REVISION OF *VICIA* L. (LEGUMINOSAE) IN CENTRAL ANATOLIA, TURKEY

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Approval of the thesis

REVISION OF *VICIA* L. (LEGUMINOSEAE) IN THE CENTRAL ANATOLIA, TURKEY

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ABSTRACT

REVISION OF *VICIA* L. (LEGUMINOSEAE) IN THE CENTRAL ANATOLIA, TURKEY

Binzat, Okan Kaan

Ph. D. Department of Biology

Supervisor: Prof Dr. Musa Doğan

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In this revisional study based on the the genus *Vicia* in Central Anatolia large quantities of data have been compilled from specimens representing the group of the taxa being studied. These data were then synthesized to make taxon descriptions, keys, geographical distributions and ecological preferences.

Since 2009, about 700 specimens have been collected from Central Anatolia and examined as the research materials. In addition, a large number of specimens have also been studied in the following herbaria ANK, GAZI, MUĞ, HUB and E.

According to the Flora of Turkey (Davis 1985), there were 16 species found in Central Anatolia. But this study has shown that genus Vicia covers 22 species (*V. noeana, V. anatolica, V. pannonica, V. hybrida, V. sericocarpa, V. narbonensis, V. galilaea, V. ervilia, V. caesarea, V. cracca, V. villosa, V. monantha, V. canescens, V. cappadocica, V. articulata, V. cassubica, V.peregrina, V. truncatula, V. grandiflora, V. lathyroides, V. cuspidata, V sativa)* in this region.

Some morphological characters were used to understand whether they have a diagnostic value or not. These characters, which include habit, leaf, stem, inflorescence, calyx, corolla and style properties, were compared at infrageneric level and species level.

Systematic value of pollen micromorphology, trichome micromorphology and petal epidermal micromorphology of *Vicia* in Central Anatolia were observed. Pollen grains equatorial view, polar view and exine ornamentations, trichome types of calyces and leaves can be useful for separating the species in sectional level.

Geographical and ecological distributions maps were updated. In addition to this, the conservation status of the genus *Vicia* in Cental Anatolia was reassessed at regional level. The threat categories include 2 taxa DD, 1 taxon CR, 7 taxa EN, 1 taxon VU, 1 taxon NT and 14 taxa LC. The main threat categories for this genus are identified as overgrazing, constructions, land clearing and urbanizations.

The infrageneric delimitations were performed by the use of multivariate analysis. Identification keys for sections and species were also given. Synonym, species updated descriptions, phenology, habitat, distribution in Central Anatolia, distribution in Turkey and general distribution, phytogeograpy, endemism, specimen citations photographs of species and distribution maps were also indicated.

Keywords: Leguminosea, *Vicia*, revision, morphology, palynology, anatomy, Central Anatolia, Turkey

ÖZ

İÇ ANADOLU BÖLGESİNDE YAYILIŞ GÖSTEREN *VICIA* L. (LEGUMINOSAE) CİNSİNİN REVİZYONU

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Eylül 2012, 165 sayfa

Bu çalışma İç Anadolu bölgesindeki *Vicia* cinsi üzerine yapılmıştır. İlgili taksona ait çok sayıda örnekten elde edilen bilgiler derlenmiştir. Bu bilgiler morfolojik, anatomik çalışmaların yanı sıra takson tanımlamalarında, anahtar oluşturulmasında ve coğrafik dağılım ile ekolojik gereksinimlerin belirlenmesinde kullanılmıştır.

2009 yılından buyana, araştırma örnekleri olarak yaklaşık 700 adet örnek toplanmış ve üzerlerinde gerekli çalışmalar yapılmıştır. Ayrıca oldukça fazla sayıda herbaryum örneği ANK, GAZI, HUB, MUĞ, Royal Botanic Garden Edinburgh (E.) herbaryumlarında görülmüş ve çalışılmıştır.

Flora of Turkey'e göre (Davis, 1985), kaynağına göre 16 farklı tür İç Anadolu bölgesinde bulunmaktaydı. Fakat yapılan çalışma göstermiştirki bu alanda *Vicia* cinsine ait 22 tür bulunmaktadır. (*V. noeana, V. anatolica, V. pannonica, V. hybrida, V. sericocarpa, V. narbonensis, V. galilaeaa, V. ervilia, V. caesarea, V. cracca, V. villosa, V. monantha, V. canescens, V. cappadocica, V. articulata, V. cassubica, V.peregrina, V. truncatula, V. grandiflora, V. lathyroides, V. cuspidata, V sativa).*

Bazı morfolojik karakterlerin, habit, yaprak gövde, çiçek durumu, kaliks, taç yaprak ve style biçimi gibi cins içi sınıflandırmada ve türlerin belirlenmesinde belirleyici olup olmadığı üzerine çalışılmıştır.

