, species were grouped by stamen characters and other morplogical similarities.

In this part of the thesis, I have divided the species like Hedge into species-groups according to their morphological similarities. As well as, I have made the infrageneric delimitation of the species by means of numerical taxonomic methods. An identification key of the sections is also provided.

The morphometric analysis was carried out on the specimens stemming from own collections by measuring 46 vegetative and reproductive characters to investigate

their taxonomic delimitations (Table 14). For this purpose, 1 or more individuals were selected. Selection of specimens was undertaken according to the following criteria: well-preserved and dried specimens; well-developed flowers and nutlets. Some morphological characters hard to infer from dried specimens, such as colour and length of corolla and calyx, were noted in the field. For all specimens, termed OTUs (Operational taxonomic units; Ward, 1993) in numerical phenetics, characters were scored for a multivariate analysis (Sneath & Sokal, 1973).

Table 14. Morphological characters screened for the numerical taxonomic analysis

Number	Characters	Scoring
1	Perennial	0
	Annual	1
2.	Plant erect	0
	Plant caespitose	1
	Plant mat-forming	2
	Plant ascending	3
	Plant procumbent	4
3	Shrubby	0
	Suffruticose	1
	Herbaceous	2
4	Stem with capitat glandular hair	0
	Stem without capitat glandular hair	1
5	Stem branched above	0
	Stem branched below	1
	Stem unbranched	2
6	Stem indumentum with mostly antrorse hairs	0
	Stem indumentum with mostly retrorse hairs	1
	Stem with spreading hairs	2
	Others	3
7	Stem glabrous, glaucous	0
	Stem pilose	1
	Stem villous	2
	Stem scabridulous	3
	Stem arachnoid	4
	Stem pubescent	5
	Stem tomentosa	6
8	Bracts or floral leaves equal or shorter than calyx	0
	Bracts or floral leaves longer than calyx	1
9	Bracts linear	0
	Bracts lanceolate	1
	Bracts elliptic	2
	Bracts oblong	3

Table 14 continue

	Bracts ovate	4
	Bracts rhombic	5
	Bracts absent	6
10	Bracts length (average)	mm
11	Bracts width (average)	mm
12	Bracts pink to mauve	0
	Bracts green	1
13	Bracts membranous	0
	Bracts not membranous	1
14	Inflorescence paniculate	0
	Inflorescence not paniculate	1
15	Verticellasters distant	0
	Verticellasters close	1
16	Verticillaster 1-2 flowered	0
	Verticillaster 2-8 flowered	1
	Verticilaster 8- 40 flowered	2
17	Pedisel length (average)	mm
18	Calyx campanulate	0
	Calyx infundibular	1
	Calyx tubular	2
	Calyx t ubular-campanulate	3
	Calyx obtriangular	4
19	Calyx membranous in fruit	0
	Calyx not membranous in fruit	1
20	Calyx not or scarcely accrescent (in fruit)	0
	Calyx strongly accrescent (in fruit)	1
21	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
22	Calyx length (average)	mm
23	Calyx green	0

Table 14 continue

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

Table 14 continue

	Stamen type B	1
	Stamen type C	2
37	Stamens included upper lip of corolla	0
	Stamen clearly exceeding upper lip of corolla	1
38	Leaves pinnatisect	0
	Leaves lyrate	1
	Leaves undivided	2
39	Terminal leaflet broad	0
	Terminal leaflet linear-oblong	1
	Simple, terminal leaflet absent	2
40	Leaves linear	0
	Leaves lanceolate	1
	Leaves elliptic	2
	Leaves oblong	3
	Leaves ovate	4
	Leaves orbicular	5
	Leaves obovate	6
41	Leaves petiolate	0
	Leaves sessile	1
42	Leaf length (average)	mm
43	Leaf width (average)	mm
44	Leaf indumentum of unbranched hairs, or absent	0
	Leaf indumentum of dendroid to dendroid-stellate	1
	Leaf indumentum absent	2
45	Leaf indumentum with gland or glandular hair	0
	Leaf indumentum without gland or glandular hair	1
46	Leaves not fleshy	0
	Leaves fleshy	1

For numerical analysis, a similarity matrix was created first using Gower's (1971) general coefficient similarity (Sneath and Sokal, 1973), which can be used directly with a mixture of character types (binary, alternative, qualitative, quantitative and semi-quantitative characters) as well as taking into account missing values (St-Laurent *et al.*, 2000). This similarity matrix was then clustered by using UPGMA (the unweighted pair-group method using arithmetic averages) and the results are shown in the phenogram.

UPGMA is the most frequently used (Rosemburgh, 1984) and also appears to produce the best results (Radford, 1986) in terms of three properties: accurate reflection of the similarity matrix, symmetrical hierarchical structure and congruence with classification derived by traditional methods (Ward, 1993). For this analysis, the MVSP (a multivariate statistics package for IBM PC and compatibles) program package for clustering analysis was applied.

As a result of our numerical analysis, a cut-off line across the phenogram at 0.78 similarity level distinguishes the sections like Bentham's *Prodromus* and Boissier's *Flora Orientalis* and other floras, the UPGMA clustering analysis have separated specimens under seven sections (Figure 107) (Doğan *et al*., 2007).

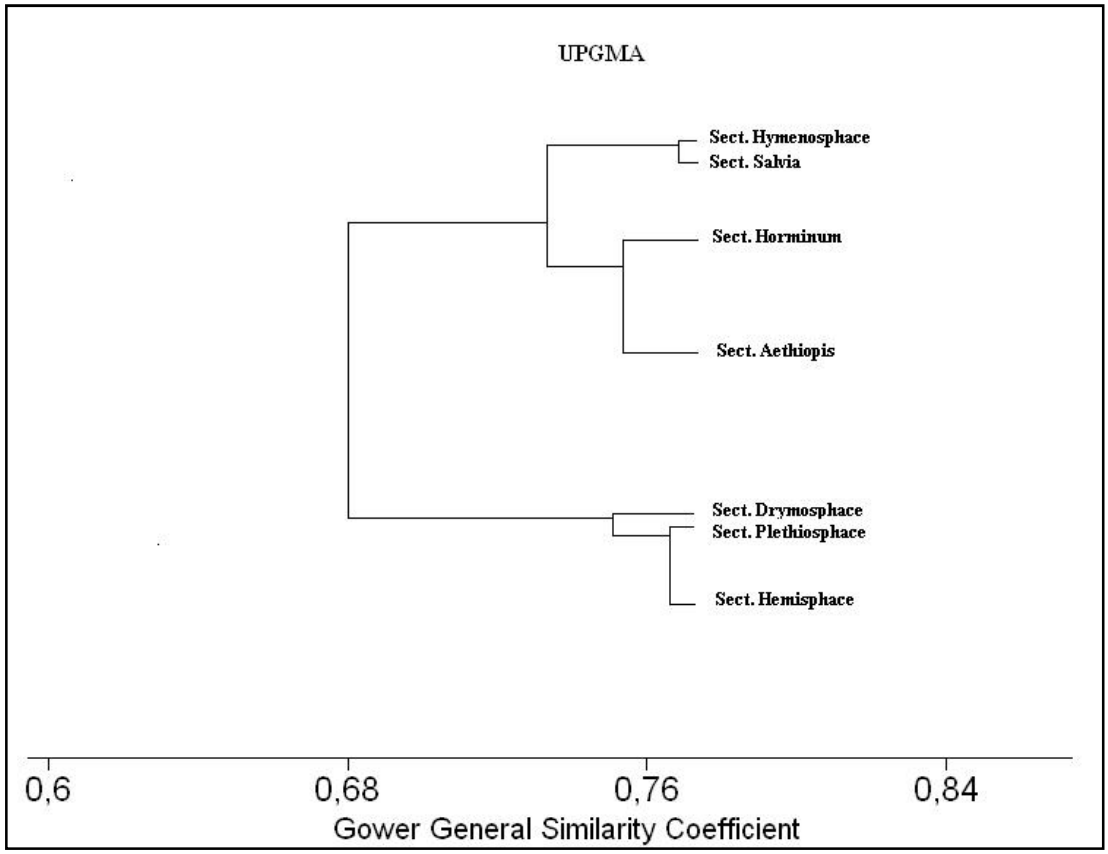

Figure 107. As a summary of the main phenogram, the UPGMA clustering analysis has separated specimens under seven sections. These sections are as follows: *Salvia*, *Hymenosphace*, *Drymosphace*, *Aethiopis*, *Plethiosphace*, *Horminum* and *Hemisphace*. Section *Eusphace* Benth. later designated as the type section of the genus *Salvia.*

Key for the Sections of Genus *Salvia* L. in the Mediterranean and Aegean geographic Regions of Turkey

1a. Annuals…….…...……**Sect. *Horminum***

1b. Biennials or Perennials…….....2

2a. Corolla tube annulate (hairy-ringed inside)…….…….……3

2b. Corolla tube not annulate (not hairy-ringed inside)…….…….6

3a. Connective longer than filament and not articulated with it, arms unequal, the sterile arm shorter, subulate (Stamen type C)……..…….**Sect. *Hemisphace***

3b. Not as above, Stamen Type A or B……...……...….4

4a Stamen type B…….……**Sect. *Drymosphace***

4b Stamen type A……...5

5a. Calyx membranous and strongly accrescent in fruit…….**Sect. *Hymenosphace***

5b. Calyx not membranous and not strongly accrescent in fruit…..….**Sect. *Salvia***

6a. Calyx campanulate, upper lip concave and 2-sulcate in fruit……..**Sect. *Plethiosphace***

6b. Calyx tubular or campanulate, upper lip is not concave and not 2-sulcate in fruit…….…….……...**Sect. *Aethiopis***

Section 1 *Salvia* Hedge (Sect. *Euphace* Benth.):

The section is composed of shrubs and herbs with a relatively primitive staminal structure. The characteristic features of this section are leaves pinnatisect or simple, stems herbaceous or suffruticose, calyx little enlarging after anthesis and lips not diverging, upper lip of corolla more or less straight and corolla tube annulate. Staminal connectives are equal or slightly longer than filaments and lower theca fertile (Hedge, 1972).

Species: *S. aucheri* subsp. *aucheri, S. aucheri* subsp. *canescens, S. fruticosa, S. tomentosa, S. aramiensis, S. potentillifolia, S. nydeggeri, S. cedronella, S. adenophylla, S. quezelii, S. marashica, S. wiedemannii, S. pisidica, S. albimaculata, S. tchihatcheffii, S. heldreichiana, S. caespitosa, S. suffruticosa, S. tigrina, S. recognita, S. pilifera, S. pinnata* and *S. bracteata*.

Section 2 *Hymenosphace* Benth.:

The section comprises woody semi-shrubs with a relatively primitive staminal structure. The characteristic feature of the section is a calyx greatly enlarging after anthesis and containing four nutlets only one or two of which usually reaching maturity. The largest number of species in section *Hymenosphace* grows in Turkey but other members grow in Iran and Central Asia (Hedge, 1965).

Species: *S. cadmica, S. smyrnaea, S. blepharochlaena, S. pomifera, S. sericeo-tomentosa, S. multicaulis, S. cryptantha, S. haussknechtii.*

Section 3 *Horminum* (Moench) Dumort:

Annuals, Calyx tubular, deflexed in fruit. Upper lip o corolla more or less straight, tube not hairy ringed. Connective longer than filaments, arms unequal, the sterile arm shorter and more or less flattened distally (Hedge, 1972).

Species: *S. viridis*

Section 4 *Aethiopis* 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 (Hedge, 1972).

Species: *S. syriaca, S. modesta, S. hypargeia, S. palaestina, S. sclarea, S. chrysophylla, S. aethiopis, S. ceratophylla, S. chionantha, S. argentea, S. microstegia, S. frigida, S. yosgadensis, S. candidissima, S. cyanescens, S. cilicica, S. cassia, S. indica.*

Section 5 *Drymosphace* Benth.:

Like Sect. *Aethiopis* but perennial herbs; upper lip of corolla strongly falcate; shorter arm of staminal connective with a sterile cell (Hedge,1972).

Species: *S. glutinosa.*

Section 6 *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: *S. virgata, S. viscosa, S. adenocaulon, S. dichroantha, S. verbenaca.*

Section 7 *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 (Hedge, 1972).

Species: *S. verticillata* subsp. *amasiaca, S. napifolia, S. russelii*.

Comparision of the sections according to their morphological differences is given in Table 15.

Table 15. Comparision of the sections according to their morphological differences

	Salvia	*Hymenosphace*	*Aethiopis*	*Plethiosphace*	*Drymosphace*	*Horminum*	*Hemisphace*
Leaf	Biennial or perennial	Biennial or perennial	Biennial or perennial	Biennial or perennial	Biennial or perennial	Annual	Biennial or perennial
	Pinnatisect or trisect	Pinnatisect or simple with or without basal lobes	Simple	Simple	Simple with or without basal lobes	Simple	Simple with or without basal lobes
Calyx	Thick-textured	Membranous	Thick-textured	Thick-textured	Thick-textured	Thick-textured	Thick-textured
	Upper lip not concave and not 2-sulcate in fruit	Upper lip not concave and not 2-sulcate in fruit	Upper lip not concave and not 2-sulcate in fruit	Upper lip concave and 2-sulcate in fruit	Upper lip not concave and not 2-sulcate in fruit	Upper lip not concave and not 2-sulcate in fruit	Upper lip not concave and not 2-sulcate in fruit
Corolla	Tube annulate	Tube annulate	Tube not annulate	Tube not annulate	Tube annulate	Tube not annulate	Tube annulate
	Tube not squamulate	Tube not squamulate	Tube squamulate	Tube squamulate or not	Tube not squamulate	Tube not squamulate	Tube not squamulate
	Upper lip more or less straight	Upper lip more or less straight	Upper lip more or less falcate	Upper lip straight or falcate	Upper lip strongly falcate	Upper lip more or less falcate	Upper lip more or less straight
Stamen (Hedge, 1982a)	Type A	Type A	Type B	Type B	Type B	Type B	Type C

3.6. Revision

The Genus *Salvia* L.

Herbaceous, suffruticose, chamaephytes or shrubby perennials, biennials or rarely annual, aromatic plants. Leaves undivided, lobed or pinnatisect. Inflorescence of variously arranged cymes or often in false whorls (verticillaters). Verticillasters (1-) 2-8 (-40) flowered distant or approximating. Bracts always present, bracteoles sometimes present. Calyx tubular, campanulate or infundibular, bilabiate, more or less distinctly 2-labiate, upper lip short 3-dentate, lower lip 2-dentate. Fruting calyces slightly or clearly expanded and then sometimes membranous. Corolla white, yellow, pink, purple or violet, bilabiate. Upper lip straight to falcate (hood), lower lip (labellum) 3-lobed with a broad concave middle lobe and two small lateral lobes; tube straight or curved, or ventricose, annulate (hairy ring) or not, squamulate or not (esquamulate). Stamens 2, with a short filament and a short or much elongated connective bearing at the upper and a fertile theca end, at the lower end, either a smaller fertile or subfertile theca (stamen type A) or variously shaped sterile tissue (Stamen type B); stamens normally articulating at junction of filament and connective, rarely not (Stamen type C): staminods (posterior pair of stamens) always present, small. Style 2 lobed. Nutlets glabrous or hairy, ovoid, oblong, spherical, obovate and ovate, trigonous or rounded, often producing mucilage on wetting (myxocarpy) (Hedge 1972; 1982a; 1982b).

Identification key

1. Annual, stems often topped by a coloured coma of sterile bracts **31. viridis**
1. Biennial or perennial, stems without a coma
   2. Fruiting calyces membranous-reticulate, infundibular with widely spreading rounded lobes
      3. Leaves pinnatisect, petioles often prominently ciliate with long white eglandular hairs
         4. Stems eglandular pilose; corolla less than 25 mm **23. haussknechtii**
         4. Stems glandular villous; corolla 30-50 mm **26. blepharochleana**
      3. Leaves simple, rarely with 1-2 pairs of small lateral basal lobes
         5. Shrubs with woody stems at least below.
            6. Leaves narrowly oblong, clearly attenuate at base; stems up to 50 cm; calyx often green; corolla upper lip yellow lower one white (S.Anatolia, Amanos Da., Hatay) **28. sericeo-tomentosa**
            6. Leaves oblong to ovate-oblong, not attenuate at base; stems up to 150 cm; calyx often purplish; corolla purplish blue (W. Anatolia, Aydın-İzmir **27. pomifera**
         5. Herbs with a woody rootstock and herbaceaous stems
            7. Corolla 27-33 mm; stems glandular pilose and eglandular villous **24. cadmica**
            7. Corolla 15-22 mm; stems eglandular, branched or dendroid hairy
               8. Calyx green, stem dendroid hairy **30. cryptantha**
               8. Calyx purple, stem with or without dendroid hairs **29. multicaulis**
   2. Fruiting calyx not membranous-reticulate, thick textured, tubular to infundibular with more or less dentate lobes
      9. Staminal connectives shorter than or equal to filaments, upper theca larger than the lower theca which bears at least some fertile pollen
         10. Leaves all undivided or trilobed
            11. Stems glabrous or subglabrous above
               12. Calyx 12-16 mm; leaves cuneate at base **4. aramiensis**
               12. Calyx 6-8 mm; leaves cordate or rounded at base **1. aucheri**
            11. Stems pilose to villouse above

13. Leaves mostly basal; flowering stems up to 35 cm, glandular below

14. Calyces expanding in fruit with clearly divergent lips, upper lip subentire . **24. cadmica**

14. Calyces scarcely expanded in fruit, upper lip clearly tridentate (W. Anatolia, İzmir and Aydın) **25. smyrnaea**

13. Leaves distributed over stems; flowering stems up to 120 cm, eglandular below

15. Shrub, calyx ca. 9-10 mm; pedicels ca. 2-3 mm **2. fruticosa**

15. Suffruticose herb; calyx 12-16 mm; pedicels 5-10 mm **3. tomentosa**

10. Leaves pinnatisect or trisect

16. Terminal leaf segment broadly oblong to ovate; petioles usually without prominent ciliate hairs

17. Bracts or floral leaves clearly longer than calyces **9. bracteata**

17. Bracts equal to or clearly shorter than the calyces

18. Verticillasters 1-2 -flowered

19. Herb; stems densely glandular villous, to 15-20 cm; calyx tubular ca. 18-20 mm **22. quezelii**

19. Shrub; stem glabrous above, to 70-130 cm; calyx campanulate ca. 6-8 mm **1. aucheri**

18. Verticillaters 2-10 -flowered

20. Stem glabrous below/above

21. Corolla purplish-blue with white markings **7. pilifera**

21. Corolla yellow or cream **5. tigrina**

20. Stem glandular villous below/above

22. Shrub; calyx ca. 9-10 mm; leaves eglandular-tomentosa to velutinose **2. fruticosa**

22. Herb; calyx (8-) 12-20 mm; leaves glandular pilose

23. Calyx urceolate; corolla 25-30 mm **8. pinnata**

23. Calyx ovate; corolla 20-40 mm **7. recognita**

16. Terminal leaf segment ± linear-lanceolate or shortly obovate-cuneate; petioles often prominently ciliate with long white eglandular hairs
    24. Corolla yellow or yellowish white
        25. Stem glabrous or almost so
            26. Shrubs, leaves glabrous or glaucous **10. cedronella**
            26. Herbs, leaves pilose **21. suffruticosa**
        25. Stem pilose or villous
            27. Leaves dense capitate glandular hairy **11. adenopylla**
            27. Leaves without capitate glandular hairs
                28. Stems erect **12. potentillifolia**
                28. Stems procumbent **13. nydeggeri**
    24. Corolla white, pink, violet to blue
        29. Dwarf mat forming subshrubs
            30. Leaves trifoliate or trisect **18. tchihatcheffii**
            30. Leaves pinnatisect with 2-4 pairs of leaflets
                31. Corolla 10-18 mm and white to light violet **18. tchihatcheffii**
                31. Corolla 30-40 mm and violet blue to lilac pink (rarely cream) with white markings on lower lip **20. caespitosa**
        29. Taller growing ascending erect to erect subshrubs
            32. Inflorescence a clearly condenced ovoid or oblong spike
                33. Stems eglandular above and below; corolla white, 10-18 mm . **18. tchihatcheffii**
                33. Stems glandular capitate above; corolla blue-purple, (20-) 25-30 mm **19. heldreichiana**
            32. Inflorescence of distant or approximating verticillasters
                34. Stem with an indumentum of mostly antrorse hairs above and below (Eastern Aegean region, Sivrihisar) **14. wiedemannii**
                34. Stem with an indumentum of mostly retrorse hairs above and below

35. Leaves mostly trisect; calyces tubular to campanulate; corolla light to deep blue, lower lip white spotted

36. Calyx 6-12 mm in flowering; corolla 18-23 mm **16. pisidica**

36. Calyx 11-16 mm in flowering; corolla (26-) 30-40 mm (Ermenek) **17. albimaculata**

35. Leaves pinnatisect; calyces infundibular, upper lip clearly longer than lower lip; corolla pink (Kahramanmaraş) **15. marashica**

9. Staminal connectives longer than filaments, lower theca reduced

37. Upper lip of corolla straight and corolla tube annulate, verticillasters 8-40 flowered; lower theca subulate

38. Upper lip of corolla clearly narrowed at base; calyx in flower 5-7 mm

39. Leaves linear-oblong; calyx teeth not mucronate **57. russellii**

39. Leaves oblong to ovate; calyx teeth mucronate **56. verticillata**

38. Upper lip of corolla not narrowed at base; calyx in flower ca. 12 mm **58. napifolia**

37. Upper lip of corolla more or less falcate, corolla tube not annulate; verticilasters 2-8 -flowered; lower theca reduced to a usually dolabriform plate of tissue

40. Corolla more than 20 mm

41. Corolla tube not squamulate, ventricose or not

42. Leaves linear-lanceolate **33. hypargeia**

42. Leaves oblong to broadly ovate

43. Flowers lilac; bracts broadly ovate, 15-20 x 16-18 mm . **34. palaestina**

43. Flowers yellow; bracts ovate, 8-10 x 6-7 mm **50. glutinosa**

41. Corolla tube squamulate, ventricose

44. Upper lip of corolla lilac

45. Bracts clearly longer than calyces **35. sclarea**

45. Bracts not or scarcely longer than calyces

46. Lower lip of corolla dark violet; calyx truncate at apex; leaves 30 x 20 cm (eastern Mediterranean) **49. indica**

46. Lower lip of corolla light blue, cream or white

47. Calyx usually tinged purple; lower lip of corolla lilac to violet . **46. cyanescens**

47. Calyx green; lower lip of corolla cream, yellow or white

48. Leaves oblong, serrulate, mostly in upper part of stem **36. chrysophylla**

48. Leaves ovate, deeply serrate to erose, mostly basal **40. argentea**

44. Upper lip of corolla white

49. Leaves linear-lanceolate to linear oblong **39. chionantha**

49. Leaves oblong, ovate to orbicular

50. Calyx shortly papilose or glandular pilose; inflorescence ± selender

51. Leaves orbicular, cordate at base

52. Calyx 5-8 mm; corolla (14-) 20-22 mm **47. cilicica**

52. Calyx 7-12 mm, (20-) 25-30 mm **48. cassia**

51. Leaves oblong to broadly ovate, rounded to cordate **45. candidissima**

50. Calyx long spreading capitate glandular hairy; inflorescence ± sturdy

53. Stems lanate at base; leaves usually lanate beneath, margin obtusely lobed or serrate **41. microstegia**

53. Stems not lanate at base; leaves ± sparsely lanate, margins deeply serrate or erose **40. argentea**

40. Corolla less than 20 mm

54. Flowers lilac, violet, purplish or pink to red

55. Corolla tube squamulate

56. Corolla with a lilac-violet hood and a yellow lower lip; leaves oblong, lowermost bracts leaf like (western Mediterranean) **36. chrysophylla**

56. Corolla with a pale lilac or white hood and a white or yellow lower lip; leaves orbicular, ovate to oblong; lowermost bracts not leaf like

57. Leaves ± orbicular, pannose

58. Cauline leaves ca. 4 pairs; inflorescence few flowered . **47. cilicica**

58. Cauline leaves several; inflorescence many flowered (cf. also candidissima) **46. cyanescens**

57. Leaves ovate to oblong, pilose, villous or ± pannose

59. Stems eglandular-pilose above and below **43. yosgadensis**

59. Stems glandular pilose to villous above

60. Corolla 16-20 mm; leaves pilose to lanate beneath; calyx teeth short spinulose **46. cyanescens**

60. Corolla less than 16 mm; leaves arachnoid to sublanate beneath; calyx teeth long spinulose

61. Corolla 12-16 mm, white; bracts 8-12 x 7-11 mm **42. frigida**

61. Corolla 8-11 mm, purple; bracts 6-18 x 6-7 mm **44. modesta**

55. Corolla tube not squamulate

62. Leaves oblong

63. Stems densely glandular pilose above and below **53. adenocaulon**

63. Stems eglandular pilose below, glandular pilose or villous above or eglandular

64. Stems eglandular above and below; leaves crenulate . **54. dichroantha**

64. Stems glandular above; leaves pinnatifid to subentire . **55. verbenaca**

62. Leaves ovate-oblong to broadly ovate

65. Calyx 5-7 mm; stems usually less than 50 cm **55. verbenaca**

65. Calyx 6-11 mm; stems 30-100 cm

66. Corolla pink to red, leaves membranous, eglandular papillose-pubescent and not rugose **52. viscosa**

66. Corolla violet blue to lilac (white), leaves thick, eglandular or glandular pilose to tomentose and rugose **51. virgata**

54. Flowers white, yellow or cream

67. Leaves pinnatifid with spreading linear segments; biennial **38. ceratophylla**

67. Leaves not pinnatifid; perennial, rarely biennial

68. Inflorescence candelabriform, widely spreading, stems eglandular lanate; biennial or perennial **37. aethiopis**

68. Inflorescence not candelabriform; stems pilose or villous; perennials

69. Leaves regularly ovate, cordate, serrulate; corolla ca. 10 mm .

32. syriaca

69. Leaves oblong to broadly ovate to orbicular, cordate to cuneate, margins crenate to erose; corolla 8-20 mm

70. Leaves ± orbicular **47. cilicica**

70. Leaves oblong to broadly ovate

71. Upper lip of calyx ± bisulcate in flower, clearly so in fruit and recurved . **51. virgata**

71. Upper lip of corolla not bisulcate and not recurved in fruit

72. Leaves ± densely lanate; corolla 17-20 mm; upper lip strongly falcate . **41. microstegia**

72. Leaves not densely lanate

73. Stems eglandular above and below; calyx eglandular (glandular) . **43. yosgadensis**

73. Stems glandular above; calyx glandular

74. Corolla 8-11 mm, purple; bracts 6-18 x 6-7. 5 mm **44. modesta**

74. Corolla 12-16 mm, white to pale lilac; bracts 8-12 x 7-11 mm **42. frigida**

Section 1 ***Salvia*** Hedge (synonym: *Eusphace* Benth.)