İç Anadolu bölgesindeki *Vicia* cinsine ait türlerin birbirinden ayırt edilmesinde pollen mikromorfolojisi, tüy mikromorfolojisi ve taç yapragın mikromorfolojisinin sistematik değeri incelenmiştir. Polenlerin ekvatoral ve kutup görünümleri, exine yüzeyinin ornamentasyonu kaliks ve yaprak yüzeyindeki tüylerin çeşitleri ve sıklığı. Seksiyonlar düzeyinde türlerin ayırt edilmesinde faydalı olabilmektedir.

Coğrafik ve ekolojik dağılım haritalı bu çalışma ile yeniden düzenlenmiştir. Buna ilaveten Bölgede yaşayan *Vicia* cinsine ait bitkilerin koruma statüleri belirlenmiştir. Bölgesel ölçekte 2 takson DD, 1 takson CR, 7 takson EN, 1 takson VU, 1 takson NT ve 14 takson LC kategorisindedir. Çalışma alanındaki cins ait bireyler için görülebilecek ana tehdit unsurları; aşırı otlatma, inşaat çalışmaları, arazi açma ve kentleşmedir.

Cins içi sınıflandırma yapılırken çoklu varyasyon analizi kullanılmıştır. Seksiyon ve tür anahtarları hazırlanılmıştır. Taksonların sinonimleri, tip örnekleri, güncellenmiş tanımlamaları, çiçeklenme zamanları, İç Anadolu bölgesindeki, Türkiyedeki ve genel dağılımları, dağılım haritaları, fitocoğrafayası ve endemic olup olmadıkları, adresleri ve fotoğrafları verilmiştir.

Anahtar kelimeler: Leguminosea, Vicia, revizyon, morfoloji, palinoloji, anatomi, İç Anadolu bölgesi, Türkiye

To My Mother,

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ABBREVIATIONS

ANK	: Ankara University Herbarium (Faculty of Science)
DD	: Data Deficient
EN	: Endangered
Fig.	: Figure
GPS	: Global Positioning System
GAZİ	: Gazi University Herbarium (Faculty of Science)
Holo.	: Holotype
HUB	: Hacettepe University Herbarium (Faculty of Science)
IUCN	: International Union for Conservation of Nature
LC	: Least concern
LM	: Light microscopy
m	: Meter
MUĞ	: Muğla University Herbarium (Faculty of Science)
NT	: Near threatened
E	: Royal Botanic Garden Edinburgh
Subps.	: Subspecies
Syn.	: Synonym
UPGMA	: Un-Weihted Pair Group Method with Arithmetic mean
Var.	: Variety
VU	: Vulnerable
Unk. Or Multi.	: Unknown or Multiregional
µm	: Micrometer

CHAPTER 1

INTRODUCTION

1.1. Introduction to the Family Leguminosae

Leguminosae or Fabaceae is a large and economically important family of the flowering plants. It is commonly known as the legume family, the bean family, the pea family or the pulse family. The name Fabaceae, which comes from the defunct genus Faba, is now included in *Vicia*. Leguminosae is an older name, however, it is still considered valid, and refers to the typical fruit of these plants, which are called legumes (Wikipedia, 9 October 2010).

Leguminoseae is the second largest family of the seed-plants with about 430 genera with 7000 species. It belongs to the series Rosales of the Dicotyledons which has three well-marked suborders known as Papilionatae, Mimosoideae and Caesalpinioideae (Herenden et al., 2005). Their methods of acquiring the essentials for growth and their modes of defence and reproduction are the main reasons of the variation of the family. The Leguminosae is ranging from the giant plants to ephemerals and scattered from Equator to the edges of the cold and hot deserts. Biodiversity of the family is high in the areas of varied topography with seasonal climate (Polhill et al., 1981). Legumes are particularly diverse in the tropical forests and the temperate shrublands with a seasonally dry or arid climate. Nitrogen demanding metabolism of Legumes prefers semi-arid to arid habitat. They can "fix" atmospheric nitrogen via a symbiotic association with root-nodulating bacteria which is why many species have the ability to colonize barren and marginal lands. This is just one of several ways in which legumes obtain high levels of nitrogen to meet the demands of their metabolism (McKey, 1994; Sprent, 2001). The fixation of atmospheric nitrogen via root-nodulating rhizobial bacteria (in addition to arbuscular

mycorrhizas, ectomycorrhizas, and uptake of inorganic nitrogen compounds) is just one of them. This process is a hallmark of legume biology (Sprent, 2001). Legumes play an important role in the terrestrial nitrogen cycle regardless of whether they form root nodules (Sprent, 2001).