1. ***S. aucheri*** Bentham in Ann. Sci. Nat. ser. 2, 6:38 (1836).

Perennial herb with woody rootstock. Stems 15-110 cm, erect, branched above, sparsely eglandular pilose or glabrous below, glabrous and sometimes glaucous above. Leaves mostly towards base of stem, simple or occasionally with one pair of lateral lobes, 1.4-10 (-13.5) x (0.4-) 2-5 (-6) cm, oblong, elliptic to ovate-elliptic, adpressed white pubescent beneath, margin finely crenulate, rugulose; petiole 0.5-4 cm, without ciliate hairs. Inflorescence paniculate, 17-75 cm; verticillasters 2-3 flowered or irregularly so, clearly distant; bracts elliptic to ovate-elliptic, 1.5-4 x 0.5-1.5 mm, green, bracteoles present. Pedicels 2-4 mm, erecto-patent. Calyx ovate to tubular-campanulate, 4-10 mm, green to purplish scarcely accresent in fruit, densely glandular pilose, striate; upper lip clearly tridentate, calyx teeth triangular ca. 1-2 mm, ciliate, acuminate. Corolla light blue or pinkish with white spotted lower lip, 20-40 mm; corolla tube straight below, widening above, annulate, not squamulate; upper lip ± straight, Stamens A. Anther ca. 3-4 mm, upper theca ca. 2.5-5 mm, lower theca ca. 1.5-2 mm, filaments ca. 5-6.5 mm.

1. Stem length 45- 110 cm, (1.4-) 4-10 (-13.5) x 2-5(-6) cm, calyx length 6-10 mm, corolla whitish to light blue and 20-40 mm subsp. ***aucheri***

1. Stem length 15-70 cm, 1-3.5 (-4.5) x 0.4-2 cm, calyx length 4-6 (-7) mm, corolla pinkish to lilac and 15-23 mm . subsp. ***canescens***

subsp. ***aucheri*** stat. nova (Figure 108)

Habitat and Phenology: April to May. Limestone slopes, in *Quercus* scrub, among bushes, macchie, 550- 1700 m

Type: Described from Cilicia

S. Anatolia. **C5** Adana: Pozantı, around Gülek Boğazı, open shrubs and calcerous rocks, 1130-1140 m, 24.7.2005, 37 17 250 N 34 47 072 E, G. Akaydın & F.Celep 980!. Adana: Pozantı to Akçatekir Kasabası, roadsides, 18.7.2008, 778 m, 37 24 949 N, 34 52 594 E, F.Celep 1574!, ibid, 26.7.2006, F.Celep 1198!, Mersin: Çamlıyayla (Namrun), Pozantı to Çamlıyayla, Kadıncık Valley, around Kaburgediği village, slopes, 17.7.2008, 580 m, 37 09 450 N 34 48 650 E, F.Celep 1570!, ibid, 24.7.2005, G.Akaydın & F.Celep 983!, Niğde-Adana: Çiftehan, Bolkar Dağları, Çiftehan to Alihoca village about 1-2 km from main road, 30.7.2008, 1020-1200 m, 37 30 665 N 34 44 304 E, F.Celep 1359! İçel: 6 km N. of Tarsus, Spitzenberger 190. Konya: Tschakit river at Akköpri, 780 m, Siehe 296. **C6** Adana: Osmaniye, 550 m, Akman 3029!. Hatay: 10km W. of Hassan Beyli, M. & D. Zohary 3434!

Endemic. Medit. Element.

Figure 108. Habit of *S. aucheri* subsp. *aucheri*

subsp. ***canescens*** (Boiss. & Heldr.) F.Celep & Dogan stat. nova in Boiss., Fl. Or. 4: 593 (1879). Syn: *S. canescens* var. *canescens* Boiss. & Heldr., in Boiss., Fl. Or. 4: 593 (1879), *S. ermenekensis* Rech. fil. in Ost. Bot. Zeitschr. 95:423 (1949)!, (Figure 109).

Habitat and Phenology: June (July). Rocky place, open *Quercus* and *Pinus*. 850-1600 m.

Type: Syntypes: [Turkey C4 Konya] ad Bounarbachi (Pinarbasi), [25 vi 1845], Heldreich [951] (G!) et in valle Djoksu (Göksu) inter Karaman et Ermenek Isauriae, Heldreich (G).

C4 Karaman: Mut to Ermenek, 25 km before Ermenek, Çamlıca village to Damlaçal, roadsides, 1200 m, 25.7.2008, 36 37 846 N 33 01 761 E, G. Akaydın & F.Celep 994!. Karaman: Ermenek, Mut to Ermenek, 1,5-2 km before Ermenek, 1300-1400, 26.7.2005, 36 37 715 N 32 54 609 E, G. Akaydın & F.Celep 999!, ibid 15.06.2006, F.Celep 1126!, Karaman: Mut to Ermenek, 39 km before Ermenek, slopes, 872 m, 21.6.2007, 36 34 171 N 33 10 196 E, F.Celep 1245!, Konya: Karaman to Mut, 1350 m, Hub.-Mor. 17191 Içel: 1 km N.E. of Gülnar, 950 m, Hub.-Mor. 9587.

Endemic. Medit. Element.

Figure 109. Habit of *S. aucheri* subsp. *canescens*

The species is endemic and allied to *S. divaricata.* E. Medit. element. *S. aucheri* is an endemic species and its dried leaves are commonly consumed as a herbal tea by local folk in Turkey. The type of *S. aucheri* was collected from Gülek in eastern part of the Mediterranean region of Turkey and described as a new species by Bentham (1836). Then the type of *S. aucheri* var. *canescens* was collected by Heldreich from Pinarbasi in central part of the Mediterranean region of Turkey in 1845 and described by Boissier & Heldreich (1879). The name *S. sieheana* Hausskn. was also applied to *S. aucheri* var. *aucheri*.

Subsequently, var. *canescens* was raised to species level as *S. ermenekensis* by K. H. Rechinger from Heldreich's type specimen. While Turkish *Salvia* account was prepared by I. C. Hedge (1982a), he accepted the taxa as local endemic varieties under *S. aucheri* growing in the Mediterranean region of Turkey like Boissier and Heldreich's treatment. He accepted the name *S. ermenekensis* as synonym of *S. aucheri* var. *canescens* in *the Flora of Turkey*. The field and herbarium studies demonstrated that the taxa are closely related but var. *canescens* has some differences from var. *aucheri* not only morphologically but also geographically and phenologically, typically allopatric. Hence, the taxa should be evaluated at the subspecies level (Celep *et al.*, 2010e). Diagnostic morphological differences are given in Table 16.

Table 16 Diagnostic morphological characters of *S. aucheri* subsp. *aucheri* and subsp. *canescens*

	S. aucheri subsp. *aucheri*	subsp. *canescens*
Stem length (cm)	45-110 cm	15-70
Leaves	Simple or occasionally with one pair of lateral lobes	Always simple
Leaves shape	Oblong, elliptic to ovate-elliptic	Linear-elliptic to elliptic
Leaves (cm)	(1.4-) 4-13.5 x (1-) 2--6	1-3.5 (-4.5) x 0.4-2
Calyx length (mm)	6-10	4-6 (-7)
Corolla colour	Whitish to light blue	Pinkish to lilac
Corolla length (mm)	20-35 (-40)	15-23

2. *S. fruticosa* Miller, Card. Diet. ed. 8, no. 5 (1768).

Syn: *S. triloba L.* fil., Suppl. 88 (1781), *S. libanotica* Boiss. & Gaill. in Boiss., Diagn. ser. 2(4): 16 (1859), *S. lobryana* Aznav. in Mag. Bot. Lap. 1:195 (1902), *S. triloba* L. fil. subsp. *libanotica* (Boiss. & Gaill.) Holmboe, Veg. Cyprus 158 (1914), Ic: Sibth. & Sm., Fl. Graeca 1: t. 17 (1806), Huxley & Taylor, Fls. Greece t. 251 (1977), (Figure 110).

Shrub, strongly aromatic; stems erect up to 1.5 m high, much branched, sometimes with galls, tetragonal only on younger growth, often purplish with a variable indumentums, sparsely or densely eglandular pubescent to lanate or glandular below, above usually with a dense indumentums of eglandular villous and short or longer capitates hairs, but sometimes glabrous. Leaves simple or trilobed with or without small lateral segments, distributed over stems, elliptic to ovate-oblong, c. 1.2-5.5 x 0.7-2.5, rugulose, margins finely crenulate, lower surface white tomentose to velutinous or pubescent wits numerous sessile glands, apex acute or rounded, base cordate or cuneate; petiole 0.5-3 (-3.5) cm. Inflorescence sparsely or densely pilose to villous and short or long glandular capitate. Verticillasters 4-10, each verticillaster 2-10 flowered, approximating above. Lower bracts leaf like, median bracts ovate to

ovate elliptic, c. 7-15 x 3-6 mm; bracteoles present, deciduous. Pedicels c. 2-3.5 mm, up to 5 mm in fruit, erecto-patent. Calyx tubular to tubular-campanulate, not markedly bilabiate, ca. 6-10 mm, scarsely elongating in fruit, often purplish, 13-15 veined, densely short and long capitate glandular and eglandular villous with some sessile glands; upper lip shorter (upper lip with three equal, broadly triangular, acuminate, 1.5-2 mm long teeth, lower lip subequal to upper and with similar teeth), tridentate; lips convergent in fruit. Corolla pink, lavender to violet blue, rarely white, 16-27 mm; tube ± straight, 11-18 mm, widening towards throat, not squamulate, annulate; upper lip straight, glandular pilose externally. Stamens A. Anthers ca. 2 mm, upper theca ca. 2-3 mm, lower theca ca. 1 mm, filaments ca. 3-5 mm.

Habitat and Phenology: March to May (June). Macchie or phrygana among limestone rocks, s. l-400 (-700) m.

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

N.W. Turkey, W. & S.W. Anatolia. **Cl** Mugla: Yatağan to Milas, before Milas about 3-4 km, 190 m, 4.5.2006, 37 17 130 N 27 49 310 E, F.Celep 1047!, Muğla: Milas, Milas to Akbük, above Kazıklı village, 184-200 m, 4.5.2006, 37 22 382 N 27 29 597 E, F.Celep 1048!, Aydın: Didim, Akbük to Milas, Bozbük region, 10m, 9.7.2007, 37 19 755 N 27 23 691 E, F.Celep 1350!, İzmir: Kuşadasi, 20 m, D. 25177! **C2** Mugla: Fethiye to Kaş, above Kumluova village, 28-40 m, 28.4.2008, 36 20 480 N 29 17 833 E, F.Celep 1377!, Muğla: Marmaris, İçmeler to Turunç, about 1 km, 34 m, 26.4.2008, 36 47 721 N 28 13 145 E, F.Celep 1373!, Denizli: E. of Tavas, 4 vi 1938, Reese **C3** Antalya: between Beldibi and Göynük, Hub.-Mor. 9591!, Antalya: Kemer: above Çamyuva 12-20 m, 29.4.2008, 36 34 355 N 30 33 038 E, F.Celep 1382!

East Medit. Element.

S. fruticosa is closely related to *S. pomifera*, *S. tomentosa* and *S. aramiensis*. Its leaves are used as herbal tea.

Figure 110. Habit of *S. fruticosa*

3. *S. tomentosa* Miller, Card. Diet. ed. 8, no. 2 (1768).

Syn: *S. grandiflora* Etl., Salvia 17 (1777); *S. grandiflora* Etl. subsp. *aegaea* (Bohim.) Rech. fil. in Bot. Jahrb. 69:501 (1939);S. *grandiflora* Etl. subsp. *rotundifolia* (Vis.) Rech. fil., Fl. Aeg. 519 (1943). Ic: Jacq., Eclog. PI. Rai. 1: t. 36 (1811-16), (Figure 111).

Perennial suffruticose herb. Stems up to 100 cm, stems several with vegetative shoots at base, ascending to erect, quadrangular, often branched above, eglandular-tomentose with sessile glands, rarely with capitate glandular hairs above. Leaves simple, narrowly oblong to ovate, 2-12 x 0.8-6 cm, subobtuse to acute, rounded to cordate at base, occasionally with small basal lobules, entire to crenulate, rugose, tomentose hairy; petiole 1.7-7 cm. Verticillasters 4-10-flowered, distant or condensed above. Bracts broadly ovate, 5-8 x 4-8 mm, deciduous; bracteoles present. Pedicels 5-10 mm. Calyx ± tubular, 10-18 mm, accrescent to 14-18 mm in fruit, usually violet, pilose to villous with some sessile glands, with or without capitate glandular hairs; upper lip shortly tridentate, teeth subulate-pointed. Corolla lilac to

purple, blue or white, c. 22-35 mm; tube straight, 18-22 mm, incompletely annulate; upper lip straight. Stamens A.

Habitat and Phenology: April to August. Often associated with *Pinus brutia* and *P. nigra*, *Quercus pubescens*, in macchie, on limestone or igneous slopes, 90-2000 m.

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

B1 İzmir: Kemalpaşa Dağı, 38 25 061 N 27 24 015 E, 490m, SBagherpour 455!, Balıkesir: Edremit, Kazdağ, Tozlu yaylası-Kapıdağ yolu, 1322 m, 29.6.2006, E.Karabacak.4768! **B2** Kütahya: Şaphane, 1043 m, 11.6.2008, 39 01 687 N 29 02 500 E, F.Celep 1512!, Uşak: Uşak-Kula arası, Kula'dan sonra 2 km, 38 39 868 N 29 07 582 E, 592m, SBagherpour 455! **B3** Afyon: Dazkırı to Dinar, 7 km before Dinar, 1000-1100 m, 5.7.2006, F.Celep 1171! **B6** Maraş: Goksun, Hobek Da., 1600 m, D. 20227! **Cl** İzmir: Samsun Da. above Güzelcamli, Fitz & Spitz. 664. **C2** Denizli: 15 km before Kızılbucak, above Geyre, Baba Da. 1314 m, 5.7.2006, 37 43 287 N 28 49 910 E, F.Celep 1167!, Antalya: Kuhu Da. S. of Elmali, Çiğlikara, Fitz & Spitz. 221 **C3** Antalya: Akseki, Murtiçi, Çukurbağ village c. 5 km, 655 m, 2.7.2006, 36 52 531 N 31 49 343 E, F.Celep 1150!, Isparta: Ağlassun to Isparta, 1600 m, Khan et al. 341. **C4 K**araman: Ermenek, above Başyayla, 1526-1650 m, 2.7.2006, 36 45 865 N 32 40 525 E, F.Celep 1145!, Konya: Ermenek to Karaman, 1040 m, Hub.-Mor. 8384. **C5** İçel: Çamlıyayla, around Namrun Castle, 1300-1350 m, 24.7.2005, 37 09 933 N 34 36 029 E, G. Akaydın & F.Celep 986!, Adana: d. Feke, Süphandere to Belankoy, 1000 m, D. 19563 **C6** Kahramanmaraş: Andırın, Andırın to Geben Yaylası, 1444, 12.6.2006, 37 39 437 N 36 26 622 E, F.Celep 1089!.

Medit. Element.

S. tomentosa is distributed in all regions of Turkey except for the eastern Anatolia. It is closely related to *S. fruticosa* and *S. aramiensis*. Its leaves are used as herbal tea.

Figure 111. Habit of *S. tomentosa*

4. *S. aramiensis* Rech. fil. in Ark Bot. ser. 2, 1:317 (1949).

Syn: *S. grandiflora* Etl. var. *cuneata* Post, Fl. Syria 626 (1896), (Figure 112).

Perennial suffruticose herb. Stems to 1.3 m, stiffly erect, quadrangular, densely eglandular-tomentose with sessile glands below, upper parts of stem finely pilose and subglabrous. Leaves simple, narrowly oblong, elliptic to obovate, 1.4-6 x 0.4-3 cm, crenulate; petiole 0.5-3 cm. Inflorescence condensed towards to apex. Verticillasters 2-10-flowered. Bracts ovate, 5-8 *x* 4-8 mm, deciduous; bracteoles present. Pedicels 1.5-4 (-7) mm. Calyx ± tubular, 9-15 mm, accrescent to 10-17 mm in fruit, violet, striate, short capitates glandular hairs with or without few eglandular pilose hairs, upper lip tridentate, acuminate. Corolla lilac to pink, c. 22-32 mm; tube straight, 15-20 mm; upper lip straight. Stamens A. Anther ca. 3 mm, upper theca ca. 3 mm, lower theca ca. 2 mm, filaments ca. 4-5 mm.

Habitat and Phenology: March to May. *Pinus brutia* woodland, rocky places, 150-600 m.

Type: [Turkey C5 Hatay/Syria] mons Cassius prope transitum ad Ain el Aramie, in pineto, solo schist-gneiss, c. 600 m, 17 5 1933, Samuelsson 5044 (holo. S!).

C6 Hatay: Dörtyol, Kuzuculu to Bülke, 300 m, Coode & Jones 431!, Hatay: Arsuz, Hacı Ahmetli to Karagöz village, 384 m, 30.4.2006, 36 22 085 N 35 57 445 E, F.Celep 1025!, ibid, 448 m, 2.5.2008, 36 22 171 N 35 57 564 E, G.Akaydın & F.Celep 1400!, Arsuz, Arsuz to Samandağ, after 4-5 km from Işık village, 164 m, 2.5.2008, 36 19 591 N 35 48 408 E, G. Akaydın & F.Celep 1401!.

East Medit. Element.

S. aramiensis is restricted to Amanos Mountain in the eastern part of the Mediterrranean region of Turkey. It is closely related to *S. tomentosa* and *S. fruticosa*. It differs from *S. tomentosa* and *S. fruticosa* on its condensed inflorescence at the upper part of the stem.

Figure 112. Habit of *S. aramiensis*

5. *S. tigrina* Hedge & Hub.-Mor. in Notes R.B.G. Edinb. 22: 175 (1957), (Figure 113).

Perennial herb. Stems erect, to c. 60-85 cm, unbranched, quadrangular, glabrous and glaucous below, glandular-villous above. Leaves pinnatisect, with an ovate terminal segment and 2 or 3 pairs of smaller lateral segments, glabrous or gently hirsutum, apex acute, submembranous, margins subentire, crenulate c. 8-12 x 5-8 cm, upper lateral segment sessile, ca. 2-7 x 2.5-3.5 cm, margin serrata, lower lateral segment 1.6-2 x 0.7-1.5 cm, elliptica; petiole c. 8 -11 cm, eglandular ciliate hairy. Inflorescence ca. 15 cm long, glandular villous. Verticillasters 3-5, 3-5 flowered, clearly distant, inferior ca. 5 cm. Bracts oblong, c. 4 mm long, shorter than calyx. Pedicels (4-) 6-9 mm, 10 mm in fruit, erecto-patent. Calyx tubular-infundibular, (15-) 16-20 mm, glandular-villous, bilabiate, occasionally purplish, scarcely accressent in fruit, 13 veined, upper lip tridentate with c. 2 mm spinulose teeth. Corolla yellow with dark brown spots, 30-36 mm; tube straight and gradually wider towards throat, not squamulate, densely annulate c. 9 mm from base; upper lip ± straight, 8-10 mm. Stamens A.

Connectivum Anther ca. 4-5 mm, upper theca ca. 3 mm, lower theca 2 mm, filaments 5 mm. Stylus ca. 32-36 mm long, apex bifid.

Habitat and Phenology: May to June. Within macchie, Hedges. 800 m.

Type: Turkey C6 Hatay: Musa Dag westlich ob Batiayas (Teknepınar) , Hecke, 800 m, 22 vi 1953, A. Huber-Morath 11871 (holo. Hb. Hub.-Mor.!).
Plantae montium Syriae Borealis, Nords Kalah Jurn, 10.6.1884, Post 278 (BM!).

Endemic ? East Medit. Element.

S. tigrina is closely related to *S. pilifera* and *S. recognita*. However, it differs from them on its longer pedicel and calyx, and yellow corolla. Its second location is not clear. Probably, it was collected from northern Syria. Another location has been recently observed by Mr. Fatih Orbay and Dr. Halil Çakan in Hatay: Yayladağ, Şenköy, close to Syria border.

Figure 113. Habit of *S. tigrina*

6. *S. recognita* Fisch. & Mey. in Ann. Sci. Nat. ser. 4, 1:33 (1854), (Figure 114).

Perennial herb. Stems 40-90 (-180) cm, erect, quadrangular, branched above, glandular-villous above and below with long spreading hairs, glabrous and glaucous in middle. Leaves pinnate (rarely simple) with a large oblong-ovate terminal

segment, 3-8 (-15) x 3-6 cm and 1-2 pairs of small lateral segments, rugose, crenulate, glandular-pilose; petiole 4-8 cm. Verticillasters 4-6-flowered, clearly distant. Bracts to 16 mm, deciduous. Pedicels 3-6 mm, ± erect. Calyx ovate, c. 10-14 mm, to 20 mm in fruit, glandular-villous, upper lip straight, very shortly tridentate, not mucronate, greenish-purple. Corolla lilac-pink, 30-40 mm; tube straight, widening above, ± annulate c. 14 mm from base; upper lip straight. Stamens A.

Habitat and Phenology: May to July, Limestone and igneous slopes and screes in steppe, *Quercus* scrubs, 900-2200 m.

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

Central Anatolia, rarely South and East Anatolia. **C4** İçel: 33 km E. of Mut, 1260 m, Hub.-Mor. 9602!. **C5** Niğde: Ala Da., 1980 m, Wood & Gibson l44. Niğde: Çamardı, Demirkazık village, Cımbar valley, 14.6.2006, 1604 m, 37 51 711 N 35 06 145 E, F.Celep 1102!, Adana: Pozantı, 2 km S of Karsantı, 28.6.1981, Nydegger 16477! **C6** Maraş: c l0 km N. of Andırın, c. 950 m, Sorger 73-1-3-35.

Endemic. Ir.-Tur. Element.

S. recognita is closely related to *S. pilifera* and *S. pinnata*. It is clearly differs from *S. pilifera* on its pink corolla. Similarly, *S. recognita* differs from *S. pinnata* on its longer corolla (30-40 mm, not 25-30 mm) and ovate calyx (not urseolate).

Figure 114. Habit of *S. recognita*.

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

Syn: *S. cataonica* Boiss. & Hausskn. in Boiss., Fl. Or. 4:602 (1879)!. *S. purpurascens* Post in J. Linn. Soc. (Bot.) 24:438 (1888); *S. amana* Bornm. in Notizbl. Bot. Gart. Berlin 7(63): 28 (1917), (Figure 115).

Perennial herb to c. 100 cm. Stems ascending-erect from creeping rhizome, glabrous below, glabrous, glandular pilose to villous with eglandular villous above. Leaves pinnatisect with a broad ovate-oblong terminal segment, to 3-8 x 2.5-4 cm, and 1-2 pairs of smaller lateral segments, submembranous, adpressed glabrous to pilose, margins irregularly crenulate, upper lateral segment sessile, ca. 2-8 x 1.5-6, lower lateral segment 0.6-6.5 x 0.7-3.5 cm, oblong to oblong elliptic; petiole 1.5-5.5 cm, long eglandular ciliate hairy. Verticillasters 2-15 -flowered, distant. Bracts c. 10-40 x 5-22 mm, long-acuminate, smaller than calyx. Pedicels 4-8 mm (-12), 5-8 mm in fruit, erecto-patent. Calyx tubular campanulate to infundibular, 12-20 mm, to 22 mm in fruit, densely glandular-villous or glandular-pilose with eglandular pilose to villous hairs, 12-14 veined, bilabiate, upper lip tridentate, median tooth larger, longer than lower, occasionally purplish, scarcely accressent in fruit. Corolla blue-purple with

white markings, 20-35 mm; tube straight and gradually wider towards throat, not squamulate, slightly pilose within (annulate); upper lip ± straight, not squamulate. Stamens A. Anther 3-6 mm, upper theca 4-5 mm, lower theca 2-2.5 mm, filaments ca. 5-6 mm.

Habitat and Phenology: April to May. Limestone slopes, in *Quercus* scrub, among bushes, macchie, 300-1800 (-2300) m.

Syntypes: [Turkey C6 Adiyaman] ad Akdağ in Tauro orientali [nr Besni, 1834], Aucher [1927, 1952] (G!, W!).

Eastern Mediterranean region of Turkey. **B6** Kahramanmaraş: Göksun, Berit Da., 1000-1200 m, 1865, Hausskn. (type of *S. cataonica*!) Kahramanmaraş; Ahır Dağı, Merkez to Sarıçukur village about 2 km, 764 m, 27.4.2006, 37 37 207 N 36 49 920 E, F.Celep 1017!, ibid F.Celep 1413!, Çağlayancerit, above Erince village, 1281 m, 3.5.2008, 37 44 279 N 37 24 221 E, F.Celep 1417! **C6** Kahramanmaraş: Göksun to K.Maraş, Püren tüneli, above Kurucuova village, Güneyoluk, 1783 m, 12.7.2008, 37 58 386 N 36 33 677 E, F.Celep 1547! (fruit), Adıyaman: Gölbaşı, NE of Harmanlı, 946 m, 3.5.2008, 37 51 328 N 37 45 478 E, F.Celep 1420! Gaziantep: Gaziantep-Fevzipaşa arası, Fevzipaşa'ya 30 km kala, 800 m, 18 5 1956, H. Birand (ANK!), Sof Dağı, TV kulesi civarı, 1450-1500 m, 24 6 1978, T. Ekim 3729 (ANK!), Fevzipaşa-Gaziantep arası, Fevzipaşa'nın 38 km East, 860 m, Hub.-Mor. 14206, Adana-Hatay: Haruniye to İskenderun, c. 300 m, Meincke 275 (type of *S. amana* Bornm.) Hatay: İskenderun to Antakya, c. 950 m, Buttler & Uzunoglu 13007.

Endemic. Ir.-Tur. Element.

It is indumentum and calyx shape show great variances.

Figure 115. Habit of *S. pilifera*

8. *S. pinnata* L., Sp. PI. 27 (1753). Ic: Rouy, 111. PI. Eur. Rar. 11: t. 269 (1899), (Figure 116).

Perennial herb, stems 18-60 cm, simple or sparingly branched, all leafy, procumbent to erect, quadrangular, viscid, densely glandular villous. Leaves irregularly pinnatisect, with an ovate-oblong terminal segment to c. 4-8 x 2-5 cm and 2-5 pairs of sessile or petiolate lateral segments irregularly arranged, submembranous, crenate-serrate, glandular-pilose; petiole 4-12 cm. Inflorescense raceme. Verticillasters 4-8, 4-6 (-9) flowered, distant. Bracts c. 6 mm, oblong-ovate, soon deciduous. Pedicels 5-15 (-20) mm, erecto-patent. Calyx urceolate, often dark brownish-purplish, c. 8-15 mm, scarcely expanding in fruit, densely glandular-villous; upper lip truncate, obsoletely tridentate. Corolla mauve-pink, 20-30 mm; tube gradually widening towards throat, longitudinally pilose within; upper lip ± straight, shorter than lower. Stamens A.

Habitat and Phenology: March to May. Cornfields and fallow fields, dry meadows, s.l-1060 m.

Lectotype: East Arabia, Herb. Clifford: 13.

W, N.W. and South Anatolia. **Bl** İzmir: Bornova, 1932, Guyot. **C2** Afyon: Çavdır to Tefenni, around Çavdır, 1089 m, 22.6.2007, 37 09 747 N 29 41 541 E, F.Celep 1277!, Denizli: Tavas to Kale, between Hırka to Kale village, 950 m, 26.4.2008, 37 28 094 N 28 53 989 E, F.Celep 1370! **C3** Konya: d. Beyşehir, 5 km W. of Beyşehir, 1060 m, Hub.-Morath. 8366! **C5** Mersin: Mersin, Bal. 1855:517 **C6** Kahramanmaraş: Merkez, road of Kılavuzlu village, 528 m, 27.4.2006, 37 37 430 N 36 48 440 E, F.Celep 1021!

Medit. Element.

Figure 116. Habit of *S. pinnata*

9. *S. bracteata* Banks & Sol. in Russell, Aleppo 2(2): 242 (1794), (Figure 117).

Perennial herb, more or less suffruticose at base. Stems several, 20-80 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 2.5-7 (-11) x 1.5-3.5 (-6) cm and 1-2 (- 5) pairs of smaller lateral segments, ± densely eglandular-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, purplish; bracte-oles present. Pedicels 1-5 mm. Calyx tubular-infundibular, 10-16 mm, scarcely expanding in fruit, glandular-villous. Corolla pink to purplish, 20-35 (-42) mm; tube 14-25 mm, irregularly annulate; upper lip straight. Stamens A.

Habitat and Phenology: May to July. Igneous and calcareous slopes, with *Quercus brantii*, fallow fields, edge of vineyards, roadsides, waste places, 50-2000 m.

Type: [Syria] Aleppo, Russell.
B2 Kütahya: 8 km from Simav to Gediz, 900 m, Demiriz 2095. Kütahya: Eskişehir-Kütahya arası, Kütahya'dan 30 mil, 800 m, 23 6.1962, D. 36069 (E!), Afyon: Dinar to Dazkırı, c. 9.5 km from Dinar, 1022 m, 7.6.2008, 38 02 195 N 30 03 878 E, F.Celep 1458! **B4** Kayseri: Bakırdağ, 4 km before Yaylacık village, 1420 m, 26.4.2006, 38 11 217 N 35 48 410 E, F.Celep 1060! **C2** Denizli: Acıpayam to Denizli, after Yeşilova village junction, 970 m, 22.6.2007, 37 30 229 N 29 30 574 E, F.Celep 1278! **C3** Burdur: 10 km from Burdur to Bucak, Hub.-Mor. 5201. **C4** Konya: 24 km from Beyşehir to Akseki, 1110m, Hub.-Mor. 8369.

Ir.-Tur. Element.

S. bracteata and *S. trichoclada* are very closely related species, and also several intermediate forms are observed between them in the field studies. The possible conspecifity should be tested in future.

Figure 117. Habit of *S. bracteata*

10. *S. cedronella* Boiss., Diagn. ser. 1(5): 3 (1844), (Figure 118).

Perennial suffruticose herb. Stems ascending to erect, to 70 cm, unbranched, glabrous or glaucous. Leaves pinnatisect, with a large broad obovate to elliptic terminal segment with one or two smaller lateral segments, 0.4-2.5 x 0.3-1.3 cm, thick textured, glabrous, crenulate to serrulate, dentate; petiole 0.3-1.3 cm, glabrous and

long ciliate hairs. Cauline leaves glabrous. Inflorescence 2.5-25 cm, glabrous or glaucous. Verticillasters 2-6 -flowered, ± distant. Bracts ovate, acuminate, c. 2-18 x 2-13 mm; bracteoles present. Pedicels 2-6 mm. Calyx tubular-infundibular, 5-15 mm, scarcely accressent in fruit 7-18 mm, 12-15 nerved, glabrous with few sessile glands, bilabiate, upper lip tridentate and median teeth shorter than laterals. Corolla yellow, c. 17-35 mm; tube c. 12-25 mm, tube straight and gradually wider towards throat, not squamulate, annulate; upper lip ± straight. Stamens A. Anther ca. 3-4 mm, upper theca ca. 4-5 mm, lower theca ca. 3 mm, filaments ca. 5-7 mm.

Habitat and Phenology: May-June (July). Bushy places. 900-1250 m.

Type: Type: [Turkey C2 Denizli] in collibus argillosis elatis ad orientem urbis Denisleh (Denizli) sitis, ad radices cacuminem orientalium Cadmi (Honaz Da.), vi 1842, Boissier (holo. G!, iso. W!).

S.W. Anatolia **B2** Uşak: S.E. of Uşak, Bal. 1857:1185! **B3** Afyon: Dinar to Dazkırı, about 8 km open *Pinus* forest, 978 m, 22.6.2007, 38 02 383 N 30 04 609 E, F.Celep 1290! **C2** Burdur: 34 km from Dirmil to Tefenni, Hub.-Mor. 5195! Denizli-Burdur: Acıpayam to Gölhisar, before ca. 2 km from Çamköy, close to stream and main road, 970 m, 8.6.2008, 37 16 297 N 29 32 855 E, F.Celep 1470!, Denizli: E. of Denizli, 30.5.1935, Reese! Denizli: Denizli to Burdur from Yeşilova road, junction of Pınarbaşı village, around stream slopes, 937-950 m, 9.6.2008, 37 30 463 N 29 27 727 E, F.Celep 1499!, ibid 37 30 975 N 29 27 843 E, F.Celep 1504!

Endemic. East Medit. Element.

S. cedronella and *S. adenophylla* are very closely related to each other, and in the field several intermediate forms were recognized between them. *S. cedronella* differs only from *S. adenophylla* on its glandular indumentum. As well as, they grow in the same area.

Figure 118. Habit of *S. cedronella*

11. ***S. adenophylla*** Hedge & Hub.-Mor. in Notes R.B.G. Edinb. 22: 173 (1957), (Figure 119).

Perennial suffruticose herb. Stems ascending to erect, to 70 cm, unbranched, glandular hairy. Leaves pinnatisect, with a large broad obovate to elliptic terminal segment with one or two smaller lateral segments, 0.4-2.5 x 0.3-1.3 cm, thick textured, glandular hairy, crenulate to serrulate, dentate; petiole 0.3-1.3 cm, glandular pilose and long ciliate hairs. Cauline leaves glandular hairy. Inflorescence 2.5-15 cm, glandular hairy. Verticillasters 2-6-flowered, ± distant. Bracts ovate, acuminate, c. 2-18 x 2-13 mm; bracteoles present. Pedicels 2-6 mm. Calyx tubular-infundibular, 5-15 mm, scarcely accressent in fruit 7-18 mm, 13 nerved, glandular pilose, with few sessile glands, bilabiate, upper lip tridentate and median teeth shorter than laterals. Corolla yellow, c. 17-35 mm; tube c. 12-25 mm, tube straight and gradually wider

towards throat, not squamulate, annulate; upper lip ± straight. Stamens A. Anther ca. 3-4 mm, upper theca ca. 4-5 mm, lower theca ca. 3 mm, filaments ca. 5-7 mm.

Habitat and Phenology: May-June (July). Bushy places. 900-1250 m.

Type: Type: [Turkey C2] Denizli: Kizilhisar - Yesilova, *Quercus coccifera* Macchie 72 südöstlich Denizli 2 km vor Sirçalik, 1030m, 16 vi 1954, A. Huber-Morath 12722 (holo E!, iso. Hb. Hub.-Mor.!).
S.W. Anatolia. **C2** Denizli: Denizli to Burdur from Yeşilova road, junction of Pınarbaşı village, around stream slopes, 937-950 m, 9.6.2008, 37 30 463 N 29 27 727 E, F.Celep 1500!, Denizli/Burdur: Acıpayam to Gölhisar, before ca. 2 km from Çamköy, close to stream and main road, 970 m, 8.6.2008, 37 16 297 N 29 32 855 E, F.Celep 1467! Burdur: Gölhisar to Korkuteli, 1180 m, Nydegger 10494.

Endemic. Medit. Element.

Figure 119. Habit of *S. adenophylla*

12. *S. potentillifolia* Boiss. & Heldr. ex Bentham in DC., Prodr. 12: 270 (1848), (Figure 120).

Perennial suffruticose herb. Stems ± erect, 10-60 cm, usually unbranched above, eglandular or glandular pilose or glabrous below with retrorse hairs, glandular-pilose to villous above with capitate glandular hairs, rarely eglandular or subglabrous. Leaves trisect or pinnatisect with 1 or 2 pairs of lateral segments, terminal segment elliptic to oblong-obovate, 0.6-3.2 x 0.3-1.8 cm, eglandular-pubescent with sessile glands, apically crenulate or serrulate, petiole 0.8-1.8 cm, ciliate. Inflorescence 5-25 cm, glandular pilose sometimes with eglandular villous hairy. Verticillasters 2-6 (-8) flowered, distant or somewhat approximating. Bracts ovate-acuminate, 7-15 (-20) x 3-6 (-8) mm, glabrous, eglandular pubescent or glandular pilose hairy; bracteoles present. Pedicels 3-6 (8) mm. Calyx tubular-campanulate, 8-16 mm, accrescent to 10-17 mm in fruit, capitate-glandular-villous, bilabiate, upper lip tridentate and median teeth shorter than laterals, lower lip bidentate and teeth triangular, acuminate. Corolla sulphur yellow sometimes with lilac markings ; (18-) 22-30 mm; tube c. 15-20 mm, tube straight and gradually wider towards throat, not squamulate, annulate. Stamens A. Anther ca. 4-5 mm, upper theca ca. 4-5 mm, lower theca ca. 2 mm.

Habitat and Phenology: June to July (August). Dry rocky slopes, in *Quercus coccifera* macchie, under *Pinus brutia*, 900-1700 m.

Type ?: [Turkey C4 Konya] in Tauro Isaurico supra Ermenek, Heldreich (G!).
S.W. Anatolia **C2** Afyon: 10 km from Dinar, Denizli to Çardak, 1100 m, Dudley (D. 35645!), Antalya: Kuhu Da., S. of Elmali, Çiglikara, Fitz & Spitz. 934! **C3** Antalya: 29 km S.W. of Korkuteli, 1150 m, Sorger 65-23-17! Antalya: Elmalı, Elmalı to Finike ca 10 km, entrance of Cedar Research Forest, 1094 m, 3.7.2006, 36 35 987 N 29 57 659 E, F.Celep 1159! ibid 22.6.2007, F.Celep 1262! ibid 1396-1450 m, 9.6.2008, F.Celep 1480!, Antalya: Elmalı, around Avlan Lake (Kofu Da.) to Çığlıkara forest, 1080 m, 9.6.2008, F.Celep1488!, Antalya: Elmalı to Fethiye, after Pirhasan village ca. 500 m, 1070 m, 9.6.2008, F.Celep 1490!.

Endemic. Medit. Element.

The species is closely related to *S. nydeggeri, S. cedronella* ve *S. adenophylla*. All of them are pinnatisect leaved and yellow flowered. Their indumentum show great variances.

According to many expeditions, the species was not collected from its type location. In the populations of the species, pale violet flowers were not observed.

Figure 120. Habit of *S. potentillifolia*

13. *S. nydeggeri* Hub.-Mor. Bauhinia 7(3): 181 (1982), (Figure 121).

Suffruticose perennial herb. Stems procumbent, 20-60 cm, usually unbranched above, very densely glandular and with long eglandular hairs above. Leaves with an oblong terminal segment 20-30 x 10-15 mm and 1 or 2 pairs of smallers, lanceolate to narrowly oblong lateral segments 15-20 x 3-10 mm, with unequal glandular hairs but no or only very scattered long eglandular hairs, serrate; petiole 10-20 mm, long

ciliate. Inflorescence 8-12 mm. Verticillaters 4-6, 2-4 flowered. Bracts linear-lanceolate, 10-30 x 2-8 mm, long acuminate. Pedicels 2-5 mm. Calyx tubular-infundibular, 10-17 mm, ca. 12- veined, with capitate glands and long eglandular hairs, bilabiate, upper lip tridentate, ovate-lanceolate, acute to acuminate, median tooth shorter. Corolla white or yellowish, 25-30 mm, with few glandular hairs and eglandular cilia; tube denselypilose inside; upper lip porrect, 12 mm, lower lip 3-lobed. Stamens A, Anthers ca. 5 mm, fertile theca 5 mm, steril theca ca. 2 mm.

Habitat and Phenology: June to July. Screes and busy places. 1000-1465m

Type: Type: [Turkey C2] Muğla: Föhrenwald 51 km südlich von Dirmil (Altınyayla) gegen Fethiye, 1000 m, 20.6.1981, M. Nydegger 16328 (Holo.Hb. Nydegger, Basel, iso.Hb. Hub.-Mor. Basel)

S.W. Anatolia. **C2** Antalya: Elmalı to Fethiye, after Eskihisar village, slopes, 1163-1263 m, 22.6.2007, 36 48 474 N 29 47 586E, F.Celep 1264!, ibid F.Celep 1160!, ibid F.Celep 1491! Antalya/Muğla: Elmalı to Fethiye, before Seki, around Zorlar village, 1465 m, 22.6.2007, 36 48 661 N 29 41 439 E, F.Celep 1272!, ibid F.Celep 1164!, ibid F.Celep 1493!, Muğla: Seki, Eren Da., 1300-1450 m, 7.7.2008, F.Celep 1329!.

Endemic. Medit. Element.

The species is very closely related to *S. potentillifolia*. However, it differs from *S. potentillifolia* on its bigger terminal leaflet and more or less caespitose habit.

Figure 121. Habit of *S. nydeggeri*

14. *S. wiedemannii* Boiss., Fl. Or. 4:599 (1879)

Syn: *S. wiedemannii* Boiss. var. *polychaeta* Bornm. in Feddes Rep. 5:168 (1908), (Figure 122).

Perennial suffruticose herb. Stems ± erect, 10-70 cm, usually branched above, eglandular-scabridulous with short or longer often antrorse white hairs and some sessile glands. Leaves pinnatisect with 2 pairs of lateral segments, terminal segment linear-oblong to linear-obovate, 1.2-5) x 0.2-1 cm, eglandular with very short antrorse hairs, depressed punctate, margins entire; petiole 0.2-1 cm, long-ciliate. Verticillasters 2-8 (-l) flowered, ± approximating. Bracts ovate, 6-8 x 3-4.5 mm; bracteoles present. Pedicels 3-5 mm. Calyx reddish-purple, tubular-campanulate to campanulate, 8-14 mm, to 10-15 mm in fruit, villous with many sessile glands. Corolla lilac-blue, 14-25 mm; tube c. 12-17 mm, annulate; upper lip straight. Stamens A.

Habitat and Phenology: May to June (July). Central Anatolian steppe, in *Artemisia*, roadsides and fieldsides, 500-1400 m.

Type: [Turkey A3 Ankara] prope Kadikioi, Wiedemann [340] (holo. G).
Central Anatolia **B3** Eskişehir: Sivrihisar to Emirdağ, around Camili village (main road), 885 m, 26.4.2008, 39 11 387 N 31 18 137 E, F.Celep 1361!, Kütahya: 38 km from Kütahya to Eskişehir, 900 m, Hub.-Mor. 12718!.

Endemic. Ir.-Tur. Element.

Figure 122. Habit of *S. wiedemannii*

15. *S. marashica* A. İlçim, F. Celep & Dogan, Ann. Bot. Fennici 46: 75-79, (Figure 123).

Perennial suffruticose herb with a woody rootstock. Stems many, ascending to erect, 30–70 cm, branched or not, with sterile shoots, lower parts covered with old petioles,

greyish green, dense retrorsely pilose (0.4–0.6 mm) and long villous (1.8–2.5 mm) hairy. Leaves pinnatisect, with a linear-oblong to narrowly obovate-elliptic terminal segment c. 1.2–7 x 0.3–1.8 cm and two pairs of lateral segments or rarely one pair and single leaflet on sterile shoots, greyish-green, densely pilose hairy with sessile glands, not rugose, terminal segment slightly longer and broader than laterals, margins serrate. Petiole 0.7–3.0 cm, slightly widened at base, dense retrorsely pilose and 2.0-4.5 mm long ciliate hairy. Inflorescence racemose, clearly exceeding leaves with 3–10(–12) verticillasters, each verticilasters with (1-)2–14 flowered, densely multicellular black-headed glandular pilose with some villous hairy, 10–20(–25) cm long, internodes 0.5–3 cm, clearly distant, sometimes upper verticillasters approximating. Bracts narrowly ovate to elliptic, acuminate, 0.7–1.5 x 0.2–1.0 cm, densely glandular pilose and eglandular villous hairy with sessile glands; bracteoles linear, 4–8 mm long, floral leaves similar or dissimilar to stem leaves, pinnatisect or trisect. Pedicels 2–4 mm. Calyx strongly infundibular, 12–16 mm, up to 22 mm in fruit, clearly bilabiate, scarsely expanding in fruit, upper lip c. 1 cm longer than lower and divergent in fruit, densely long eglandular villous (3–5 mm) and multicellular black headed glandular hairy with sessile glands. Corolla pink, 20–28 mm, not squamulate; tube 15–22 mm, gradually widening above, upper lip straight. Stamens 2, staminal connectives shorter than filaments, upper theca 1.8–2.1 mm, the lower theca 1.5–1.8 mm, filaments c. 3.5–5 mm. Style glabrous, 22–33 mm long, exerted from corolla lips and divided in two part at apex.