Morphologically, Leguminosae is characterized, by leaves simple to compound (pinnate, rarely palmate, or bipinnate), unifoliate, trifoliate (*Medicago, Trifolium*), sometimes phyllodic (many species of *Acacia*), or reduced to a tendril (as in *Lathyrus*), spirally arranged, with stipules present that are sometimes large and leaf-like (*Pisum*) or developed into spines (*Prosopis, Robinia*).

Flowers are usually bisexual, regular or irregular (i.e., actinomorphic to zygomorphic in symmetry, respectively), with a single superior carpel (hypogynous to perigynous), pentamerous, arranged singly or in heads, racemes or spikes. The common feature of the family is the fruit type, the legume (Polhill, 1994). In general, Legumes have one-chambered pods (one locule) with a few exceptions. They have parietal placentation along the adaxial suture, ovules two to many, in two alternating rows on a single placenta, dry and dehiscent along one or both sutures (legume), occasionally constricted into one-seeded sections (loments) or indehiscent (samara, drupe, achene) (Polhill, 1994).

Ranging from large trees to annual herbs, the family has a cosmopolitan distribution and well represented throughout temperate and tropical regions of the world (Rundel, 1989). Particularly in the tropical forests with a seasonally dry aspect and the temperate shrublands tailored by xeric climates where legumes are diverse. However, in mesic temperate habitats, including many arctic and alpine regions and the understory of the cool temperate forests they are noticeably absent to poorly represented. As it was previously stated the preference of legumes for semi-arid to arid habitats is related to their nitrogen-demanding metabolism, which is thought to be an adaptation to climatically variable or unpredictable habitats whereby leaves can be produced economically and opportunistically (McKey, 1994).

1.2. Systematics of the Family

Leguminosae has been traditionally divided into three subfamilies, the Caesalpinioideae, Mimosoideae, and Papilionoideae (they sometimes have been ranked as separate families, as in Caesalpiniaceae, Mimosaceae, and Papilionaceae). They are considered most closely related to the Connaraceae and Sapindaceae on the basis of their morphology, anatomy, and biogeographic distributions (Polhill and Raven, 1981). The three subfamilies are recognized by the characteristics of the flower in particular. Size, symmetry, aestivation of petals, sepals (united or free), stamen number and heteromorphy, pollen (single or polyads), also presence of a pleurogram, embryo radicle shape, leaf complexity, and presence of root nodules are the characteristics of the flowers (Lewis et al., 2005). Differences in these characteristics led to the view that the Mimosoideae and Papilionoideae are unique and distinct lineages in the family. Those before mentioned two families' lineages arose independently within a paraphyletic "basal" caesalpinioid assemblage. The *Dimorphandra* group of tribe Caesalpinieae and papilionoid tribe Swartzieae were considered likely transitional groups between them, respectively (Polhill, 1994).

There are three subfamilies of the legume family which are Papilionoideae, Mimosoideae, Caesalpinioideae.

The subfamily Papilionoideae members have true papilionaceous flowers. They have upper petal outside the lateral petals in the bud. Most of the Leguminosae have typically pea-like flowers. *Astragalus* (locoweed), *Dalea* (smoke tree), *Erythrina* (coral tree), *Lupinus* (lupine), *Lathyrus* (sweet pea), *Robinia* (black locust) and *Vicia* are in this subfamily.