Habitat and Phenology: April. *S. marashica* grows on rocky mountain slopes at an altitude of 700-1700 m.

Type: Turkey. C6 Kahramanmaraş: Yukarı Ceyhan vadisi (upper Ceyhan valley), Ahır Dağı, (Ahır Mt.), around Maksutlu village, 1450-1600 m, rocky places, 17. 4. 2001 A. İlçim 995 (holotype KSUH; isotypes E, K, ANK, GAZI, VANF).
East Mediterranean Region of Turkey. **C6:** Kahramanmaraş: Ahır Da. Sarıçukur to Maksutlu village, 871 m, 27.4.2006, 37 39 140 N 36 50 538 E, F.Celep 1020!

Endemic. Medit. Element.

This new species is related to the three other endemics, *S. rosifolia*, *S. huberi* and *S. pisidica*, from which it differs on its larger, serrate and densely pilose terminal leaf segment, multicellular black-headed glandular pilose hairs densely covering the inflorescence, clearly bilabiate, infundibular and long villous hairs densely covering the calyx. In addition, it differs from *S. pisidica* on its longer stems and pink corollas. This new species is also different from *S. rosifolia* and *S. huberi* on its flowering time. While *S. rosifolia* and *S. huberi* flower from June to August this new species flowers in April.

Figure 123. Habit of *S. marashica*

16. *S. pisidica* Boiss. & Heldr. ex Bentham in DC., Prodr. 12: 269 (1848), (Figure 124).

Perennial suffruticose herb. Stems procumbent ascending, (4-) 10-35 cm, eglandular pilose-pubescent below, retrorse, pilose to villous above with or without capitate glandular hairs. Leaves trisect or rarely pinnatisect with 2 pairs of small lateral

segments, terminal segment obovate-cuneate to linear-obovate, 0.4-3 x 0.2-1 cm, eglandular-pubescent with sessile glands, apically crenulate to serrate; petiole 0.5-1.4 cm, long ciliate. Inflorescence ca. 2-15 cm long. Verticillasters 2-8-flowered, usually distant. Bracts elliptic to ovate-acuminate, 5-16 x 2-6 mm, shorter than calyx, bracteoles present. Pedicels 2-6 mm. Calyx ± tubular to campanulate, 6-12 mm, scarcely accressent in fruit to 14 mm, veined, bilabiate, upper lip tridentate, ovate-lanceolate, acute to acuminate, median tooth shorter; often purplish, eglandular or capitate glandular-villous with sessile glands. Corolla violet-blue, 18-25 mm; tube straight c. 12-15 mm, and gradually wider towards throat, not squamulate, annulate; upper lip broad, ± straight. Stamens A. Anther ca. 5-6 mm, upper theca ca. 5-6 mm, lower theca ca. 2 mm, stylus ca. 20-30 mm.

Habitat and Phenology: (April) May to June. *Quercus coccifera* macchie, dry limestone slopes, fieldsides, 950-1950 m.

Type: Type: [Turkey C3 Burdur] in collibus tophaceis prope Burdur, v 1845, Heldreich (holo. G! iso. E! W!).

S.W. Anatolia. **B2** Uşak: Yaparlar Kieni, S.E. of Uşak, Bal. 1857:1191! **B3** Afyon: Dazkırı to Dinar, before about 8-10 km from Dinar, 1026 m, 5.7.2006, 38 02 240 N 30 03 320 E, F.Celep 1170!, ibid F.Celep 1456!, ibid F.Celep 1457! **C2** Burdur: Dirmil (Altinyayla) to Tefenni, Hub.-Mor. 5202!, Antalya: Kuhu Da., Çiglikara, 1750 m, Fitz and Spitz. 772! **C3** Burdur: 6 km after Burdur towards Antalya, A. Baytop (ISTE 9506)! Burdur: Burdur to Yeşilova, after Burdur ca. 20 km 940 m, 8.6.2008, 37 36 559 N 30 08 494 E, F.Celep 1460!, Burdur: Burdur to Çavdır, above Hacılar village, 950 m, 8.6.2008, 37 33 470 N 30 04 483 E, F.Celep 1461!, Burdur: Tefenni to Çavdır, before Çavdır ca.13 km, 1236-1250 m, 37 14 398 N 29 44 914 E, F.Celep 1465! Burdur: Çavdır to Korkuteli, above Kızılcadağ, Koru Da, Çığlık Yaylası, 1600-1900 m, 8.6.2008, 37 03 259 N 29 59 301 E, F.Celep 1473!, Afyon: 20 km S. of Dinar towards Burdur, 1150 m, Hub.-Mor. 17705!, Antalya: 9 km N.E. of Elmali towards Korkuteli, 1120 m, Hub.-Mor. 16625!, Antalya: Korkuteli to Antalya about 7-8 km, slopes, 1140 m, 3.5.2006, 36 59 230 N 30 09 120 E, F.Celep 1041!, ibid about 9-12 km from Korkuteli, 1256 m, 2.7.2006, F.Celep 1156!, Antalya: Elmalı, Yeşiloba to Söğüt, 1410 m, 3.5.2006, 37 02 550 N 29 51 560 E, F.Celep 1042!, Antalya: Elmalı,

Finike to Elmalı, before Elmalı about 1-2 km, rocky slopes, 1027 m, 28.4.2008, 36 42 674 N 29 55 035 E, F.Celep 1381!, Isparta: Isparta to Dinar, 20 km before Dinar, 1170 m, 7.6.2008, 37 55 168 N 30 16 187 E, F.Celep 1454! **C4** Antalya: Anamur to Gazipaşa, Akman 6113!

Endemic. Medit. Element.

The species is closely similar to *S. albimaculata*. Both species are endemic to Turkey. *S. albimaculata* is restricted to Ermenek in central part of the Mediterranean region of Turkey; however *S. pisidica* is confined to western part of the Mediterranean region and southern part of the Aegean region of Turkey. Both species have blue corolla and pinnatisect leaves. However, *S. albimaculata* differs from *S. pisidica* on its longer corolla and calyx.

Figure 124. Habit of *S. pisidica*

17. ***S. albimaculata*** Hedge & Hub.-Mor. in Notes R.B.G. Edinb. 22: 174 (1957), (Figure 125).

Perennial suffruticose herb. Flowering stems ascending to erect, unbranched, (10-) 20-40 cm, ± retrorse-pubescent below with sessile glands, densely capitate-glandular pilose to villous (eglandular pilose to villous) above. Leaves mostly basal, trisect, rarely with an extra pair of lateral segments, terminal segment linear-obovate, 0.7-1.8 x 0.4-0.7 cm, eglandular-pubescent with numerous sessile glands, greyish, apically crenulate to serrulate, petiole 0.4-1 cm, sparsely ciliate. Inflorescence ca. 3-15 cm long, densely glandular pilose to villous (eglandular pilose to villous) hairy. Verticillasters 2 (-5) -flowered, clearly distant. Bracts lanceolate-acuminate, c. 5-8 x 2 (-2.5) mm, shorter than calyx, eglandular pubescent (glandular pilose) hairy; bracteoles present. Pedicels 5-8 (15) mm. Calyx ± tubular, 10-18 mm, scarcely accressent in fruit 14-20 mm, 14 veined, bilabiate, upper lip tridentate, ovate-lanceolate, acute to acuminate, median tooth shorter; suffused purplish or green, densely capitate-glandular pilose to villous, split to c. 1/3 of its length. Corolla deep blue with a white spotted lower lip, c. 26-40 mm; tube c. 18-30 mm, tube straight and gradually wider towards throat, not squamulate, corolla 2-3 times longer than calyx, annulate, not squamulate. Stamens A. Anther ca. 6 mm, upper theca ca. 6 mm, lower theca ca. 2 mm, style ca. 35-40 mm.

Habitat and Phenology: May to June. Screes and open busy. 800-1650 m.

Type: Type: [Turkey C4] Konya: d. Ermenek, Kalkmergel, 2 km ob Ermenek am Weg nach Karaman, 1360 m, 9 vi 1948, A. Huber-Morath, H. Reese, J. Renz, Huber-Morath 8382 (holo. Hb. Hub.-Mor.!).

C4 Konya: 11 km N. of Ermenek on road to Anamur, 1100 m, Hub.-Mor. 9589! Karaman: Ermenek to Mut, about 300-500 m, 1273 m, 1.5.2006, 36 37 149 N 32 55 327 E, F.Celep 1032!, ibid G.Akaydın & F.Celep 998!, ibid F.Celep 1249!, Karaman: above Ermenek, Ermenek to Karaman, 1477 m, 2.7.2006, 36 37 941 N 32 55 336 E, F.Celep 1142! Karaman: Ermenek, Ermenek to Karaman, around Tekeçatı, 1650 m, 26.6.2009, 36 43 513 N 32 55 068 E, F.Celep 1703!, Karaman: Ermenek, Kazancı town (observed).

Endemic. Medit. Element.

Figure 125. Habit of *S. albimaculata*

18. *S. tchihatcheffii* (Fisch. & Mey.) Boiss., Fl. Or. 4: 598 (1879).

Syn: *Dracocephalum tchihatcheffii* Fisch. & Mey. in Ann. Sci. Nat. ser. 4, 1:34 (1854), (Figure 126).

Perennial suffruticose herb. Sterile stems prostrate, leafy; fertile stems procumbent-ascending, unbranched, 10-25 cm, eglandular-pubescent with sessile glands, hairs ± retrorse. Leaves trisect or pinnatisect with 2 pairs of lateral segments, terminal segment linear oblong, 0.7-3 x 0.2-0.8 cm, glabrescent with sessile glands, entire or terminal segment apically toothed; petiole 0.3-1 cm, ciliate. Inflorescence a condensed ± dense 'spike'. Verticillasters 2-6 (-8) -flowered. Bracts ovate-acuminate 6-16 x 4-7 mm; bracteoles present. Pedicels 3-5 mm. Calyx tubular-campanulate,. 8-

11 mm, to 9-12 mm in fruit, puberulent-ciliate with sessile glands. Corolla white to light violet, 10-15 mm; tube 7-10 mm, annulate; upper lip ± straight. Stamens A.

Habitat and Phenology: (April) May. Steppe, limestone slopes and *Pinus* woodland. 400-1200 m.

Type: [Turkey B4 Ankara] [in vallibus herbosis sylvaticis montis] Kure- dagh (Galatia), 950 m, Tchihatcheff (E! G).
Central (west) Anatolia. **B2** Kütahya: Kütahya-Bozüyük arası, İnönü'nün 22 km güneyi, 950 m, Hub.-Mor. l2720! **B3** Eskişehir: Eskişehir-Kütahya arası, 880 m, Demiriz l780 (E!), Kütahya: Kütahya'dan Eskişehir'e 40 km, 930 m, A. Baytop (ISTE 25368!)

Endemic. Ir.-Tur.Element.

Figure 126. Habit of *S. tchihatcheffii*

19. *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 (I851) nom. nud.; S. *brevispicata* Davis in Kew Bull. 6:96 (1951)!, (Figure 127).

Shrub, much branched, 25-50 cm, to 1.5 m. Young shoots ± erect, leafy, pilose and villous with some sessile glands below, short hairs ± 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. 5-15 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 ± tubular infundibular, 14-17 mm, scarcely accressent 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 wşth white spotted lower lip, (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.

Habitat and Phenology: June to July (August). Limestone slopes, with *Pinus nigra* and *Quercus* screes, fieldsides. (900-) 1000-1750 (-2000) m.

Type: Syntypes: [Turkey C5 Icel] in monte Tauro prope Gülek Boghas, Kotschy 437 (G!); [Turkey B4 Konya] in collibus aridis Lycaoniae ad Karaman, Heldreich (G!). S. & C. Anatolia. **B3** Isparta: Sarkikaraağac, Kale Da., 1250 m, Simon 75-079!. **C3** Isparta: Beyşehir to Şarkıkaraağaç, 18 km before Şarkıkaraağaç, above Kıyakdede village, 1240-1300 m, 6.6.2008, 37 57 637 N 31 28 515 E, F.Celep 1427!, 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!, İçel: 33 km W. from Silifke to

Gülnar, c. 900 m, Hub.-Mor. 9590!, Karaman: Ermenek, Ermenek to Karaman, around Bayır village, 1160 m, 26.7.2005, G. Akaydın & F.Celep 1004!, Karaman: Ermenek, above Çamlıca village, Damlaçal, 1755 m, 25.7.2005, 36 39 846 N 33 01 053 E, G.Akaydın & F.Celep 995! Karaman: Ermenek, above Başyayla town, 1526-1794 m, 2.7.2006, 36 45 865 N 32 40 525 E, F.Celep1144!, Karaman: above Kazımkarabekir, Hacıbaba Tepesi, 1318 m, 1.7.2006, 37 09 882 N 32 57 969 E, F.Celep 1130! ibid 1519 m, M. Dogan & F.Celep 1132! **C5** Adana: Pozantı, Gülek, Kandilsırtı pass, 1370 m, 14.6.2006, 37 17 176 N 34 44 231 E, F.Celep 1108! Mersin: Çamlıyayla (Namrun), 1.5-2 from Sebil village to Cehennem valley, 1207 m, 25.7.2005, G. Akaydın & F.Celep 988!, Nigde: 20km from Ulukisla, 12.6.1937, Reese!, Konya: d. Eregli, Aydos Da., 1700 m, Erik 2445!

Endemic. Medit. Element.

Figure 127. Habit of *S. heldreichiana*

20. *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), (Figure 128).

Dwarf suffruticose perennial forming mats to c. 60 cm diam. Stems procumbent to ± erect, eglandular pubescent below, pubescent to villous above with some capitate glandular hairs. Leaves pinnatisect, obovate in outline, crehate, terminal segments ± lanceolate, 0.6-2 x 0.1-0.6 cm, with 2-4-pairsof lateral ± oblong segments; petiole 0.5-2 cm, often long-ciliate. Racemes condensed, scarcely exceeding leaf level. Verticillasters 2-6 -flowered, approximating. Bracts ovate, acuminate, 11-12x5-8 mm; bracteoles present. Pedicels 3-6 mm. Calyx campanulate, often purplish, 10-14 mm, to 15 mm in fruit, indumentum variable, from eglandular pilose/villous with sessile glands to densely capitate-glandular. Corolla violet-blue to lilac-pinkish (rarely white), 18-40 mm; tube straight, 11-30 mm annulate. Stamens A.

Habitat and Phenology: (May-) June to July. . Rocky limestone and igneous slopes, terraces, 1200-2700 m.

Type: Type: [Turkey B6 Sivas] in Monte Saru-tchitchek (Sariçiçek) in Cappadocia Orientali, Montbret [2015] (iso. K!, G!, W!).
Mainly C. & S. Anatolia. **B5** Kayseri: Bakir Da. at Akoluk Y. above Kisge, 2000 m, D. 19455! **B6** Kayseri: Sarız, Yeşilkent (Yalak), Binboğa Da., above Dayoluk village, Afan Yaylası, 2172 m, 10.6.2006, 38 21 082 N 36 30 905 E, F.Celep 1070!, Kayseri: Sarız-Pınarbaşı arası, Sarız'dan 3-4 km sonra, 38 30 01 N 36 29 53 E, 1700-1800 m, 8.6.2006, AKahraman 1233!, Kayseri: Pınarbaşı to Sarız, after 2 km from Aşağı Beyçayır village, 1634-1690 m, 19.6.2007, 38 39 070 N 36 26 801 E, F.Celep 1218!, Kahramanmaraş: Göksun, Ericek, Berit Da, above Kınıköz village, 2496 m, 24.7.2006, 38 00 793 N 36 49 966 E, F.Celep 1195!, Adana: d. Saimbeyli, Bozoglan Da. above Obruk Y., 2000 m, D. 19712!, **C3** Antalya: Tahtali Da., Kemer, 2200 m, D. 14173!, Antalya: Kemer, top of Tahtalı Mountain, 2200-2300 m, 9.6.2008, 36 32 338 N 30 26 347 E, F.Celep 1520!, Antalya: Merkez, above Feslikan Yaylası, Karçukuru

mevkii, 1929-1950 m, 3.7.2006, 36 48 693 N 30 23 098 E, F.Celep 1154!, **C5** Nigde: Ala Da., N. part, Ulupinar Y., 2000 m, Spitzenberger 146!

Endemic. Ir.- Tur. Element ?

The species is closely related to *S. pachystachys* and *S. hedgeana* In this group, *S. caespitosa* and *S. hedgeana* are endemic species. *S. hedgeana* has been recently described from central Anatolia, which is known only two close locations *S. hedgeana* differs from *S. caespitosa* and *S. pachystachs* on its trifoliate leaves.

The species has some variable characters such as indumentum, corolla colour and leaf shape. Antalya population has large and pink corolla as well as its leaf indumentum is eglandular pilose. However, Kahramanmaraş population has blue corolla and glandular leaves.

Figure 128. Habit of *S. caespitosa* (Antalya)

21. *S. suffruticosa* Montbret & Aucher ex Bentham in Ann. Sci. Nat. ser. 2, 6:39(1836).

Syn: *S. alexandri* Pobed. in Fl. URSS 21:653 (1954), (Figure 129).

Perennial herb, somewhat suffruticose at base. Stems many, ascending, 30-60 cm, branched above, often yellowish-green, usually glabrous, occasionally pilose. Leaves pinnatisect, ovate in outline, terminal segment lanceolate, cumeate at base, acute, sharply dentate, 2.5-5.5 x 0.5-2 cm, with 2-3 (-4) pairs of smaller lateral segments, pilose on veins with some 2-3(-4) pairs of smaller lateral segments, pilose on veins with some sessile glands, serrulate to serrate; petiole 0.6-3 cm with ciliate hairs. Inflorescence axis with short-stipitate glands. Verticillasters 2-8 (-10)-flowered, distant. Bracts ovate-acuminate, 8-17 x 4-8 mm; bracteoles present. Pedicels 3-8 mm. Calyx campanulate, 8-12 mm, to c. 15 mm in fruit and broadening, subglabrous to pilose-villous with dark subsessile glands; upper lip tridentate. Corolla sulphur yellow or with lilac coloration, 22-25(-30) mm; tube c. 15 mm, annulate; upper lip ± straight. Stamens A.

Habitat and Phenology: April to June. Banks in steppe, fallow fields, vineyards, 300-2000 m.

Type: [Turkey B6 Maraş] ad Akdog in Tauro orientalis, [1834], Aucher [2131] (holo. G, iso. W! K!).
Central & East Anatolia **B5** Kayseri: Yahyalı, Sazak, Zamantı Vadisi, 1350 m, 1.6.1978, A. Baytop, E. Tuzlacı and K. Alpınar 40150 (ISTE!) **C4** Konya: Konya'dan Bozkır'a 50 km, 1070 m, Hub.-Mor. 8374. **C5** Niğde: Ulukışla, 12.6.1937, Reese **C6** Maraş: Maraş'ın 15 km batısı, Ceyhan nehri vadisi, 500 m, 5.6.1957, D. 27440!, Hatay: İskenderun, Amanos Dağları, 700 m, 5.6.1968, Y. Akman 7695.

Ir.-Tur. Element.

S. suffruticosa is closely related to *S. ballsiana*. However, *S. ballsiana* differs from *S. suffruticosa* on its stiffly erect habit, taller stem, entire leaves having with 1 or no pair of small lateral segments (rarely 2 pairs) and very fine decumbent hairs all over, longer petioles, much shorter acute calyx teeth, dense glandular indumentums with stalked glands on calyces and floral leaves, longer corollas, yellow upper lips and white lower lips.

Figure 129. Habit of *S. suffruticosa*

22. ***S. quezelii*** Hedge & Afzal-Rafii in Notes R.B.G. Edinb. 38:47 (1980), (Figure 130).

Perennial herb with a woody rootstock. Stems procumbent ascending, 6-45 cm, densely spreading glandular and eglandular villous with some capitate glandular hairs and sessile glands. Leaves pinnate, with an elliptic terminal segment, 0.4-3.6 x 0.4-2.4 cm, and 1-3 pairs of small lateral segments, rugulose, finely crenulate, densely (e)glandular villous with some eglandular hairs and sessile glands; petiole 0.5-8 cm, ciliate. Inflorescence few-flowered, 5-35 cm. Verticillasters 1-3-flowered, distant. Bracts ovate-elliptic, 5-30 x 4-9 mm, glandular villous hairy; bracteoles present. Pedicels 4-8mm, ± erect to erecto-patent. Calyx tubular, 18-24 mm in flower, to 28 mm in fruit, green, in fruit rarely purplish tinted, sparcely villous-pilose (e)glandular, 14-16 veined; upper lip very shortly tridentate, ± truncate, ± equal to lower. Corolla white-cream 25-34 mm; lilac dots on lower lip, tube straight and gradually wider towards throat, not squamulate, 16-25 mm, indistinctly annulate; upper lip ± straight. Stamens A. Filament 4-5 mm, connective 5-8 mm, style to 35 mm. Anthers ca. 3-5 mm.

Habitat and Phenology: May to June (August ?). Calcareous rocks, 500-1300 m.

Type: ?: Turkey C5 Içel: S. of Bolkar Dag, near Namrun, among calcareous rocks, 1300 m, Quezel 73113 (holo. E! iso. Hb. Quezel).
S. Anatolia. **C5** İçel; Mersin to Fındıkpınar, 500 m, 14 8 1931, Eig & M. Zohary!
C4 Mersin: Anamur to Ermenek, about 37-39 km, 1023 m, 31.5.2009, 36 13 060 N 32 53 970 E, F.Celep 1626!.

Endemic. Medit. Element.

Known only from the cited gatherings, this appears to be a remarkably distinct species on account of the dense glandular indumentum on all parts, the pinnate

rugulose leaves, the few-flowered inflorescences and the large tubular calyces (Hedge 1982a).

The species did not found in its known localities despite many expeditions. According to our studies, type locality and flowering time of the species were given wrong. The specimens which were collected by Eig & Zohary at August 1931 are only two dry leaves.

Figure 130. Habit of *S. quezelii*

Section 2 ***Hymenosphace*** Bentham

23. ***S. haussknechtii*** Boiss., Fl. Or. 4:605 (1879), (Figure 131).

Dwarf suffruticose perennial, probably mat-forming. Stems short, leafy, c. 20 cm, procumbent, with an eglandular antrorse ± dense pilose indumentum. Leaves pinnatisect, ± elliptic in outline, with an elliptic, serrulate, 1.0-4.0 x 0.4-1.5 cm,

terminal segment and 2 or 4 smaller lateral segments; indumentum eglandular with antrorse short hairs and few sessile glands; petiole 1-2 cm, long-ciliate. Inflorescence condensed, 5-8 cm. Verticillasters 4-6 (-8) flowered. Bracts ovate, acuminate, c. 15 x 6 mm; bracteoles present? Pedicels c. 3 mm. Fruiting calyx infundibular, membranous, 17-22 mm, with divergent lips, eglandular; upper lip somewhat longer than lower. Corolla unknown.

Habitat and Phenology: June-July? (August, in fruit). Rocky places. 2135-2660 m.

Type: Type: [Turkey B6 Maraş in saxosis mentis Berytdagh (Berit Da.) Cataoniae, 2135-2440 m, [l0 viii 1865], Haussknecht (holo. G!, iso. JE!).

Endemic. Medit. Element.

It is known only type gathering. The species is closely related to *S. caespitosa* and *S. multicaulis*. It differs from *S. caespitosa* on its membranous calyx and differs from *S. multicaulis* on its pinnatisect leaves (Hedge 1982a). According to studies, it is flowering time probably June to July, not August. Its type location is not clear, therefore the species was not collected in this study despite many expeditions to the Berit Mountain.

Figure 131. Habit of *S. haussknechtii*

24. *S. cadmica* Boiss. in Diagn. Ser. 1(5): 6 (1844), (Figures 132).

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

Perennial herb with a woody rootstock. Stems one or few, ascending to erect, unbranched, (8-) 12-20 (-35) cm, more or less densely eglandular villous and glandular pilose. Leaves mostly basal, ovate, ovate-oblong to elliptic or obovate, simple or with 1-2 pairs of small lateral segments, 10-50 x 5-35 mm, rugulose, crenulate, more or less densely glandular pilose and eglandular villous with sessile glands; petiole 1-4 (-6) cm. Inflorescence 7-30 (-36) cm long, clearly exceeding leaves, unbranched (rarely branched), verticilasters (2-) 4-10 (-12) flowered; internodes 1.5-4 cm long. Bracts broadly ovate - acuminate, 0.8-2 (-5) x 0.7-2 cm, green to purplish green, more or less densely glandular pilose to villous (and eglandular villous) with sessile glands. Pedicels 1-4 mm. Calyx campanulate, 9-20 mm, up to 28 mm in fruit, gren to purplish-green, more or less densely long

glandular or eglandular villose indumentum and glandular pilose pubescent with sessile glands, expanding and becoming membranaceous with increasingly divergent lips in fruit; upper lip subentire or rarely tridentate. Corolla entirely white or light lavender to amethyst, 23-35 mm; tube 17-25 mm, straight on abaxial side, gradually widening at adaxial side, annulate at throat. Stamens 2, type A (Hedge, 1982a); staminal connectives shorter than flaments; upper theca 2-3 mm; the lower theca 1.5-3 mm; connective 4-6 mm. Style 25-35 mm, long exerted from corolla, distal part usually violet, glabrous and apex bilobed.

1. Calyx 20-28 mm in fruit; corolla entirely white…….....**var. *cadmica***
1. Calyx 14-20 mm in fruit; corolla light lavender to amethyst with dark to light violet stripes…..……...…….**var. *bozkiriensis***

S. cadmica var. *cadmica*: **B2** Kütahya: Gediz to Kütahya, 18 km S of Kütahya, 1000 m, limestone gorge, 7.7.1962, *Davis* 36917 (E!). **B3** Eskişehir: Sündiken mountain, Kartal yangın kulesi üstü, 1400 m, 5. 6. 1971, T.Ekim 631. **B4** Ankara: Elmadağ mountain, 39 49 254 N 32 57 706 E, 1466 m, on limestone rocks, 15.5.2007, F.Celep 1212 **C2** Denizli: Acıpayam, Bozdağ, Geyran Yaylası, 1450 m, open forest, 4.7.1997, Aytaç 7643 (E!); Denizli: in Cadmo orientali (Honaz Da.) supra colossam, 6.1842, Boissier (K!, Type of *S. cadmica*). **C3** Burdur: 16 km from Burdur to Antalya, 1300 m, 11.6.1962 **C4** Konya: Bozkır, Bozkır to Akseki, Around Dere Village, 37 10 034 N 32 09 489 E, 1150 m, on limestone rocks, 11.5.2007, F.Celep 1208; Şarkıkaragaç to Aksehir, Sultan mountain, above Bağkonak village, 38 13 197 N 31 17 375 E, 1250 m, on limestone rocks, F.Celep 1210, Aksehir, Sultan Da., 1100 m, 14.4.1899, Bornmüller 5427 (E!, Type of *S. cadmica* var. *bracycalycina*).

var. b*ozkiriensis* F.Celep & Dogan **var. nova**

Type: Turkey. C4 Konya: Bozkır, Erenler Tepesi (Sivri), İkidelik mevkii, 37 11 604 N 32 14 782 E, 1160 m, on calcareous rocks, 2.5.2006, Leg: F. Celep 1034- A. Kahraman (holotype: GAZI; isotypes ANK, E).

S. cadmica var. *bozkiriensis*: **B4** Ankara: Elmadag mountain, 39 49 254 N 32 57 706 E, 1466 m, on limestone rocks, 15.5.2007, F.Celep 1211 **C3** Şarkıkaragac to Aksehir,

Sultan mountain, above Bagkonak village, 38 13 197 N 31 17 375 E, 1250 m, on limestone rocks, F.Celep 1209 **C4** Konya: Bozkır, Bozkır to Akseki, Around Dere Village, 37 10 034 N 32 09 489 E, 1150 m, on limestone rocks, 11.5.2007, F.Celep 1207.

var. b*ozkiriensis* differs from var. *cadmica* by its calyx 14-20 mm in fruit; corolla light lavender to amethyst with dark to light violet stripes

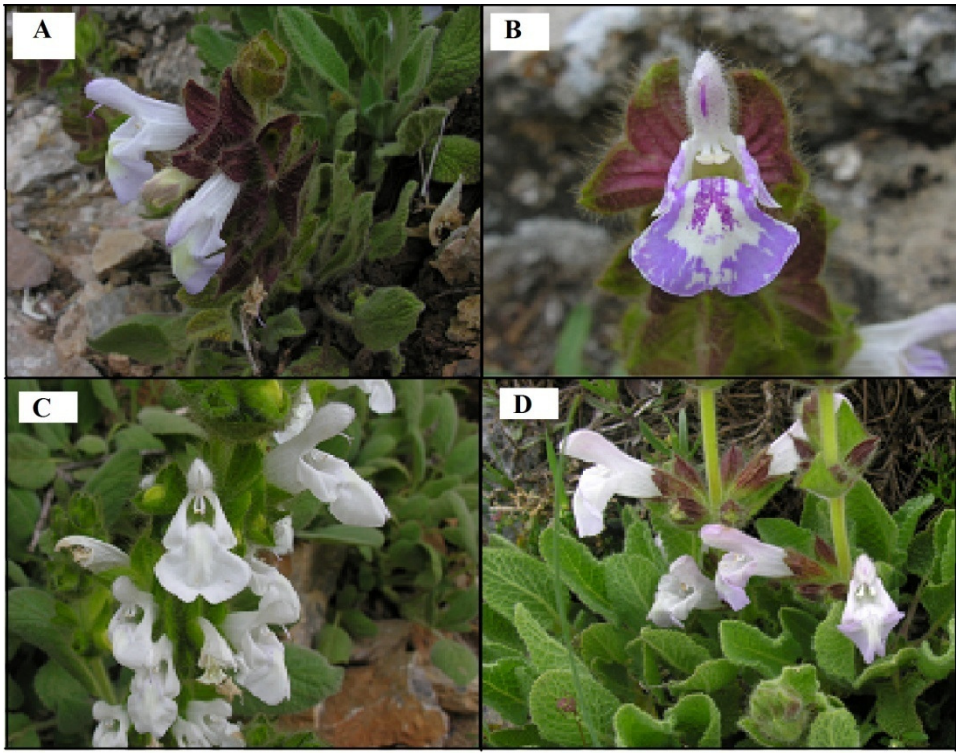

Figure 132. Habit of *S. cadmica* var. *bozkiriensis* (A, B), var. *cadmica* (C) and *S. smyrnaea* (D).

25. *S. smyrnaea* Boiss. Diagn. ser. 1(5): 5 (1844), (Figure 132).

Perennial herb with a woody rootstock. Stems (one) few or many, ascending to erect, unbranched, 9- 16 (-22) cm, densely eglandular villose and glandular pilose hairy. Leaves mostly basal, ovate, ovate-oblong to elliptic, simple or with 1-2 pairs of small lateral segments 12-35 x 10-22 mm, rugulose, crenulate, scarsely glandular pilose

and a few eglandular villose hairy with sessile glands; petiole 1.2-4 (-5) cm. Inflorescence racemose, 8-17 (-22) cm long, clearly exceeding leaves with 4 – 6 (8) verticillasters, each verticilasters with (2-) 4-6 (-7) flowered; internodes 1.5-4 cm long. Bracts broadly ovate, ovate to oblong, lowermost bracts obovate to spatulate, 1-2.5 (-5) x 0.7-2 cm, acuminate, purplish green, glandular villose hairy with sessile glands. Pedicels 3-6 mm. Calyx tubular campanulate, 10-15 mm, up to 18 mm in fruit, purplish-green, densely glandular villose with sessile glands, scarcely expanding in fruit; upper lip clearly tridentate. Corolla pinkish to light violet-blue without spots on lower lip, 28-35 mm, sparsely villose and glandular hairy outside, not squamulate; tube 18-24 mm, straight below, gradually widening above, annulate. Stamens 2, type A; staminal connectives shorter than flaments; upper theca 3 mm; the lower theca 1.5-2 mm; connective 3-4 mm. Style tip violet, glabrous, 25-34 mm, long exerted from corolla lips and divided in two part at apex.

Habitat and Phenology: May. Calcareous rocks and open *Pinus* forest. 900-1510 m.

Type: Type: [Turkey Bl Izmir] in cacumine montis Tartali (Tahtali Da.) ad orientem Smyrneam (Izmir), v 1842, Boissier (holo. G! iso. W!, JE!).
West Anatolia. **Bl** İzmir: Kemalpaşa, top of Nif Da., Alava 4910! İzmir: Kemalpaşa, Nif Dağı, around summit, 1450-1510 m, 4.5.2006, 38 23 225 N 27 21 350 E, F.Celep 1053!,ibid 1057 m, 9.7.2007, 38 23 021 N 27 22 292 E, F.Celep 1354! (in fruit) **Cl** Aydin: Söke, Gümüşdağ, 920 m.Uslu 4127!.

Endemic. Medit. Element.

The species is closely related to *S. cadmica*. *S. smyrnaea* differs from *S. cadmica* on its thick textured and clearly dentate calyx. As well as, *S. smyrnaea* is confined to only İzmir and Aydın.

26. ***S. blepharochlaena*** Hedge & Hub.-Mor. in Notes R.B.G. Edinb. 22:178 (1957), (Figure 133).

Perennial herb, woody at base. Stems ascending-erect, 10-40 cm, densely glandular-villous. Leaves mostly basal, pinnatisect, oblong in outline, glandular-villous, with 3-5 pairs of lateral segments; terminal segment oblong-elliptic, serrate to serrulate, sessile, 10-12 x 4-5 mm; petiole to 25 mm. Verticillasters (2-) 4-6-flowered, ± distant. Bracts of median verticillasters broadly ovate, c. 3 x 2 cm, cordate. Pedicels 0-1 mm. Calyx broadly infundibular, 18-26 mm, green or purplish-suffused, to c. 26 x 25 mm in fruit, with divergent $lips_s$ densely glandular-villous; upper lip subentire or indistinctly 3-toothed. Corolla white with a pale yellow upper lip and violet veined labellum, 30-50 mm; tube to 35 mm, broad, annulate. Stamens A.

Habitat and Phenology: May to June. Calcareous rocks and serpentine slopes. 1000-2000 m.

Type: [Turkey B6] Sivas: d. Kangal, Tecer-Gürün, Gipsschutt, 37 km nordlich Tecer, 1570 m, 27.6.1955, A. Huber-Morath 13048 (holo. G!).
Central and NE Mediterranean region of Turkey. **B6** Kayseri: Sarız-Pınarbaşı arası, Aşağıbeyçayırı civarı, 38 38 25 N 36 26 28 E, 1650 m, 20.7.2006, AKahraman 1355!, Kayseri: Pınarbaşı, Aşağıbeyçayırı köyü-Sarız arası, yaklaşık 25 km to Sarız, 38 38 474 N 36 26 471 E, 1636 m, 17.6.2008, AKahraman 1492A!, Kayseri: Sarız, Binboğa Dağı, Kırkısrak-Bakır köyleri arası, 38 27 587 N 36 38 601 E, 1677 m, 23.7.2008, AKahraman 1583B!, Kayseri: Pınarbaşı, A. Beyçayırı'nın 2 km güneyi, 38 38 800 N 36 26 605 E, 1032 m, SBagherpour 321! Kayseri: Sarız-Pınarbaşı arası, Sopan Dağı, Pınarbaşı'nın 15 km güneyi, 1620 m, Hub.-Mor. 1077 **C4** Karaman, Karaman to Mut, c. 1.2 km, 1112, 1.7.2006, 37 08 205 N 33 13 618 E, F.Celep1134!, Konya: Mut'a giden yol üzerinde Karaman'ın 10 km güneyi, 14.6.1950, Reese!.

Endemic. Ir.-Tur. Element.

The species differs from *S. cadmica* on its pinnatisect basal leaves. The species is also similar to recently described species *S. anatolica*.

Figure 133. Habit of *S. blepharochlaena*

27. *S. pomifera* L., Sp. PI. 24(1753).

Syn: *S. calycina* Sibth. & Sm.,Fl. Graeca 1:13, t. 16 (1806). Ic: Tournef., Voy. Levant t. 92 (1717); Huxley & Taylor, Fls. Greece t. 248(1977), (Figure 134).

Shrub, strongly aromatic; Stems erect up to 1.5 m, glabrous or adpressed-pubescent below, glabrous above, often galled. Leaves ovate to oblong , 1.5-8 x 0.5-4.5 cm, rugulose, densely adpressed-pubescent on lower surface, young leaves white-sericeous, finely crenulate to subentire; petiole c. 0.7-3 cm. Inflorescence paniculate, glabrous. Verticillasters 4-6 (-10) -flowered, approximating above. Bracts c. 5-15 x 4-12 mm, broadly ovate, deciduous. Pedicels 2-4 mm, erect. Calyx broadly campanulate, often purplish, c. 15 mm, shortly glandular-pilose; upper lip subentire, truncate; lips diverging in fruit, membranous. Corolla purplish-blue with paler lower lip, 22-35 mm; tube widening from base, densely annulate 6 mm from base; upper lip ± straight. Stamens A. Anther ca. 4 mm, upher theca ca.4 mm, lower theca ca. 2.5-3 mm, filaments ca. 10 mm.

Habitat and Phenology: April to May. Rocky slopes, limestone cliffs, macchie. 1-100 (-800) m.

Type: Described from Crete (Hb. Linn. 42/6!).
West Anatolia. **Bl** Izmir: Efes to Manisa, Bornm. obs. **Cl** İzmir: Samsun Da., s.1-50 m, D. 41695!, Aydin: 5 km N. of Kuşadasi, 10 m, Hub.-Mor. 17534! Aydın: Kuşadası, Davutlar, Milli Park, 10-25 m, 4.5.2006, 37 42 648 N 27 12 671 E, F.Celep 1050!

Medit. Element.

It is leaves used as a herbal tea. The species differs from *S. fruticosa* on its membranous calyx, different corolla morphologies and basal leaves.

Figure 134. Habit of *S. pomifera*

28. *S. serico-tomentosa* Rech. fil. in Öst. Bot. Zeitschr. 99:52 (1952). Ic: Ark. Bot. 5:t. 49 (1960).

Perennial suffruticose herb; stems ascending erect, 20-70 cm, densely sericeous tomentose and short glandular pilose indument with sessile glands. Leaves simple, mostly basal, oblong, oblong to lanceolate attenuate at base, 10-60 x 6-18 mm, densely sericeous tomentose and short glandular pilose with sessile glands, margins minutely crenulate, petiole 0.5-3 cm. Verticillasters 2 to 4-flowered, distant; bracts broadly ovate to cordate, acuminate, 5-20 x 5-20 mm, green or green to purplish green; pedicels 3-7 mm. Calyx membranous, green to purplishgreen, glabrous or eglandular tomentose and short glandular pilose with sessile glands, broadly campanulate, 12-22 mm, broadening and expanding to 30 mm in fruit, upper calyx lip entire; corolla white to cream with yellow upper lip, 25-32 mm, corolla tube c. 20-23 mm, slightly curved and widening toward throat, upper corolla lip ±straight; stamens 2, staminal connectives shorter than filaments; style white, glabrous, 20-25 mm.

28a. ***Salvia sericeo-tomentosa*** var. ***tomentosa*** Rechinger f. (Figure 135)

Habitat and Phenology: April-May. Open *Pinus* and macchie , 10-1000 m.

Type: Turkey, C6 Hatay : Amanus, ascent to Achagi Zarkoun (Aşağı Zerkum) from the Karakisieh side (Jabal al Ahmar), 800-1000 m, *Pinetum halepense* ?, [30 vi 1932], Eig & M. Zohary (holo. S, iso. HUJ) .

28b. ***Salvia sericeo-tomentosa*** Rechinger var. ***hatayica*** Celep & Dogan, **var. nov.** (Figure 136)
Habitat and Phenology: April-May. Open *Pinus* and macchie , 10-1000 m.

Type: Turkey. Hatay: Samandag to Arsuz, among *Quercus coccifera* shrubs, 36º 12' 734" N 35º 51' 218" E, 20-50 m, 19 Jun. 2007, F. Celep 1232 & G. Akgül (holotype, GAZI; isotype, ANK, E, K, MO) (Figure 136).

Amanos Mountain. Hatay: Samandag to Arsuz, among *Quercus coccifera* shrubs, 36 15 684 N 35 48 706 E, 20-50 m, 2.5.2008, G. Akaydın & F. Celep 1402.

The new variety differs from the autonymic variety in its densely sericeous tomentose and glandular pilose inflorescences

Endemic. Medit. Element.

The species differs from *S. euphratica* on its narrower oblong leaves and yellow corollas.

Figure 135. Habit of *S. sericeo-tomentosa* var. s*ericeo-tomentosa*

Figure 136. Habit of *S. sericeo-tomentosa* var. *hatayica*

29. *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*, (Figure 136).

Perennial herb, mat-forming, with a woody rootstock. Stems ascending to erect, 12-55 cm, usually glandular-pilose to villous, especially above, rarely glabrous, occasionally with dendroid hairs. Leaves simple, rarely with 1-2-pairs of small basal lobes, broadly ovate-elliptic to suborbicular, 2-4.5 (-7) x 1-3.5 cm, rugose, crenulate, with a dense indumentum of adpressed dendroid to dendroid-stellate hairs; petiole 1.5-6 cm. Verticillasters 4-10 -flowered, usually distant. Bracts broadly ovate, c. 15 - 10 mm; bracteoles present. Pedicels 2-4 mm, erecto-patent. Calyx campanulate, c. 12-17 mm, to c. 22 mm in fruit and broadening, entire, sparsely to densely glandular-pilose or villous, purplish-violet, rarely yellow-green; upper lip indistinctly 3-lobed. Corolla purplish-violet, rarely white, c. 16-22 mm; tube straight, c. 12-14 mm, annulate; upper lip straight. Stamens A.

Habitat and Phenology: April to July. Rocky limestone and igneous slopes, shale and sandy slopes, scree, fallow fields, in *Quercus* scrub, *Artemisia* steppe. 550-2600m.

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

East, Central and South Anatolia. **B5** Kayseri: Bakırdağ to Saimbeyli, around Gezbeli pass, 1900 m, 9.6.2006, 38 12 225 N 35 59 650 E, F.Celep 1066! **C5** Niğde: Çamardı, Aladağlar, above Çukurbağ village, Sıyırma Yaylası, 2300-2600 m, 14.6.2006, F.Celep 1098! **C6** Kahramanmaraş: Merkez, Ahır Da., around Maksutlu village, 26.4.2006, 883 m, 37 41 111 N 36 54 269 E, F.Celep 1015!

Ir.-Tur. Element.

In the populations of the species, both green and purplish calyces were observed. Its leaves, corolla and calyx properties show great variances (Hedge 1982a).

Figure 137. Habit of *S. multicaulis*

30. *S. cryptantha* Montbret & Aucher ex Bentham in Ann. Sci. Nat. ser. 2, 6:40(1836), (Figure 138).

Similar in facies and general dimensions to *S. multicaulis* but usually a smaller plant with narrower leaves (1.5-5 x 0.8-2.5 cm) without basal lobes; stem indumentum ± always of branched to dendroid hairs and sessile glands (without glandular hairs);

calyx yellowish-green (rarely tinged purple), with an indumentum of sessile glands with or without some eglandular villous hairs, upper lip generally longer than lower; corollas white to pinkish (to ± purple); nutlets pale brown.

Habitat and Phenology: April to July. Rocky limestone slopes, dry steppe, fallow fields, roadsides, 650-2500 m.

Type: Syntypes- [Turkey B5/6?] in Cappadocia orientali, Montbret [2282] (W), Aucher [1531] (P).
Central Anatolia **B2** Kütahya: Gediz to Kütahya, c. 10 km before Kütahya, 961 m, 11.6.2008, 39 22 098 N 30 04 022 E, F.Celep 1516! **B3** Afyon: c. 9.5 km S.W. of İsçehisar towards Afyon, 1070 m, Buttler 13196! **C3** Konya: Şarkıkırkağaç to Beyşehir, c. 10 km before Beyşehir, 1139 m, 4.5.2008, 37 45 887 N 31 40 401 E, F.Celep 1429! **C4** Karaman, Karaman to Mut, c. 1.2 km, 1112, 1.7.2006, 37 08 205 N 33 13 618 E, F.Celep1135!, Konya: Konya to Akören, before 35-40 km Akören, 3-5 km befor Sarıkız village, 1302 m, 11.5.2007, 34 40 216 N 32 23 975 E, F.Celep 1204! **C5** Nigde: Pozanti to Niğde, 1300 m, Coode & Jones 1239!

Endemic. Ir.-Tur. Element.

Figure 138. Habit of *S. cryptantha*

Section 3 *Horminum* Bentham.

31. *S. viridis* L., Sp. PI. 24 (1753).

Syn: *S. horminum* L., Sp. PI. 24(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), (Figure 139).

Annuals. Stems simple or branched, (7-) 25 (-45) cm, glandular or eglandular pilose, topped by a usually violet or pink coma (rarely white) or coma absent. Leaves simple, oblong-ovate, c. 2-7 x 1-3 cm, finely crenulate, obtuse, rugose; petiole 2-5 cm. Verticillasters 4-6-flowered, distant or approximating. Bracts broadly ovate, c. 10x10 mm; bracteoles present. Verticillasters 4-6 -flowered. Pedicels 2-3 mm, erect, flattened. Calyx tubular, 7-12 mm, to c. 13 mm in fruit and strongly deflexed, eglandular-pilose or glandular; upper lip ± truncate. Corolla lilac-purple to white, 12-15 mm; tube straight, glabrous within; upper lip broad, ± falcate. Stamens B.

Habitat and Phenology: March to July. Rocky slopes, macchie with *Cistus* phrygana, sand-dunes, fields and waste ground, 1 -1300 m.