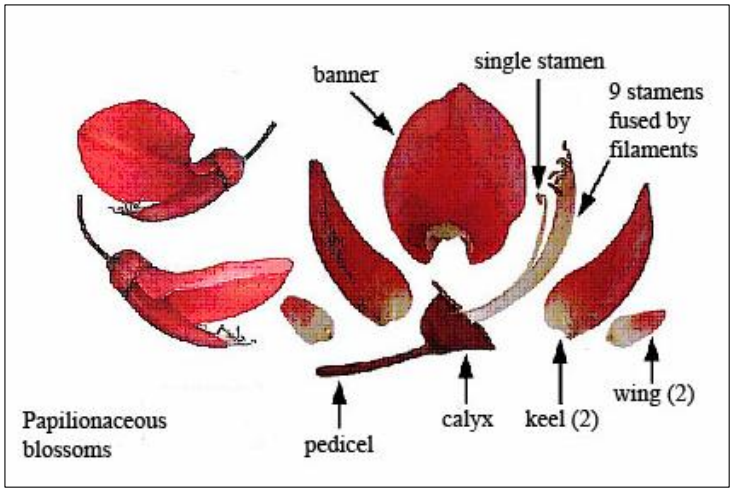

Figure 1. Papilionaceous flower (Armstrong, 2002)

Major perianth segments removed from their attachment inside the calyx of papilionaceous flower are shown in Figure 1. There are five petals in their flowers. One of them is a large oval banner or standard shape petal. The other two elongate keel petals are fused together enclosing the stamens, and the remainder two are reduced wings. Nine stamen filaments are united into a sheath that surrounds the pistil and one stamen filament is separated from the fused nine. This condition referred to as diadelphous.

The subfamily Caesalpinioideae members have bilateral flowers (Figure 2). They are typical with their five distinct petals and with their upper petals (banner) enveloped in the bud by the lateral wings. This subfamily includes *Bauhinia* (orchid tree), *Cassia* (senna), *Caesalpinia* (brazilwood), *Cercis* (redbud), *Cercidium* (palo verde), *Delonix* (royal poinciana), *Haematoxylum* (logwood), *Ceratonia* (carob), *Parkinsonia* (Jerusalem thorn) and *Tamarindus* (tamarind).

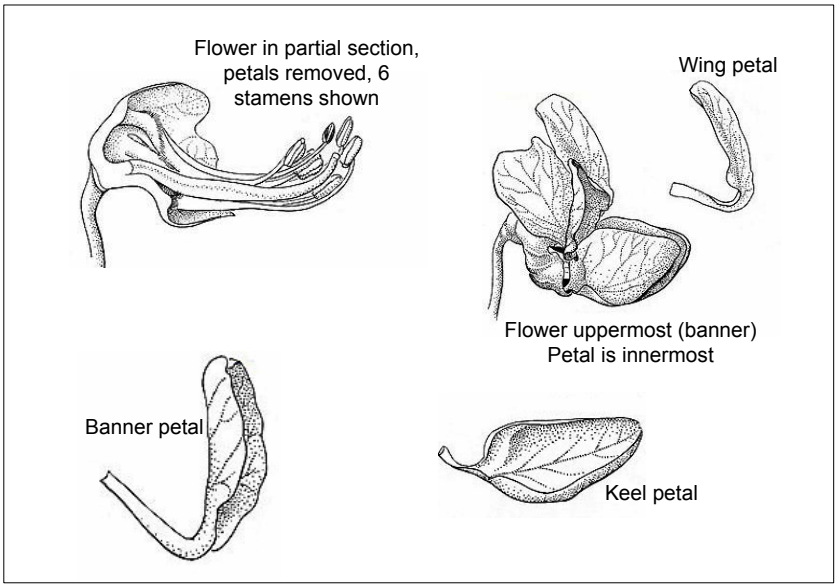

Figure 2. Caesalpinioiceous flower (*Cercis canadensis*) (Watson & Dallwitz, 1992)

The subfamily Mimosoideae members have flowers (Figure 3) with radial symmetry, small, inconspicuous corollas and numerous, showy stamens. The flowers are typical in many-flowered heads or spikes. This subfamily includes *Acacia* (wattle), *Albizia* (silk tree), *Calliandra* (powder puff), *Prosopis* (mesquite) and *Samanea* (monkeypod).