Lectotype: Hortus Cliffortianus *Salvia* Hedge (Jarvis, Cafferty & Forrest (eds.) Taxon 50 (2): 517, 2001) (BM-000557585 photo!).
Bl İzmir: Bournabat (Bornova) near İzmir, Bal. 1854:312 İzmir: Çiğli Havaalanı karşısı, tuzlu habitatlar, 11.4.1979, Ö.Seçmen 1870 & L.Bekat **B2** Kütahya: Kütahya'dan 10 km önce, eski yol, yol kenarı, 1.6.1993, G.Yıldız, Denizli: Çivril-Işıklı yolu, Beydilli ve Homa arası, 900 m, 06.6.1983, Y.Gemici 2099 **B5** Adana: Saimbeyli, 1100 m, P.H.Davis 19883 **B6** Adana: Tscham (Çam) Oluk, Maniss. 1008 **Cl** Aydın: Milet harabeleri, 04.4.1995, A.Erdağ, G.Görk & N.Keyikçi 98 (EGE!), Aydın: Çine-Aydın yolu 6. km, 16.4.1980, Ö.Seçmen 2144, E.Leblebici & L.Bekat (EGE!) Muğla: Marmaris-Datça, Hisarönü köyü, körfez, 23.4.1969, K.Fitz & F.Spitzenbeger **C2** Muğla: Köyceğiz, Toparlar köyü çevresi, 10-200 m, metamofik güney yamaçlar, 18.3.1991, A.Güner 8249 et al., Muğla: Fethiye-Ölüdeniz yolu, Fethiye çıkışı, Maden yolu, 100-200 m, kayalık yamaçlar, M.Koyuncu 5900 & S.Erik **C3** Isparta: Sütçüler, Çobanisa'dan 1 km önce, 1080 m, kalkerli kayalık

yamaçlar, maki, *Juniperus excelsa* ormanı, 26.5.1974, H.Peşmen 1076 & A.Güner , Antalya: Finike, Gökliman, 24.4.1970, Ö.Seçmen & M.Aydar, Antalya: Kemer, Göynük deresinin batısı, deniz seviyesi 5 m, deniz kenarı, 9.5.1978, H.Peşmen 3708, Antalya: Akseki, Murtiçi ve Çukurköy arası, Olcaağzı mevkii, 550-650 m, maki açıklıkları, 2.5.1996, A.Duran 3453.**C4** Karaman: Mut-Karaman yolu, 300 m, Coode & Jones 930, Mersin: Mut ve Ermenek arası, Suçatı, 150 m, tarla, 30.4.1980, S.Kurucu, **C5** Mersin: Tarsus, Egemen köyü, 26.4.1955, K.Karamanoğlu **C6** Antep: Antep-Nurdağı arası, 550 m, 29.4.2006, AKahraman 1077! Osmaniye: Haruniye, Kurtlar köyü, 450 m, 11.4.1951, Düziçi Köy Enstitüsü, Kahramanmaraş: Zeytun, Armutludere alanı, 1600-1900 m, kayalıklar, 6.6.1989, Z.Aytaç 2695.

Figure 139. Habit of *S. viridis*

Section 4 ***Aethiopis*** Bentham.

32. ***S. syriaca*** L., Systema ed. 10:854 (1759). Ic: Boul., Fl. Lib. Syr. t. 351 (1930), (Figure 140).

Perennial herb; rhizomatous. Stems c. 30 (-80) cm, yellowish-green, erect, simple or branched, eglandular-pubescent to villous below, denser above (and rarely glandular). Leaves simple, obtuse or acute, ovate, cordate, c. 5-16 x 3-10 cm, rugose, slightly erose to serrulate, shortly eglandular or glandular-pubescent below with sessile glands, rugose; petiole c. 3-6 cm. Verticillasters 2-6 -flowered, distant. Bracts ovate, c. 5 x 5 mm. Pedicels 3-4 mm, erecto-patent. Calyx tubular, 5-10 mm, 10-12 veined, densely eglandular or glandular-pubescent, upper lip straight, tridentate; calyx scarcely expanding in fruit. Corolla white to cream, 8-12 mm; upper lip slightly falcate, tube straight, glabrous within; upper lip ± straight to slightly falcate. Stamens B.

Habitat and Phenology: April to July. Steppe, marly banks, fallow and cultivated fields, 350-2180

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

Generally Central Anatolia. **B2** Uşak: Uşak, 1857, Bal. **B3** Afyon: Sandıklı to Dinar, A. Baytop (ISTE 9401)! **B4** Konya: Cihanbeyli, D. 18722! **B5** Kayseri-K.maraş: Sarız, Yeşilkent (Yalak), after 1 km after Doğankonak village, 1562 m, 10.06.2006, 38 14 757 N 36 25 724 E, F.Celep 1075! **C2** Denizli: Tavas to Kale, 950 m, Hub.-Mor. 5204 **C3** Antalya: Elmali to Korkuteli, 1120 m, Dudley 35216 **C4** Karaman: Ermenek, Sarıveliler, above Tepebaşı village, 2.5.2006, 1365 m, 36 38 744 N 32 42 853 E, F.Celep 1033!

Ir.-Tur. Element.

Figure 140. Habit of *S. syriaca*

33. *S. hypargeia* Fisch. & Mey., Ann. Sci. Nat. Bot. sér. 4(1):34 (1854).
Syn: *S. montbretii* sensu Boiss., *Flora Orientalis* 4:611 p.p. non Bentham (1836). Ic. Tchihat., Asie Min. Bot. Atlas t.22 (1860), (Figure 141).

Perennial herb forming tufts to 60 cm diam. Stems erect, sturdy, 25-40 (-60) cm, usually unbranched, eglandular arachnoid to lanate below, glandular pilose above. Leaves simple, linear to linear-oblong, 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. 15 x 12 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.

Habitat and Phenology: June to July. 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, South and East Anatolia. **B5** Kayseri: Bakır Da. Kisge üzeri, P.H.Davis 19277, Kayseri: Pınarbaşı-Sarız arası, Sarız'a 3-4 km kala, 38 30 01 N 36 26 53 E, 1692 ft, 8.6.2006, AKahraman 1234! **C4** Karaman: Ermenek-Balkusan deresi yolu, 1500 m, P.H.Davis 16197!, Karaman: Değirmenbaşı köyü çevresi, 1500 m, *Pinus nigra* ormanı açıklıkları, 22.6.1979, M.Vural 1578 et al., Karaman: Ermenek-Karaman yolu 22. km, Aktepe alanı, 1600 m, *Pinus nigra* açıklıkları, 28.6.1980, E.Tuzlacı (ISTE 45168!) **C5** Konya: d. Ereğli, Aydos Da., 1400m, S.Erik 2948 (HUB!) Mersin: Tarsus, Namrun yolu, Sarıkavak köyü çevresi, 900 m, 6.6.1981, M.Koyuncu 4398 & S.Erik, Adana: Gülek boğazı çevresi, 1200-1300 m, yamaçlar, 14.6.2006, F.Celep 1106!,**C5** Niğde: Çamardı, Aladağlar, above Çukurbağ village, 1613 m, 14.6.2006, 37 47 601 N 35 03 792 E, F.Celep 1097!

Endemic. Ir.-Tur. Element.

Figure 141. Habit of *S. hypargeia*

34. *S. palaestina* Bentham, Lab. Gen. Sp. 718 (1835).

Syn: *S. lorentii* Hochst. in Lorent, Wanderungen 333 (1845), (Figure 142).

Stems are 20-65 cm. The stem indumentum is hirsute with long flattened eglandular hairs below and densely glandular pilose (sometimes with long flattened eglandular hairs) above. Leaves are 4.5-15 (-20) 1.5-7 (-9) cm, oblong to ovate and erose. The leaf indumentum is tomentose. Petiole 2.5-15 cm. Inflorescence is 10-50 cm. Verticillasters are (2-) 3-6-flowered. Bracts are 15-25 x 10-20 mm, often tinged pink or purple. Pedicels are 2–5 mm. Calyces are almost tubular, often pink or purple (rarely green), 12-16 mm in flower and 17-25 mm in fruit. The calyx indumentum is papillose-glandular with some longer hairs. Its upper lip is equally tridentate and spinulose. Calyx teeth are 2-4 mm, corolla 20-35 mm long, lilac or whitish-lilac. Corolla tube is 10–20 mm long and not squamulate. Filaments are 2-3 mm long. Fertile anthers are 3-4 mm. Upper thecae are 12-15 mm and lower thecae are 1-2 mm. Style is 25-45 mm.Sstamen type B.

Habitat and Phenology: May to July. Limestone and igneous rocky slopes, cliffs, in *Quercus* scrub, vineyards, fallow fields, 300-1500 m.

Type: (Lebanon) in Palaestinae arvis, N. Bove (holo. G).
Southeast Anatolia. **C6** Kahramanmaraş: Kılavuzlu-Güvercinlik köyleri arası, 37^0 38’ 392’’ K 36^0 48’ 462’’ D, 469 m, 11.6. 2006, F.Celep 1082!

Ir.-Tur. Element.

Figure 142. Habit of *S. palaestina*

35. *S. sclarea* L., Sp. PI. 27 (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), (Figure 143).

Biennial or short-lived perennial aromatic herb with erect rather coarse quadrangular stems to 120 cm, much branched above, pubescent to hirsute below, glandular above. Leaves simple, broadly ovate to ovate-oblong, c. 6-15 x 5-10 cm, cordate at base, pubescent, irregularly crenate-erose; petiole 3-9 cm. Inflorescence paniculate, many-flowered; Verticillasters 2-6 -flowered, distant. Bracts ± obscuring flowers, pink to mauve, membranous, ovate, acuminate, 10-35 x 8-25 mm. Pedicels 2-3 mm, erecto-patent. Calyx ovate-campanulate, c. 10 mm, to 15 mm in fruit, scabrid, glandular punctuate and sparsely white-pubescent with sessile glands; upper lip tridentate, mucronate. Corolla with a lilac, purplish pink or pale blue upper lip and cream lower lip, 20-30 mm; upper lip strongly falcate, tube abruptly ventricose, squamulate. Stamens B.

Habitat and Phenology: May to August. Rocky igneous slopes, mixed deciduous and coniferous woodland, shale banks, fields, roadsides. 1-2000 m.

Type: Syria and Italia (Hb. S-LINN. 42/45!).

Lectotype: Luis Rosúa & Blanca, Taxon 35: 719. 1986.

B1 Manisa: Soma dağı, 400 m, maki, 26.5.1966, H.Peşmen 440 **B2** Manisa: Kula to Selendi, above Baldıran village, 676-678 m, 11.6.2008, 38 41 744 N 28 51 286 E, F.Celep 1508! **B3** Afyon: Dazkırı, Darıcılar köyünüm güneyi, 1000 m, dere kenarı, 18.vi.1984, Z.Aytaç 1253 **B5** Kayseri: Develi to Bakırdağ, after 2 km from Kılıçkaya village, 1421 m, 9.6.2006, 38 14 586 N 35 45 910 E, F.Celep 1057!, Niğde: Çamardı, Aladağlar, Sokullupınar Yaylası çevresi, 1800-2200 m, 23.7.2005, 37 50 051 N 35 06 045 E, F.Celep 968! **B6** Kayseri: Sarız-Pınarbaşı arası, Sarız'a 2-3 km kala, 38^0 27' 51'' K 36^0 28' 24'' D, 1577 m, 20.7.2006, AKahraman 1356! **C2** Uşak: 7km to Sivaslı, 38 32 534 N 29 37 713 E, 797 m, 30.5.2008, SBagherpour 453! Burdur: Altınyayla to Gölhisar, 6 km before Gölhisar, 1249 22.6.2007, 37 02 948 N 29 32 382 E, F.Celep 1275! Burdur: Dirmil-Gölhisar yolu, Boncuk Dağları, 1310 m, *Quercus coccifera* ormanı, 15.6.2001, E.Karabacak 1218 **C3** Antalya: Elmalı, Elmalı to Fethiye, around Eskihisar village, 1122 m, 3.7.2006, 36 49 607 N 29 47 371 E, F.Celep 1161!,Antalya: Akseki, Güzelsu, Katranlık Mvk., 1200 m, yol kenarı, 28.v.1996, A.Duran 3764 **C4** Karaman: Ermenek ve Gülnar arası, Üçbölük köyü üzeri, 800-900 m, 17.6.1982, N.Tanker & M.Koyuncu 5615, Antalya: Alanya, Türbelinaz yaylası, 1100 m, *Pinus nigra* ormanı, 25.6.1978, E.Leblebici, Mersin: Gülnar, Yeniceköy'ün kuzeyi, 900 m, H.Demiriz 431 **C5** Adana: Pozantı, Gülek Boğazı, 1149 m, 14.6.2006, 37 17 250 N 34 47 072 E, F.Celep 1104! Niğde: Aladağ'ın kuzeybatı tarafı, Demirkazık köyü yakınları, 1500 m, yol kenarı ve otlatma düzlükleri, 25.7.1984, G.Görk, P.Hartvig & A.Strid 23969 **C6** Kahramanmaraş: Andırın, Güzeloba village, 1076 m, 11.6.2006, 37 34 514 N 36 48 462 E, F.Celep 1084!

Oligormorphic species.

Figure 143. Habit of *S. sclarea*

36. *S. chrysophylla* Stapf in Denkschr. Akad. Wiss. Wien, Math.-Nat. Kl. 50(2):96 (1885).

Syn: *S. bourgeana* Baibey in Bull. Soc. Vaud. Sci. Nat. 21: 96 (1886)! Ic: Barbey, Lydie, Lycie, Carie t. 3 (1890), *as S. bourgeana*, (Figure 144).

Perennial herb with erect quadrangular stems, 10-60 cm, densely tomentose with sessile glands below, glandular tomentose above. Leaves simple, mostly in upper part of stems, oblong to lanceolate, 2-13 x 0.6-4.5 cm, tomentose with numerous sessile glands beneath, rugulose, serrulate; petiole 1-6 cm. Inflorescence glandular tomentose. Verticillasters 2-8- flowered, distant. Bracts ovate acuminate, upper ca. 6-20 x 4-10 mm, eglandular tomentose, lowermost leaf-like. Pedicels 1-3 mm, erecto-patent. Calyx tubular campanulate to infundibular, c. 7-11 mm, to 12 mm in fruit, glandular tomentose with eglandular pilose hairy; upper lip tridentate, mucronate. Corolla with lilac hood and yellow lip, 15-25 mm; squamulate, ventricose, not annulate; upper lip falcate. Stamens B. Anther ca. 3 mm, upper theca ca. 14-16 mm, lower theca 2-3 mm, filaments ca. 4-5 mm.

Habitat and Phenology: July to August. Limestone slopes, grassy meadows, 1300-2300 m.

Type: Type: [Turkey C2 Antalya] Lyciaad Guruva (Göyre), 14vii 1882, Luschan (holo. WU!).

S.W. Anatolia. **C2** Denizli: Boz Da. nr Geyran Y., 1370 m, D. 13341! Muğla: Girdev (Eren) Da., 70 km E. of Fethiye, 2250 m, Lambert & Thorp 618! top of pass between Tscheipatzar (Çaypazari) and Makri (Fethiye), Pichler 532 (type of *S. bourgeana*)!, Antalya: Elmalı, Elmalı to Kaş, Göyre town, Akdağlar, above Uçansu, 2119-2300 m, 7.7.2007, 36 34 432 N 29 36 432 E, F.Celep 1327!, Muğla: Elmalı to Fethiye, Seki, Eren Da., 7.7.2007, 1800-1850 m, 36 44 890 N 29 36 477 E, F.Celep 1330!, Antalya: Kuhu Da. S. of Elmali, Fitz & Spitz. 206! **C3** Antalya: Antalya to Elmalı, 1920 m, Çetik 2070!

Endemic. Medit. Element.

An isolated species in S.W. Anatolia but with some similarities to the N.W. Iranian *S. sahendica* Boiss. & Buhse and the Afghan *S. rhytidea* Bentham (Hedge 1982a).

Figure 144. Habit of *S. chrysophylla*

37. *S. aethiopis* L., Sp. PI. 27 (1753).

Ic: Jav. & Csap., Ic. Fl. Hung. 432, t. 2931 (1934);F1. RPR 8: t. 42 f. 1 (1961), (Figure 145).

Biennial or perennial herbs. Stems erect, sturdy, quadrangular, 25-120 cm, eglandular lanate, hairs denser below, with sessile glands. Leaves simple, mostly basal, ovate-elliptic to oblong, 7-21 (-32) x 4-14 cm, ± lanate rugose, acute to obtuse, erose, cauline leaves sessile, oblong-ovate, petiole 4-14 cm. Inflorescence widely branched pramidial panicle, large, many branched, candelabriform, many-flowered. Verticillasters 4-10 -flowered, approximating above. Bracts broadly obovate, c. 10-14 x 13-17 mm, cuspidate, sparsely pilose. Calyx tubular-ovate, c. 10-15 mm, densely white lanate, in fruit to c. 15 mm; upper lip tridentate, median tooth shorter. Corolla white, c. 12-22 mm, often with

a pale yellow lip; tube abruptly ventricose, squamulate; upper lip subfalcate or falcate. Stamens B.

Habitat and Phenology: May to August. Steppe, igneous and limestone slopes, fallow fields, roadside banks. 1-2100 m.

Type: Illyria (Yugoslavia), Greece & Africa (Hb. S-LINN. 42/48!)
B1 Manisa: Soma, Karaçam, E.Şarer 1003! **B2** Afyon: Dazkırı, İdris köyü, Serenlikuyu çevresi, 1325 m, su kenarı, 21.6.1984, Z.Aytaç 1439, Kütahya: Kütahya-Afyon yolu 34. km, Kulaksız dağı etekleri, 1150-1200 m, step, 5.7.1994, E.Akçiçek 893 **B3** Kütahya to Eskişehir c. 22 km, 960-1050 m, 11.6.2008, F.Celep 1517 **B5** Adana: Bakırdağ to Saimbeyli, Hanyeri to Tufanbeyli village, 3 km before Doğanbeyli village, 1467 m, 9.6.2006, 38 08 864 N 36 07 372 E, F.Celep 1069! **C2** Denizli: Cankurtaran, 1200 m, E.Şarer 1007!, Burdur: Burdur to Karamanlı, c. 5 km before Karamanlı, 1117 m, 8.6.2008, 37 22 744 N 29 52 303 E, F.Celep 1462! **C3** Konya: Şarkıkırkağaç to Beyşehir, c. 10 km before Beyşehir, 1139 m, 4.5.2008, 37 45 887 N 31 40 401 E, F.Celep 1430! **C4** Konya: Küçük Köy, Konya to Çumra, 980 m, Helbaek 2551 **C6** Kahramanmaraş: Andırın, Andırın to Geben Yaylası, 1444, 12.6.2006, 37 39 437 N 36 26 622 E, F.Celep 1085!.

Figure 145. Habit of *S. aethiopis*

38. *S. ceratophylla* L., Sp. PI. 27 (1753), (Figure 146).

Perennial or biennial herb, with a stout woody root. Stems sturdy, 25-60 cm, glandular-villous, densely above. Leaves mostly basal, deeply pinnatifid, "oblong in outline, with spreading linear segments, the segments alternate, narrow, linear, obtuse, coarselt toothed to suboblate, the terminal segments usually several times as long as the lateral segments, white-lanate when young, 10-30 x 4-8 cm, rachis winged, rugose; petiole subabsent. Inflorescence pyramidial and spreading paniculate, yellowish-green. Verticillasters 2-6 - flowered, distant. Bracts ovate, cuspidate, c. 15x12 mm. Pedicels erecto-patent, 2-4 mm. Calyx ovate-campanulate, c. 10-12 mm, to c. 16 mm in fruit with diverging lips, glandular-villous; upper lip tridentate with cuspidate teeth; Corolla cream or sulphur, rarely with lilac upper lip, 15-30 mm; tube abruptly ventricose, squamulate; upper lip falcate. Stamens B.

Habitat and Phenology: April to July. Limestone, igneous and gypsum slopes, corn and fallow fields, waste ground, 300-2250 m.

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

C2 Burdur: Gölhisar to Acıpayam, c. 22 km before Acıpayam, after Kumatşarı village, 963 m, 3.5.2006, 37 18 300 N 29 31 570 E, F.Celep 1044! **C3** Burdur: Burdur to Antalya, A.Huber-Morath 5210 Antalya: Korkuteli to Elmalı, c. 25 from Korkuteli, 1285 m, 21.6.2007, 36 55 975 N 30 05 492 E, F.Celep1261! **C4** Mersin: Mut to Büyük Egri Da., 800 m, Coode & Jones 913 **C5** Niğde: Niğde, 100 m, *Siehe* 1898:38 Niğde: Ulukışla-Darboğaz kavşağı, *Artemisia* stebi, 13.6.1991, Y.Gemici 6072.

Ir.-Tur. Element.

Figure 146. Habit of *S. ceratophylla*

39. *S. chionantha* Boiss., Diagn. ser. 1(5): 8 (1844), (Figure 147).

Perennial herb. Stems erect, 50-120 cm, sturdy, quadrangular, glandular-pilose with capitate glandular hairs. Leaves mostly basal, linear-lanceolate, 6-25 x 1.5-4 cm, lanate-pannose with sessile glands, entire to crenulate, attenuate into 2-7 cm petiole. Inflorescence widely paniculate, glandular pilose. Verticillasters 4-10-flowered, clearly distant. Bracts broadly ovate, acuminate, c. 6-15 x 4-10 mm. Pedicels 3-6 mm. Calyx campanulate, 8-12 (-15) mm, to 14-18 mm in fruit, glandular-pilose, upper lip tridentate, teeth spinulose. Corolla white with lower lip, 22-40 mm, upper lip strongly falcate, tube ventricose, squamulate, c. 8-10 mm, not squamulate;. Stamens B. Anther ca. 3-4 mm, upper theca ca. 12-16 mm, lower theca ca. 3-4 mm, filaments ca. 3-4 mm.

Habitat and Phenology: May to June (-July). *Quercus* scrub, fields, 1000-1450 m.

Type: Type: [Turkey C2 Denizli] inter segetes planitiei interioris elatae Cariensis ad meridiem Cadmi, vi 1842, Boissier (holo. G!).

S.W. Anatolia. **C2** Antalya: 6 km from Akçay to Elmali, 1000 m, Hub.-Mor. 16624!, Antalya: Elmalı, Yeşiloba to Söğüt (Korkuteli to Altınyayla), 1410 m, 3.5.2006 (only basal leaves) 37 02 550 N 29 51 560 E, F.Celep 1043!, Muğla: Elmalı to Fethiye, Seki, Zorlar village, 1448 m, 3.7.2006, 36 48 777 N 29 41 426 E, F.Celep 1165!, Muğla: Fethiye, Fethiye to Altınyayla, 1270 m, 22.6.2007, 36 53 835 N 29 40 040 E, F.Celep 1273!, Burdur: d. Tefenni, 3 km N. of Dirmil (Altinyayla), 1350 m, Hub.-Mor. 8145!, Burdur: Tefenni to Çavdır, about 4-6 km, fields, 1166 m, 8.6.2007, 37 15 406 N 29 45 288 E, F.Celep 1464! **C3** Antalya: Elmalı, around Avlan Lake, road of Çığlıkkara forest (Kofu Da.), 1055 m, 9.6.2008, 36 34 737 N 29 55 211 E, F.Celep 1485!, Antalya: Elmalı to Korkuteli, about 17-20 km, 1289 m, 3.7.2006, 38 55 734 N 30 04 924 E, F.Celep 1158!, ibid about 25 km, 1285 m, 21.6.2007, 36 55 975 N 30 05 492 E, F.Celep 1258!

Endemic. Medit. Element.

The species differs from *S. argentea* and *S. atropatana* on its bigger linear lanceolate leaves and widely paniculate inflorescence. The species is only distributed in S.W. Anatolia.

Figure 147. Habit of *S. chionantha*

40. *S. argentea* L., Sp. PI. ed. 2:38 (1762).

Syn: *S. tmolea* Boiss., Diagn. ser. 1(5):9 (1844)! Ic: Sibth. & Sm., Fl. Graeca 1:20, t. 27 (1806); Bot. Mag. t. 9675 (1946), *as S. argentea* var. *rhodopea*, (Figure 148).

Perennial herb with a woody rootstock, Stems few or several, erect, 20-120 cm, eglandular or glandular pilose to villous. Leaves mostly basal, variable in size and shape, ovate to oblong, 3-20 x 3-8 (-14) cm, white or grey lanate, obtusely lobed or erose; petiole 3-16 (-20) cm. Inflorescence usually a widely spreading panicle, densely glandular pilose to villous. Verticillasters 4-8 (-10) flowered, usually distant. Bracts variable, broadly ovate, 7-17 x 5-15 mm. Pedicels 2-5 mm. Calyx ± campanulate, 7-12 mm, to c. 11-14 mm in fruit, densely glandular with capitate glandular hairs and sessile glands; upper lip tridentate, median tooth much shorter; lips ± equal. Corolla white, lip fading yellow, 16-32 mm, tube 7-10 mm, ventricose, squamulate; upper lip compressed, strongly falcate. Stamens B. Anther ca. 4 mm, upper theca ca. 12-15 mm, lower theca ca. 3 mm, filaments ca. 3-4 mm.

Habitat and Phenology: April to June (-July). Limestone and igneous slopes, rock ledges, with *Pinus*, 150-2000 m.

Type: Type(?): 'Habitat in Creta'. [No possible type specimen has been traced; the species is not known from Crete.]
West Anatolia. **B1** Izmir: Yamanlar Da., 1000 m, Şarer 1000! **B2** Izmir: d. Ödemii, Boz Da., 1280m, Hub.-Mor. 2807! **C2** Muğla: Köyceğiz, Sandras Da, above Yeşil Köy, 1660 m, 10.6.2008, 37 02 702 N 28 47 433 E, F.Celep 1494!, Antalya: Elmalı, Elmalı to Finike, above Avlan Lake, Ördibek Yaylası, 1573 m, 7.7.2007, 36 29 501 N 29 55 831 E, F.Celep 1315!, Antalya: Elmalı, Elmalı to Finike, Cedar Research Forest to Kızlar Sivrisi, 1620 m, 7.7.2007, 36 35 225 N 30 01 310 E, F.Celep 1479!, Antalya: Elmalı to Fethiye, Göğübeli pass, 1850 m, 22.6.2007, 36 50 783 N 29 44 733 E, F.Celep 1265!, Denizli: Tmoli occidentalis (Boz Da.) above Philadelphia (Alaşehir), 6 1842, Boiss. (type of *S. tmolea*!) **C3** Antalya: d. Kemer, Tahtali Da.,

Peynirlik, 1700 m, Peşmen & Güner 4304!, Konya: Seydişehir to Akseki, before 38 km from Akseki, 1658 m, 6.6.2008, 37 12 444 N 31 55 115 E, F.Celep 1434!

Medit. Element.

Figure 148. Habit of *S. argentea*

41. *S. microstegia* Boiss. & Bal. in Boiss., Diagn. ser. 2(4):17 (1859).

Syn: *S. verbascifolia* Bieb. var. *cana* Boiss., Fl. Or. 4:619 (1879)! *S. chnoodes* Stapf inDenkschr. Akad. Wiss. Wien, Math.-Nat. Kl. 50:98(1885)! Ic: J. Roy. Hort. Soc. 85(10): t. 140(1960), (Figure 149).

Perennial herb with a woody rootstock, Stems few or several, erect, 20-120 cm, densely pilose-villous glandular, often eglandular lanate below. Leaves mostly basal, variable in size and shape, ovate to oblong, (3.5-) 7-17 (-20) x 3-8 (-14) cm, white or grey lanate, obtusely lobed, irregularly serrate or erose, sub-cordate; petiole 2-16 (-20) cm, tomentose. Inflorescence usually a widely spreading panicle, often yellowish-green. Verticillasters 2-6 -flowered, usually distant. Bracts variable, broadly ovate, 9-17 x 8-14 mm. Pedicels 2-5 mm. Calyx ± campanulate, 9-13 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, lower lip fading yellow, 17-30 mm, tube 5-15 mm, ventricose, squamulate; upper lip compressed, strongly falcate. Stamens B.

Habitat and Phenology: July to August. Rocky limestone and igneous slopes, screes, in *Quercus*, *Pinus* woodland, fleldside, 970-3350 m.

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

East and Southeast Mediterranean region of Turkey. **B5** Kayseri: Bakırdağ to Saimbeyli, around Gezbeli pass, above Hanyeri village, 1880 m, 9.6.2006, 38 12 700 N 36 00 304 E, F.Celep 1067! **B6** Kayseri: Sarız-Pınarbaşı arası, Sarız'dan sonraki vadiler, 38^0 30' 01'' K 36^0 26' 53'' D, 1692 m, 5.7.2007, AKahraman 1399! Sivas: Pınarbaşı-Gürün arası, Güneşli köyü yakınları, 38^0 50' 417'' K 36^0 53' 296'' D, 1868 m, 17 v 2008, AKahraman 1493!, Kahramanmaraş: Göksun, Binboğa dağı, 1800 m, 17.vii.1992, M.Koyuncu 9702, Kahramanmaraş: Çardak, Berit dağı, Arpa Çukuru yaylası üzeri, 2800 m, 26.7.1952, *P.H.Davis* 20332 **C4** Karaman: above Kazımkarabekir, Hacıbaba Tepesi, 1519 m, 1.7.2006, 37 09 882 N 32 57 969 E, F.Celep 1133! **C5** İçel: Aslanköy to Fındıkpınar, 1415 m, 15.6.2006, 36 59 721 N 34 16 672 E, F.Celep 1117! **C6** Adana: Karsantı, Tırak bölgesi, Kaldı dağının doğusu, Ziyaret tepesi, 1900 m, orman açıklıkları, 27.7.1979, E.Tuzlacı & M.Saraçoğlu (ISTE 43342!) Kahramanmaraş: Engizek dağı, Sinkört yaylası, 2150 m, kayalık yerler, 13.7.1988, H.Duman 4222! , Kahramanmaraş: Göksun, Berit Mountain., Kabaktepe village, Cırıklar yaylası, 2300 m, 14.7.2008, 38 01 237 N 36 57 877 E, F.Celep 1560!.

Ir.-Tur. Element.

The species is closely related to *S. argentea*. However, it distributed mainly eastern part of the Mediterranean region of Turkey.

Figure 149. Habit of *S. microstegia*

42. *S. frigida* Boiss., Diagn. ser. 1(5): 10 (1844).

Syn: *S. spinulosa* Montbret & Aucher ex Bentham in DC., Prodr. 12:283 (1848)! *S. frigida* Boiss. var. *oblongifolia* Boiss., Fl. Or. 4:621 (1879)! S *frigida* Boiss. var. *albiflora* Bornm. in Beih. Bot. Centr. 24(2):487 (1909)!, (Figure 150).

Perennial herb with a thick woody rootstock. Stems solitary or several, erect, 8-40 (-50) cm, below pilose to villous with sessile glands, densely glandular above with capitate glands. Leaves mostly basal, variable, ovate to narrowly oblong, 2-15 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. 8-12 x 7-11 mm. Pedicels 2-3 mm. Calyx campanulate to infundibular, 7-10 mm, to 10-12 mm in fruit and widening, densely capitate-glandular; teeth usually prominently spinulose; upper lip tridentate, median tooth much shorter, truncate or not. Corolla white, lower lip yellow, 12-16 mm; tube c. 8 mm, ventricose, squamulate; upper lip narrow, somewhat falcate, scarcely bifid. Stamens B.

Habitat and Phenology: May to July. *Pinus nigra, Juniperus, Abies* and *Pyrus* woodland; limestone slopes and crevices, meadows, 1000-2500 m.

Type: 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!).
B2 Kütahya: Şaphane, Akdağ aroun summit, Gökçukur Yaylası, 1690-1750 m, 11.6.2008, 39 04 252 N 29 14 880 E, F.Celep 1509! **B5** Kayseri: Pınarbaşı Şirvan Dağı batısı, 38 41 131 N 36 23 087 E, 1760 m, SBagherpour 326 **B6** Kayseri: Sarız-Pınarbaşı arası, Sarız'dan c. 3-4 km, 1690 m, 8.6.2006, AKahraman 1235B! **C2** Denizli: Honaz Da., 1300 m, Sorger 62-32a-29 **C3** Isparta: Aksu, Akpınar Da. summit, 1940 m, 7.6.2008, 37 49 670 N 31 03 471 E, F.Celep 1446! **C4** Konya: Bozkir to Çamli, 1400 m, Çetik et al. 1017! **C5** Içel: Tekir Tepesi, 1270 m, Sorger

62-68-37! **C6** Kahramanmaraş: Çağlayancerit, above Erince village, 1500 m, 11.06.2006, 37 44 929 N 37 24 452 E, F.Celep 1082!.

Ir.-Tur. Element.

The species varies widely in its indumentums and leaf shapes. The species is closely related to *S. yosgadensis*, *S. modesta* and *S. ekimiana*. In the western part of the Mediterranean region of Turkey, intermediate forms between *S. frigida* and *S. argentea* can be found.

Figure 150. Habit of *S. frigida*

43. *S. yosgadensis* Freyn & Bornm. in Öst. Bot. Zeitschr. 42:348 (1892), (Figure 151).

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, 4-10 x 3-6 cm, rugulose, pubescent with many sessile glands, irregularly serrate to erose; petiole 1-5 cm. Inflorescence widely paniculate. Verticillasters 4-6-flowered, ± distant. Bracts ovate, 8-15 x 7-14 mm. Pedicels 2-3 mm. Calyx infundibular, 7-11 mm, to 10-15 mm in fruit and widening, eglandular pubescent with many sessile glands, teeth clearly spinulose. Corolla white or tinged lilac, 12-14 mm; tube c. 7 mm, ventricose, squamulate; upper lip narrow, scarcely falcate, scarcely bifid. Stamens B.

Habitat and Phenology: May to June. *Quercus* scrub, disturbed steppe, fields, 800-1635 m.

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

Central Anatolia and Eastern part of Aegean Region. **B3** Kütahya: Kütahya to Eskişehir c. 40 km, 950-1100 m, 11.6.2008, 39 42 311 N 30 09 480 E, F.Celep 1518!, Eskişehir: 11 km E. of Eskişehir, 800 m, Sorger 64-11-22! **C5** Konya: Ereğli to Ulukişla, 1200 m, It. Leyd. 1959:1018!

Endemic. Ir.-Tur. Element.

Figure 151. Habit of *S. yosgadensis*

44. *S. modesta* Boiss., Fl. Or. 4:621 (1879) p.p. Notes R.B.G. Edinb. 22:181 (1957), (Figure 152).

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 ± 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.

Habitat and Phenology: (May) June. Calcareous and igneus slopes. (1500) 1700-2200 m.

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

Central Anatolia and Anti-Taurus. **B5** Kayseri: Bakirdağ to Saimbeyli, 2000 m, Hub.-Mor. 10763! Kayseri/Adana: Bakırdağ to Saimbeyli, Gezbeli pass, 1970 m, 9.6.2006, 38 12 225 N 35 59 650 E, F.Celep 1065!, Kayseri, Sarız, Yeşilkent (Yalak), Binboğa Da., above Dayoluk village, Afan Yaylası, 2172 m, 10.6.2006, 38 21 065 N 36 30 649 E, F.Celep 1072!

Endemic. Ir.-Tur. Element.

Figure 152. Habit of *S. modesta*

45. *S. candidissima* Vahl, Enum. PI. 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. Corrolla white or white with yellow lip, 20-32 mm; tube c. 12 mm, ventricose, squamulate; upper lip strongly falcate. Stamens B

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

1. 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***

subsp. *candidissima* Syn: *S. candidissima* Vahl var, *cordifolia* Nab. in Publ. Fac. Sci. Univ. Masaryk Brno 70:52, t. 4 f. 3 (1926). Ic: Jacq., Eclog. PI. Rar. t. 16 (1811), as *S. odorala* Wild, (Figure 153).

Habitat and Phenology: May-August (Eylül). Kayalık yamaçlar, yol ve tarla kenarları. 700-2000 m.

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

Inner mainly & E. Anatolia. **B3** Konya: Beyşehir to Ilgın, 5-6 km before Aşağıçiğil village, 1100-1300 m, 27.7.2005, F.Celep 1008! **B6** 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, F.Celep

1074 **C3** Konya: 6-8 km west of Konya near Altınkaya barajı, 37 53 221 N 32 15 267 E, 1350 m, 26.7.2005, SBagherpour 209! **C4** Karaman: Ermenek, Kazancı town, around Beşkuyu yaylası, 1300-1400 m, 26.7.2005, F.Celep 997! **C5** Nigde: Çamardı, Çukurbağ village, Emli Boğazı, 2000m, 24.7.2005, 37 45 855 N 35 06 460 E, F.Celep 975!.

Ir.-Tur. element.

Figure 153. Habit of *S. candidissima* subsp. *candidissima*

subsp. *occidentalis* Hedge (Figure 154).

Type: Type: Turkey C2 Antalya: Elmali, 2 vi 1860, Bourgeau 1860:225 (holo. E! iso. G! K! W!).

Inner, mainly W. Anatolia. **B2** Kültahya: 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, 991 m, 5.7.2006, 38 00 779 N 29 58 205 E, F.Celep 1169! **C2** Mugla: 3 km N.E. of Muğla, 880 m, Nydegger 10189,

Antalya: Elmalı, Cedar Research Forest, 1690 m, 7.7.2007, 36 35 800 N 30 02 077 E, F.Celep 1326! **C3** Isparta: Aksu, above Yaka village, 1558 m, 7.6.2008, 37 44 169 N 31 15 462 E, F.Celep 1444! **C4** İçel: Gülnar to Ermenek, around Bereket village, 1300-1400 m, 25.7.2005i 36 21 625 N 33 13 862 E, F.Celep 993! **C5** Nigde: Ala Da., Çukurbağ village, Emli Boğazı, 1835-2000 m, 24.07.2005, 37 45 355 N 35 06 460 E, F.Celep 975!

Ir.-Tur. Element ?

Figure 154. Habit of *S. candidissima* subsp. *occidentalis*

46. *S. cyanescens* Boiss. & Bal. in Boiss., Diagn. Ser. (2(4): 19 (1859), (Figure 155).

Perennial herb. Stems erect, 15-80 cm, branched above, pilose to lanate below, pilose with sessile glands to ± densely papillose glandular above. Leaves simple, oblong to broadly ovate to suborbicular, 3-9 x 2-6.5 cm, pannose, serrulate to subentire, ±

cordate; petiole 1-7 cm. Inflorescence paniculate with slender branches; verticillasters (l-) 2-6-flowered, distant. Bracts broadly ovate-acuminate, 2.5-6 x 2-4.5 mm. Pedicels 1.5-3 mm. Calyx tubular-campanulate, usually purple-tinted, 7-12 mm, to 9-14 mm in fruit, shortly pilose or papillose glandular; upper lip tridentate, median tooth longer or shorter than, laterals, scarcely mucronate. Corolla lilac to violet, 16-32 mm; tube 7-20 mm, ventricose, squamulate (rarely not); upper lip strongly falcate. staminal connectives clearly longer than filaments, upper theca 8-10 mm, the lower theca 2-4 mm, filaments c. 2-3 mm, fertile anther 2.5-4 mm, dolabriform tissue 2-2.5 mm. Style glabrous, 17-23 mm long, exerted from corolla lips and divided in two part at apex. Stamens B.

Habitat and Phenology: June to July (August). Limestone 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 Dagh Cappadociae inter Tarsous et Caesaream, [14 vi 1856], Balansa [233] (holo. G! iso G!).
C4 Konya: N. of Sille, 1200 m, A.Huber-Morath 8020 Konya**:** Kocaş'ın 25 km kuzeybatısı, 22.6.1953, H.Birand & Zohary, Konya: Hadim-Korualan yolu 2. km, 1680 m, 14.7.1998, K.H.C.Başer 1417 **C4** Karaman: Ermenek: Karamanbey geçidine gelmeden 5 km önce, 1657 m, 1.7.2006, 36 52 652 N 32 56 513 E, F.Celep 1140! **C5 Nigde:** Ala Da., Ulupınar Y. to Kara G., c. 2300 m, *Spitzenberger* 64

Endemic. Ir.-Tur. Element.

Figure 155. Habit of *S. cyanescens*

47. *S. cilicica* Boiss. & Kotschy in Boiss., Diagn. ser. 2(4): 19 (1859).

Syn: *S. crassifolia* sensu Boiss., Fl. Or. 4:622 (1879) p.p. non Sibth. & Sm. (1806) nee Desf. (1809), (Figure 156).

Perennial herb. Stems erect, 30-120 cm, branched above and slender, pannose to ± lanate below, densely (or not) pilose with capitate glandular hails above. Leaves simple, broadly ovate to orbicular, 2-10.5 x 3-11 cm, pannose, serrulate to subentire, cordate; petiole on lower leaves 1.5-7 cm, upper leaves sessile. Inflorescence paniculate, few-flowered, to 60 cm, shortly pilose hairy; verticillasters (l-) 2-6-flowered, clearly distant. Bracts bradly ovate-acuminate, c. 2.5-4 x 2-3 mm, shorter than calyx. Pedicels 1-3 mm. Calyx tubular-campanulate, striate, 5-8 mm, to c. 9 mm in fruit, shortly pilose with sessile glands; upper lip scarcely tridentate, recurved in fruit. Corolla lilac-white with yellow lower lip, 14-20 (-25) mm; tube c. 5-8 mm, ventricose, squamulate; upper lip clearly falcate. Stamens B. Anther ca. 3 mm, upper theca ca. 8-9 mm, lower theca ca. 1-2 mm, filaments ca. 1-2 mm.

Habitat and Phenology: July to September. Limestone and granit slopes, in phrygana, among *Pinus*, 750-2200 m.

Type: Type: [Turkey C5 Nigde] in schistosis vinetorum pagi Anadscha Tauri Cilicici, in calcareis ad fluvium Bosantetchai (Pozanti Cay) in via inter Tar-sous et Caesaream (Kayseri), 1220m, viii [1855], Balansa [546] (holo. G!).
East Akdeniz. **B6** Maras: Berit Da., 2100 m, Hausskn. 1256! Kahramanmaraş: Göksun, Berit Da., Yeşilköy to Kınıköz village, 1411-1514 m, 10.6.2006, 38 00 693 N 36 43 968 E, F.Celep 1077! Kahramanmaraş: Göksun, Erçek'ten Yeşilköy'e, Yeşilköy'den 2-3 km önce, 38 00 721 N 36 44 568 E, 1411 m, 5.7.2007, A.Kahraman 1390! **C5** Niğde: Çiftehan, Çiftehan to Ulukışla, Alihoca-Madenköy road, ca. 1-2 km from main road, 1020-1200 m, 30.7.2007, 37 30 665 N 34 44 304 E, F.Celep 1358!, Adana: Pozantı, Pozantı to Akçatekir, about 3-4 km, 858-945 m, 24.7.2005 37 23 287 N 34 51 027 E, G.Akaydın & F.Celep 979!.

Endemic. Medit. Element.

Figure 156. Habit of *S. cilicica*

48. *S. cassia* Samuelss. ex Rech. fil in Ark. Bot. ser. 2, 1:320 (1951), (Figure 157).

Perennial herb. Stems erect, 40-90 cm, pannose to ± lanate below, very shortly pilose with capitate glandular hails above. Leaves simple, broadly ovate to orbicular, 2-10 x 3-11 cm, pannose, serrulate to subentire, cordate; petiole on lower leaves 1.5-7 cm, upper leaves sessile. Inflorescence paniculate, 25-60 cm, shortly eglandular and glandular pilose; verticillasters (l-) 2-6-flowered, clearly distant. Bracts ovate-acuminate, c. 3-7 x 2.5-6 mm, shorter than calyx. Pedicels 1-2 (5) mm. Calyx tubular-campanulate, striate, 7-12 mm, to c. 14 mm in fruit, shortly pilose with sessile glands; upper lip scarcely tridentate, recurved in fruit. Corolla white with yellow lower lip, (16) 20-30 mm; tube c. 6-9 mm, ventricose, squamulate; upper lip clearly falcate. Stamens B. Anther 3-4 mm, upper theca ca. 15 mm, lower theca ca. 3-4 mm, filaments 2-4 mm.

Habitat and Phenology: May. Stony slopes, alluvial gravel. (10) 210-650 m.

Type: Type: [Turkey C5 Hatay/Syria] mons Cassius, in rupestribus schist.-gneiss. pineti prope transitum ad Ayn el Aramie, c. 650 m, 23 v 1933, Samuelsson 5264 (holo. S! iso. W!).

Amanoslar. **C6** Hatay: Kırıkhan, Merkez, Cevizyokuşu, 200-210 m, 3.5.2008, 36 29 753 N 36 20 710 E, F.Celep 1411! Hatay: between Karagöz and Arsuz, Hacı Ahmetli village, 2 vii 1932, Eig & M. Zohary!, Hatay: Hassa to Kilis, 22. km., 558 m, 36 50 532 N 36 41 573 E, F.Celep 1648 !.

Medit. Element.

Figure 157. Habit of *S. cassia*

49. *S. indica* L., Sp. PI. 26 (1753).

Syn: *S. brachycalyx* Boiss., Fl. Or. 4:625 (1879). Ic: Bot. Mag. t. 395 (1798), (Figure 158).

Perennial herbs. Stems 80-150 cm, erect, branched above, sparsely eglandular-pilose below, densely or sparsely glandular or eglandular pilose above. Leaves simple, 15-30 x 10-24 cm, broadly ovate, truncate, reticulate, erose-dentate, glaucous or eglandular-pilose especially on veins, cordate; cauline leaves ± sessile. Petiole 2-12 cm. Inflorescence paniculate. Verticillasters 4-8-flowered, clearly distant. Bracts 8-10 x 6-8 mm, ovate-acuminate. Pedicels 2-5 (-7) mm, erect. Calyx campanulate, 10-

12 x 7-9 mm, truncate at apex, densely glandular-villous and sparsely eglandular, slightly broadening and up to 15 mm in fruit; upper lip shortly tridentate; calyx teeth mucronate, connivent. Corolla upper lip lilac, lower lip dark violet, spotted with purple, 25-32 mm, strongly compressed laterally; tube 9-13 mm, whitish, short, squamulate within, abruptly ventricose above. Stamens 2. Upper thecae clearly longer than filaments; filaments 3-4 mm, fertile anter 4-5 mm, upper thecae 17-21 mm. Style glabrous, 38-45 mm, exerted from corolla lips and divided in two parts at apex.

Habitat and Phenology: April-May. *Rocky limestone slopes* and open bushy place. 100-1500 m.

Type: Described from 'India'. [No specimen in the Linnean herbaria has been found; no. 1079 in Hb. Tournefort (Paris) could possibly be selected as type.]
C6 K.Maraş: Çağlayancerit, above Erince village, 37^0 44’ 279’’ N 37^0 24’ 221’’ E, 1281 m, 3.5.2008, F.Celep 1419! Kırıkhan-Hamam arası, c. 100 m, 6 V 1965, Coode & Jones 547 (E!).

Ir.-Tur. Element.

Morphological characteristics such as leaf size and corolla characteristics are taxonomically significant to identify the species. *S. indica* morphologically differs from the other members of *Salvia* in terms of its large leaves and corolla upper lip lilac, lower lip dark violet, spotted with purple. Very handsome species. It could be cultivated for ornamental purposes.

Figure 158. Habit of *S. indica*

Section 5 *Drymosphace* Bentham.