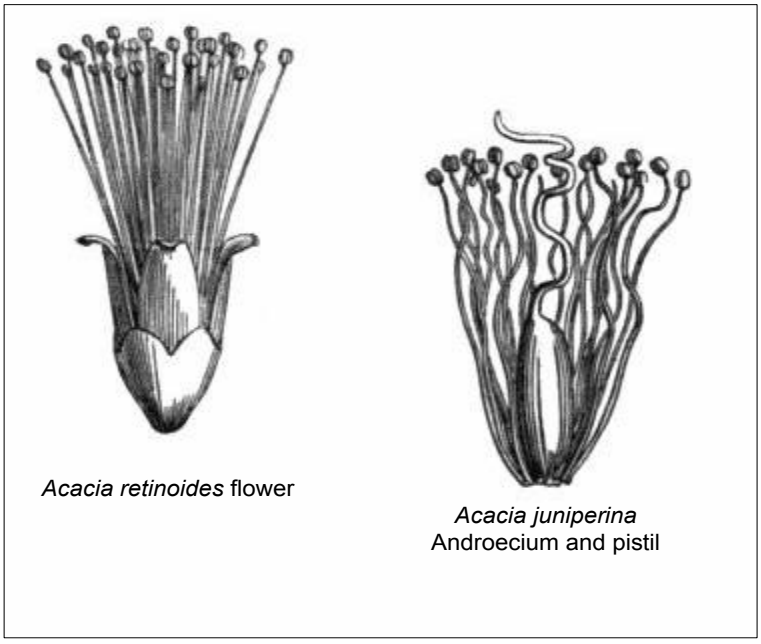

Figure 3. Mimosoideae flower (Watson & Dallwitz, 1992)

1.3. Economic Importance of Legumes

For thousands of years Legumes have agricultural importance. Lentils (*Lens esculenta*) were domesticated in Iran, 9,500 - 8,000 years ago. Their use as a food source is dating back to the prehistory of North and South America and beans 3000 years ago and earlier. They were used as a food source and for soil improvement by the Roman Empire. With 27% of the world's primary crop production today, for humans and also for farm animals legumes are an increasingly invaluable food source (Graham and Vance, 2003). On more than 13% of the total arable land under cultivation in the world Legumes were grown in 2004 (Gepts et al., 2005). Grain legumes alone provide humans 33% of the dietary protein nitrogen needs, while more than 35% of the world's processed vegetable oil needs were met by peanut (*Arachis hypogeae*) and soybeans (*Glycine max*) and a rich source of dietary protein for the poultry and pork industries (Graham and Vance, 2003).

Legumes are deficient in terms of sulfur containing amino acids needed by people and animals. On the other hand, they produce nitrogen-containing protein in abundance. For this reason, legumes and cereal crops are often raised together in order to meet the amino acids and other elements they are each deficient in (Gepts et al., 2005). The primary dietary legumes grown, such as bean (*Phaseolus vulgaris*), pea (*Pisum sativum*), chickpea (*Cicer arietinum*), pigeon pea (*Cajanus cajan*), broad bean (*Vicia faba*), cowpea (*Vigna unguiculata*), and lentils (Graham and Vance, 2003), include representatives of each of the four clades within the papilionoids, the genistoids, the dalbergioids, the hologalegina, and the phaseoloid/millettioids.

In order to fix atmospheric nitrogen many legumes form root nodules and they do this in a symbiotic relationship with the soil bacteria 'rhizobia'. Depending on the species in symbiosis, legumes are extremely diverse in their abilities to nodulate. All species can not nodulate but there is a wide variety of nodules that form. Legumes are still used as tools in agriculture and forestry as the Romans did in the past. When tilled into the soil the plants themselves or plant products like leaves and pods supply nitrogen to the soil.

By rotating legume crops with others they can also be used for soil improvement. These techniques save farmers billions of dollars in the cost of nitrogen fertilizers (Graham and Vance, 2003).

Legumes do have many uses in the industry as well. They can be used for biodegradable plastics, oils, biodiesel fuel, and dyes production. Legumes are used traditionally in folk medicines, and in modern medicine. Isoflavones commonly found in legumes are thought to reduce the risk of cancer and lower cholesterol and soybean phytoestrogens are being studied for use in postmenopausal hormone replacement therapy (Graham and Vance, 2003). Legumes produce a hypoglycemic effect when eaten. They are recommended for diabetics (Gepts et al., 2005).

1.4. Systematics of the Genus *Vicia* L.

Vicia is a member of suborder *Papilionatae*. It is a medium - sized genus and the number of species can be estimated as 180 to 210. The number of their species has not been stated yet precisely. It is because of the lack of a recent complete monograph as well as differing species concepts in floras and regional revisions. The genus is widely scattered in the temperate zone of the northern hemisphere and in extra-tropical South America (Hanelt & Mettin, 1989). The most striking diversity is found in the Mediterranean region and the Caucasus. Minor centers are in South Siberia and South America (Kupicha 1981, Nikiforova 1988, Hanelt & Mettin, 1989) (Figure 5). It is reported that a total of 64 species, 22 subspecies and 18 varieties of *Vicia* are present in Turkey; five species and three subspecies of them are endemic (Davis and Plittman 1970). 16 out of the species of *Vicia* were recorded from the Central Anatolia. These were; *V. anatolica, V. articulata, V. caesarea, V. canescens, V. cappadocica, V. cassubica, V. cracca, V. monantha, V. ervilia, V. truncatula, V. noeana V. peregrina, V. grandiflora, V. sativa, V. narbonensis, V. galilaea* (Davis, 1985).

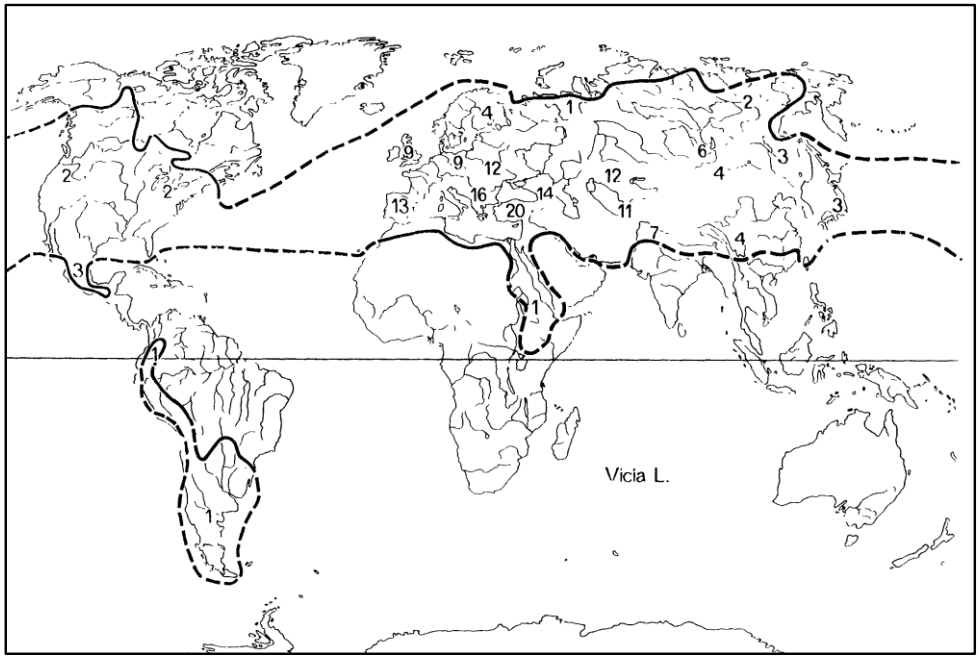

Figure 4. Natural distribution of genus *Vicia* L. in the world (broken lines on land indicate unsufficiently known limits) as marker of the phylogenetic differentiation number of sections of the genus (Hanelt & Mettin, 1989).

The taxonomic history of the genus *Vicia* L. is pretty much stable. For more than a century, its theme remained unchanged. Only in the early classifications of Linneaus (1753) and a few taxonomists, the species were grouped under the two genera (*Vicia* L. and *Ervum*). Even in the past some minor adjustments were made in its generic delimitation. For example, some of the species of *Lathyrus* and *Lens* were transferred recently to *Vicia*. It seems the most comprehensive classification of the genus, in terms of concept, position, and subdivision of the genus was made by Kupichas classification scheme (Hanelt and Mettin, 1989).

Linneaus (1753) recognized two groupings of this genus. One of his groupings was equivalent to the subgenus *Vicia*. He identified the two taxa of sect. *Hypechusa*. These are *V. hybrida* and *V. lutea*.

Alefeld (1859, 1860, 1861a, b & c) identified and raised one of the subgroup, which was *Hypechusa*, to the generic level. To define his genus he used good characters of *Hypechusa*. These characters were relative peduncle length and numbers of flowers per inflorescence, with relative seed hilum to lens position on the seed. He divided the genus *Hypechusa* into two subgenera as subgen. *Masarunia* Alef. and subgen. *Euhypechusa* Alef. According to Alefeld, the first one was consisted by the *V. hybrida* and the second one consisted by *V. pannonica, V. hyrcaninca, V. lutea, V. sericocarpa, V. melanops*.