50. *S. glutinosa* L., Sp. PI. 26 (1753). Ic: Fl. RPR 8: t. 39 f. 1 (1961); Huxley & Taylor, Fls. Greece t. 237 (1977), (Figure 159).

Perennial herb. Stems to c. 125 cm, erect, simple, branched above, ± densely glandular-villous. Leaves simple, ovate-oblong, triangular, 4-15 x 5-11 cm, sagittate-hastate, serrate-dentate, sparsely pilose or pubescent on veins and with sessile glands; petiole c. 7-11 cm. Verticillasters 4-6 -flowered, distant. Bracts ovate, c. 10x6 mm; bracteoles present, Pedicels c. 5 mm, erecto-paten, elongating in fruit. Calyx tubular to campanulate, c. 10-12 mm, to c. 17 mm in fruit, densely glandular-

villous. Corolla yellow with brownish-reddish markings, 30-40 mm; tube exserted, straight for c. 15 mm, villous within; upper lip falcate. Stamens B.

Habitat and Phenology: July-October. Moist places in deciduous (*Fagus, Alnus, Corylus*) forest and scrub and in *Picea* forest, 780-2360 m.

Type: Described from Europe (lecto. Hb. S-LINN. 42/34 photo!, Microslayt: IDC 11.18).
C6 Hatay: Samandağ, Batıayaz to Çamlıyayla village, Kabaktepe, 659 m, 25.6.2007, 36 12 625 N 35 56 117 E, F.Celep 1196!, Hatay**:** Dörtyol, Amanos Dağ, 800 m, 22.9.1967, Y.Akman 7679.

Euro-Sib. Element.

Figure 159. Habit of *S. glutinosa* (by Ersin Karacacak)

Section 6 ***Plethiosphace*** Bentham.

51. ***S. virgata*** Jacq., Hort. Vindob. 1:14,1.37(1770).

Syn: *S. sibthorpii* Sibth. & Sm., Fl. Graeca 1:17, t. 22 *C(1806);S. similata* Hausskn. in Mitt. Thür. Bot.Ver. N'.F. 11:36 (1897); S. *virgata* Jacq. var. *densiflora* Nab. in Publ. Fac. Sci. Univ. Masaryk Brno 70:52, t. 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*, (Figure 160).

Perennial. Stems erect, (10-) 30-130 cm, stem solitary, erect, leafy, 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, elliptical oblong to broadly ovate, 5-30 x 2-15 cm, eglandular-pilose with numerous sessile glands, obtuse or rounded at apex, subcordate at base, 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, 3-9 x 3.5-7 mm. Pedicels 1-3 mm. Calyx ± tubular campanulate, 6-10 mm, to 10-12 mm in fruit with a strongly recurved bisulcate upper lip, glandular or eglandular pilose or villous. Corolla violet-blue to lilac, rarely white, 10-18 mm; tube 6-12 mm, ventricose, not squamulate; upper lip falcate. Stamens B.

Habitat and Phenology: May-September. Scruby, woodland, meadows, fallow fields, roadsides, etc. 1-2300 m.

Type: Described from cultivated material; no type indicated.

Bl Izmir: Izmir to Manisa, N. of Bornova, 70 m, Hub.-Mor. 2506! **B2** Uşak: Eşme to Uşak, 737 m, 10.7.2007, 38 25 055 N 29 14 561 E, F.Celep 1355!, Kütahya: plain of Simav,750 m, E. Anglia Exped. **C1** Aydın: Söke to Kuşadası, after main junction, 4.5.2006, 72 m, 37 45 716 N 27 22 563 E, F.Celep 1049! **C2** Denizli: Honaz Da. National Park entrance, 1135, 5.7.2006, 37 38 410 N 29 13 058 E, F.Celep 1168! **C3** Antalya: Elmalı, Elmalı to Fethiye, around Eskihisar village, 1122 m, 3.7.2006, 36 49 607 N 29 47 371 E, F.Celep 1162! **C4** Konya: Beyşehir to Ilgın, 5-6 km before

Aşağıçiğil village, 27.7.2005, 1200-1400 m, F.Celep 1007! **C5:** İçel, Çamlıyayla, around Namrun Castle, 1300-1350 m, 24.7.2005, 37 09 933 N 34 36 029 E (flowers white), F.Celep 987! **C6** Hatay: Antakya to Cebeli Kasir, 12 km E. of Antakya, 350 m, Hub.-Mor. 11872!

Figure 160. Habit of *S. virgata*

52. *S. viscosa* Jacq. Misc. 2: 328. 1781. Ic. Rar. tab. 5, (Figure 161).

Perennial herb. Stems erect, 50-100 cm, below densely eglandular villous with some short glandular pilose hairy. Basal leaves ovate to ovate-oblong cordate at base, membranous, 14-20 x 8-10 cm, more or less papillose-pubescent, margins irregular dentate-erose. Lower leaves long-petiolated, 11-17 cm, densely eglandular villous, middle and upper leaves short-petiolated or sessile. Inflorescence widely branched panicle, inflorescence axis densely glandular pilose (viscid) with some eglandular villous hairy. Verticillasters 6-10 (-15), each verticillasters with 2-6 -flowered,

internodes 2-4 cm. Bracts broadly ovate, 7-12 x 5-7 mm, acuminate, glandular pilose with some villous hairy. Calyx tubular to tubular campanulate, 7-11 mm, up to 14 mm in fruit, scarcely expanding in fruit, glandular pilose with some eglandular villous, teeth shortly mucronate 0.6-1.3 mm. Corolla pink to red, 15-20 mm, tube 9-11 mm, upper lip 7-10 mm, scarcely falcate, twice and a half as long as calyx. Stamens 2, staminal connectives clearly longer than filaments. Style glabrous 17-21 mm, long exerted from corolla lips and divided in two parts at apex.

Habitat and Phenology: June-July. Open *Laurus nobilis* and *Pinus*. 1000m

C6 Hatay: Yayladağ-Antakya arası, eski karayolundan 22. km, 3.7.2001, 1000 m, *Laurus nobilis* L. altı, A.Duran 5735 (GAZI), Hatay: Samandağ to Yayladağ, road of Aydınbahçe village, about 2-3 km, 557 m, 2.6.09, 36 00 572 N 36 01 137 E!, F.Celep 1647!

Figure 161. Habit of *S. viscosa*

53. *S. adenocaulon* P.H. Davis in Kew Bull. 1951: 94 (1951), (Figure 162).

Perennial herb. Stems 8-40 cm, erect, ± unbranched, densely glandular-pilose throughout. Leaves simple, narrow oblong, 1-6 x 0.3-2.5 cm, beneath densely pilose with numerous sessile glands, crenulate, rugulose, truncate or subcordate; petiole 1-4.5 cm. Inflorescence glandular pilose, to 20 cm. Verticillasters 4-8-flowered, clearly distant. Bracts ovate-acuminate, c. 3-6 x 2-4 mm. Pedicels 1-2 mm, erecto-patent. Calyx ± tubular-campanulate, c. 6-8 mm, glandular-pilose and with many sessile glands; upper lip tri-dentate with closely connivent small teeth. Corolla pale lilac, 12-15 mm; tube ± straight, c. 7 mm, slightly ventricose, not squamulate; upper lip falcate. Stamens B. Anther ca. 2 mm, upper theca 5-6 mm, lower theca ca. 2 mm filaments 2-4 mm.

Habitat and Phenology: June-August. Calcareous area. 1500-2050 m.

Type: Type: [Turkey C4] Konya: distr. Ermenek, between Hamitseydi Bogaz and Beşkuyu (between Ermenek and Anamur), fl. pale lilac, 1500-1700 m, 16. 8.1949, Davis 16224 (holo. K! iso. BM! E! W! Hub.-Mor.!).
Mediterranean region. **C4** Karaman: Karaman to Ermenek, around Karaman Bey Pass, 1920 m, 26.7.2005, 36 49 713 N 32 56 630 E, F.Celep 1002! İbid 1.7.2006, F.Celep 1141! Karaman: Ermenek, Başyayla to Taşkent, around Feslikan pass, 1735 m, 2.7.2006, 36 51 448 N 32 31 902 E, F.Celep 1147!, Ermenek: Sarıveliler, above Civandere village, 1694 m, 21.6.2007, 36 41 918 N 32 31 046 E, F.Celep 1251!

Endemic. Medit. Element.

Related to *S. dichroantha* and *S. virgata,* with the small oblong leaves of the former and the (usually) glandular stems of the latter, but apparently specifically distinct on the small stature, leaf shape and very glandular stems (Hedge 1982a).

Figure 162. Habit of *S. adenocaulon*

54. *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), (Figure 163).

Perennial herb. Stems 20-70 cm, ascending-erect, branched above or not, eglandular-pubescent. Leaves simple, narrowly oblong to oblong-lanceolate, ± cordate, 3-14 x 0.5-3 cm, rugulose, eglandular pubescent with numerous sessile glands, crenulate; petiole 1-4.5 cm. Inflorescence paniculate or not, 5-35 cm. Verticillasters 2-6-flowered, approximating. Bracts ovate-acuminate, 1-6 x 1-4 mm. Pedicels 0.5-2 mm. Calyx tubular-campanulate, 4-7 mm, to c. 8 mm in fruit, eglandular (sometimes with glandular capitate) pubescent with numerous sessile glands, clearly bilabiate; green to purple. Corolla pale lilac or blue, 9-15 mm, ± squamulate; upper lip falcate. Stamens B.

Habitat and Phenology: June-September. Steppe, clearings in forest, fallow fields, roadsides. 700-2000 m.

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

B2 Kütahya: Domaniç, 900 m, D. 36429! **B4** Konya: Beyşehir to Ilgın yolu before Aşağıçigil, 38 01 021 N 31 53 868 E, 1386 m, SBagherpour 214! Konya: Zaferiye köyü: 2 km E of Zaferiye köyü, towards Ilgın, Bulasan Nehir yanında, 38 17 533 N 32 00 983 E, SBagherpour 215! **B5** Kayseri**:** Bakırdağ to Saimbeyli, 2-3 km before Saraycık village, 1644 m, 12.7.2008, F.Celep 1541! **C2** Antalya-Muğla: Elmalı to Fethiye, seki, Eren Mountain, 1800-1850 m, 7.7.2007, 36 44 890 N 29 36 477E, F.Celep 1340! **C3** Isparta: d. Egridir, Yukari Gokdere, 1700 m, Pesmen *&* Güner 1817! Antalya: Çalbali Da., 1700 m, D. 15247! **C4** Konya: 12 km W. of Konya, D. 16128!

Endemic. Ir.-Tur. Element.

Figure 163. Habit of *S. dichroantha*

55. *S. verbenaca* L., Sp. PI. 25 (1753).

Syn: *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), as *S. multifida;* Polunin & Huxley, Fls. Medit. t. 156 (1965). Afzal-Rafii, Z. in Bull. Soc. Bot. Fr. 126, Lettres Bot. 1979, 1: 79-86 (1979), (Figure 164).

Perennial herb with a woody rootstock; stems erect, 10-90 cm, often purplish below and often branched above, tetragonal, eglandular retrorse hairys below, above with numerous capitate glandular hairs and shorter eglandular ones. Leaves mostly basal, variable, entire, crenate, erose to pinnatifid, narrow oblong to ovate, 2-10 x 1.5-8 cm, eglandular-pubescent with sessile glands, petiole 1.2-14 cm. Verticillasters 4-10-flowered, distant or condensed above. Bracts ovate-acuminate, 3-6 x 4-7 mm; bracteoles present. Pedicel c. 1-3 mm. Calyx ± campanulate, 5-9 mm, to 6-10 mm in fruit, and broadening, with villous glandular and eglandular hairs; upper lip shortly tridentate, broadly bisulcate. Corolla lilac, blue to purple, 6-16 mm; tube ventricose, non squamulate, 6-7 mm; upper lip ± straight to subfalcate. Stamens B.

Habitat and Phenology: March to May. Banks, in *Quercus* macchie, deciduous woodland, road- and fieldsides. 1-900 m.

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

Bl İzmir: Kemalpaşa, Nif Da. to summit, 455 m, 4.5.2006, 38 25 470 N 27 24 331 E, F.Celep 1052! **C1** Muğla: Akyaka town, 28 m, 27.4.2008, 37 03 271 N 28 19 203 E, F.Celep 1372! **C2** Denizli, entrance of Honaz Da. National Park, 3.5.2006, 1155-1200 m, 37 39 380 N 29 14 290 E, F.Celep 1045! **C3** Antalya: Akseki to Manavgat, after 5-10 km from Murtiçi, 470 m, 2.5.2006, 36 47 687 N 31 45 749 E, F.Celep 1039! **C4** Karaman: Ermenek, below Top Burnu, 2.5.2006, 636 m, 36 38 217 N 32 49 464 E, F.Celep 1031! **C5** İçel: Silifke, above Cennet-Cehennem Mağaraları, 1.5.2006, 266 m, 36 27 458 N 34 05 619 E F.Celep 1029! **C6** H Hatay: İskenderun,

Belen, around Soğukoluk village, 30.04.2006, 837 m, 36 29 270 N 36 09 309 E, F.Celep 1027!

Medit. Element.

Figure 164. Habit of *S. verbenaca*

Section 7 *Hemisphace* Bentham.

56. *S. verticillata* L. subsp. **amasiaca** (Freyn & Bornm.) Bornm.
Bull. Herb. Boiss. ser. 2, 8:110 (1908).= *S. amasiaca* Freyn & Bomm. in Öst.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), (Figure 165).

Perennial herb; stems several, simple or branched, erect or ascending, 15-70 cm, many, branched above or not, pilose to villous below with sessile glands. Leaves simple, oblong to ovate, 2.5-13 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, rounded to cordate, petiole 1.5-7 (-9) cm. Verticillasters (8-)15-40-flowered, clearly distant. Bracts ovate-acuminate, c. 7 x 3 mm, deciduous. Pedicels 2-8(-10) mm, some ± deflexed. Calyx tubular, 5-6 mm to c. 7 mm in fruit with a bisulcate upper lip, violet-blue, pilose to villous with sessile glanffs, 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:

Habitat and Phenology: May to August. Screes, *Stipa* steppe, *Quercus* and *Pinus* woodland, field and roadsides. 20-2300 m.

Type: [Turkey A5 Amasya] Amasia: in rupestribus ad 4-600 m, 11 vi 1899, Bornmuller 611 (iso. B!).

Kütahya: Domaniç, 900 m, P.H.Davis 36429b, Kütahya: Şaphane kuzey tarafı üzeri, Şaphane dağını güney etekleri, 1050-1150 m, kayalık yamaçlar, H.Demiriz 2110 **B3** Kütahya: Bayat yolunun 1 km güneyi, 1100 m, 18.6.1980, Ö.Seçmen 2226 et al., Isparta: Şarkıkaraağaç, Sazlıpınar-Kolonkaya yolu, 1150-1250 m, 24.6.1994, B.Mutlu 708 **B5** Kayseri: Bakırdağ to Saimbeyli, 2-3 km before Saraycık village, 1644 m, 12.7.2008, F.Celep 1540! **C3** Konya: Beyşehir to Seydişehir, 5-7 km, 1216 m, 6.6.2008, 37 38 213 N 31 46 996 E, F.Celep 1431! **C4** Konya: Beyşehir to Ilgın, 5-6 km before Aşağıçiğil village, 27.7.2005, 1200-1400 m, F.Celep 1009! **C5** İçel: Çamlıyayla, Fakılar village, Papazın Bahçesi, 400-1000 m, 24.7.2005, 37 11 332 N 34 38 640 E, F.Celep 984! **C6** Adana: 25 km N.E. of Feke, 1200 m, F.Sorger 77-26-26

Ir.-Tur. Element.

Figure 165. Habit of *S. verticillata* subsp. *amasiaca*

57. *S. russellii* Bentham in DC., Prodr. 12: 357 (1848), (Figure 166).

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. 1-1.5 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, erecto-patent. Calyx tubular, c. 5-7 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. 9-11 mm, tube straight with annulus; upper lip straight, compressed, narrowed at base. Stamens C.

Habitat and Phenology: March to July. Rocky slopes, grassy meadows amongst Quercus, fallow and cultivated fields, 100-1600 m.

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

B6 Kahramanmaraş: Göksun to Elbistan, 1400 m, Stainton & Henderson 5593 **C2** Burdur: Tefenni to Yeşilova, 1100 m, Dudley (P.H. Davis 35297) **C5** Adana: Saimbeyli, Doğanbeyli-Akçal yolu, 1300 m, nadas tarlalar (step), 12.7.1952, P.H.Davis 19893, Dodds & R.Çetik.

Ir.-Tur. Element.

Figure 166. Habit of *S. russellii*

58. *S. napifolia* Jacq,, Hort. Vindob. 2:71, t. 152(1772).

Syn: S. *verticillata* L. subsp. *napifolia* (Jacq.) Afzal-Rafii in Acta Ecol. Iran 2:86 (1977), comb. Illegit., (Figure 167).

Perennial herb. Stems erect, several, branched above, villous, especially near stem base, shortly eglandular-pilose above with sessile glands, Leaves usually simple, occasionally lyrate, ovate to broadly ovate, 2-8 (-13) x 2-6 cm, villous with sessile

glands, crenate to erose, irregularly cordate; petiole 1-5 (-10) cm, white-ciliate. Verticillasters (4-) 8-20 -flowered, clearly distant. Bracts ovate-acuminate, c. 5 x 2 mm, deciduous. Pedicel 3-6(-8) mm. Calyx ± tubular, c. 7-9 mm, purple-violet, pilose with sessile glands, expanding in fruit to 10 mm with broad bisulcate upper lips and ± deflexed. Corolla purplish-violet, c. 10-15 mm; tube c. 8 mm, annulate; upper lip straight, equal to lower, not narrowed at base. Stamens C.

Habitat and Phenology: April-July. Rocky slopes, *Quercus cocciferae* macchie, *Poteridium* phrygana, roadsides. l-1000 m.

Type: Described from cultivated material, provenance not indicated (holo. W).
Bl İzmir: İzmir, *Bal.* 1854:313 Niğde: Çamardı, Demirkazık villaje, 1561 m, 14.6.2006, 37 51 590 N 35 05 391 E, F.Celep 1101 **B6** Adana: Feke, Çataksuyu, Saimbeyli-Göksu yolu, 900 m, P.H.Davis 19810 **C3** Antalya: Tahtalı Dağı, 900m, P.H.Davis 15130 **C4** Mersin: Fındıkpınar, around Cemilli village, 470 m, 1.6.2009, 36 48 091 n 34 27 214 E, F.Celep 1632! **C5** İçel: 35 km before Aslanköy, Aladağ village, 847 m, 15.6.2006, 36 56 411 N 34 30 123 E, F.Celep 1110!, Adana: Pozantı, 13.vii.1972, E.Yurdakulol 10299 **C6** Hatay: Antakya, Samandağ to Yayladağ, above Gözene village, 287 m, 2.6.2009, 36 03 317 N 36 00 960 E, F.Celep 1646!

East Medit. Element.

Figure 167. Habit of *S. napifolia*

CHAPTER 4

4. CONCLUSION

A revision of the Mediterranean and the Aegean geographic regions of Turkey of *Salvia* L. (Labiatae) is presented. According to the results, the study area has 60 taxa, 32 of which are endemic (mainly local endemics), 5 of which are non-endemic rare, and the remaining 23 taxa are widely distributed. The rate of endemism is 53% in the area.

Since 2005, about 2000 specimens have been collected and examined as the research materials. In addition, a large number of specimens have been seen and studied in ANK, AEF, BM, E, ERCIYES, G, GAZI, HUB, K, KNYA, LE, ISTE and ISTF herbaria. Digital photos of some specimens including type specimens have been seen from B, W and A herbaria. In the field when the specimens were detected geographical location (including GPS), habitat, phenological data and relevant field observations were all recorded.

In the study, comparative morphological characters and their variations are discussed. For example, habit, stem, leaf, inflorescence, calyx, corolla and stamen features of the species are compared in both infrageneric level and specific level and their diagnostic features are discussed. According to results, the most important diagnostic morphologic characters among the species are leaf shape, calyx properties, corolla colour, shape and length, and the stamen features.

Anatomical sections are taken from different parts of the plants such as root, stem, leaf and petiole for taxonomic evaluation. For the first time, the anatomical characteristics of *S. pisidica, S. sericeo-tomentosa, S. adenocaulon* and *S. chionantha* endemic to Turkey are examined in detail. Anatomical characters such as number of pith rays in roots, shape and size of cortex and vascular tissue in stems, number of palisade parenchyma rows and vascular bundles in leaves and the structure of the vascular bundles in petiole are found to be important characters.

Micromorphological properties, such as trichome, pollen and nutlet, of the species are comprehensively studied and their taxonomic implications are discussed.

Three main types of trichomes were observed on the stem, inflorescence axis, leaf and calyx surfaces of the species. They are peltate, capitate glandular and nonglandular. According to results, size, shape and distribution of the trichomes on the stem, inflorescence axis, leaf and calyx surfaces are found to be important characters.

Morphological and micromorphological studies and statistical analysis on the pollen grains have revealed that variation in pollen characters appears to have particular taxonomic value in separating different species. Pollen size, surface sculpturing (exine ornamentation), reticulation (reticulate or bireticulate), thickness of muri, size and number of lumina are one of the important characters for separating species. However, the similarity in exine structure and ornamentation, as well as the variability of the various parameters analyzed at interspecific and intraspecific level makes it hard to establish taxonomical boundaries. The palynologic results are not support or correlate with sectional grouping of Bentham.

Morphological and micromorphological studies and statistical analysis on the nutlets have revealed that variation in nutlet characters appears to have particular taxonomic value in separating different species and sections. Nutlets are prolate-spheroidal or near-spherical and rounded to trigonous in transverse section with the rounded-trigonous character state the most common. Nutlets of *S. pisidica* and *S. albimaculata* were abruptly attenuate at the apex. Observed nutlets displayed minimal surface sculpturing at larger scales with the exocarp smooth in all taxa except *S. pisidica* and *S. albimaculata*, which had a mid-ridge. Regarding sculpturing of nutlet surface five basic types are found; colliculate, reticulate, verrucate, foveate and rugose types. The majority of the studied taxa are of the colliculate type, followed by reticulate and verrucate. The size of nutlet ranges from 1.74 mm (*S. adenocaulon*) to 8.44 mm (*S. albimaculata*) in length and 1.14 mm (*S. russellii*) to 3.71 mm (*S. suffruticosa*) in width. Trichomes were present on nutlets of several taxa in section *Plethiosphace* and *Aethiopis*.

According to field studies and literature surveys, endemism, pyhtogeography, habitat, fenology, chorology, distribution and conservation status of the species are determined. Comprehensive information about endemism, pyhtogeography, habitat, fenology, chorology, distribution and conservation status of the species was given by Celep & Doğan (2007) and Celep et al. (2010d).

Infrageneric delimitation of the species using multivariete analysis is performed. In addition, first sectional key and sectional grouping of the species are made. As well as, an identification key of the species is given. At the end of the thesis, expanded and corrected description, address, photographs and some notes on taxonomy of the species are given.

The taxonomic studies revealed one new species, *Salvia marashica*, two new varieties, *S. sericeo-tomentosa* var. *hatayica*, *S. cadmica* var. *bozkiriensis*, one new combination, *S. aucheri* subsp. *aucheri* and one new record, *S. viscosa*. As well as, *S. sericeo-tomentosa* and *S. quezelii* are rediscovered.

During the studies, more than 20 papers were prepared, submitted or published including new taxa, records, anatomy, numeric taxonomy, trichome, pollen and nutlet micromorphology, ecology, conservation status and rediscovery. As well as, inter(national) presentations and posters were presented.

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