Boissier (1872) made a detailed infra-generic classification in *Vicia*. In order to differentiate the sect. *Hypechusa* from others, he used the relative seed lens to hilum position on the circumference of the seed. He didn't use the formal taxonomic ranks in his grouping, but he splitted the species into the three subgroups which included the species with vexillum, and the species without a pubescent vexillum. The second subgroup was divided into two more subgroups. For the division of second group, legume pubescence was used as a criterion. Ascherson & Graebner (1909) grouped the taxa included in the section *Hypechusa* into one subgroup but they were not distinguished properly from the section *Vicia*.

Fedtschenko (1948) splitted the subgenus *Vicia* species into eleven series within his section *Euvicia*. In his methodology of grouping, the relative seed hilum to lens position was not used. By the use of a combination of other characters, he splitted the sect. *Hypechusa* into three series namely *Luteae, Hyrcanicae* and *Hybridae*. He failed to provide Latin diagnosis for these series. But Radzhi (1971) published the names some years later.

Plitmann (1967) projected a well detailed classification of the annual *Vicia* of the Middle East. He used ten supra-specific taxa so as to group the 30 subgenera of *Vicia*. He had the same mentality with Fedschenko (1948). However, Plitmann divided the sect. *Hypechusa* into four series namely *Hycranicae, Hybridae, Luteae* and *Sericocarpa.*

Plitmann (1970) placed the *V. esdraelonensis* between *V. galeata* and *V. hyrcanica*. *V. monbretti* was excluded from *Vicia* and placed in *Lens* as *L. monbretti.*

Radzhi (1971) named the series proposed by Fedtschenko and grouped the three series of Fedtschenko in one distinct taxon. The greatest number of species in the subgenus *Vicia* was placed in her sect. *Vicia* was further subdivided into four subsections. These subsections contained Fedtschenko's proposed series.

Schäfer (1973) recognized 5 varieties in the species *V. narbonensis* on the basis of seed size, hilum colour, presence of a funiculus, pod shape and leaf margin serrations.

Schäfer (1973) and Maxted *et al*. (1991) provided a map of the distribution of V. narbonensis varieties.

Kupicha (1976) revised the genus *Vicia* L. and divided it into the two subgenera, namely *Vicia* and *Vicilla*. While the subgenus *Vicia* included 5 sections, *Vicilla* has covered 17 sections. Relative length of the inflorescence and the presence of nectarifous spots on the stipules were used by her for the distinction betwen the two subgenera (Table 1).

Maxted (1991) divided the genus *Vicia* L. into the subgenera *Vicilla* and *Vicia*, with 17 and 9 sections. The subgenus *Vicilla* is more diverse than the subgenus *Vicia*, containing about 140-160 species (Hanelt and Mettin 1989).

Maxted (1991) made a revisional study of the subgenus *Vicia*. According to his findings, he added two species to sect. *Hypechusa.* Those two species were *V. mollis* Boiss. & Hausskn. Ex Boiss. and *V. tigridis* Mouterde.

Table 1. Characters distinguishing between the two subgenera in *Vicia* (Van de Wouw *et al.* 2001).

Character	Subgenus Vicia	Subgenus Vicilla
Stipule nectary	Absent	Present on abaxial stipule face
Peduncle length	= or > leaf	< leaf or absent
Style type	terete, dorsally compressed pubescentor tufted, laterally compressed	dorsally compressed, tufted
Keel shape	edge curved round and above style	apical part encircled style and anthers
Legume	stipitate, sub-torulose	never stipitate
Canavanine	Present	Absent

1.5. Agricultural Importance of the Genus *Vicia* L.

The genus *Vicia* is of significant economic importance. *V. faba* and *V. ervilia* are the two species which belong to the earliest domesticated plants of the world. They are the characteristic components of the Neolithic Near Eastern food plant complex. The faba bean is still one of the most widespread grain legumes in the temperate region of the world. The genus includes some further minor food crops and more than a dozen forage plants among those the most important common vetch, *V. sativa*, cultivated in many countries in the old world and the new world (Hanelt and Mettin, 1989).

Drier areas are in need of alternative crops. The additions of grain crops, such as grain legumes give permit a diversification of the cropping rotation and thereby give better disease control. Low rainfall and alkaline soils are suitable conditions for the cultivation of *Vicia*.

Genotypes of *V. dasycarpa-villosa*, *V. sativa - amphicarpa-cordata*, *V. pannonica V. narbonensis-serratifolia*, represent a wide and largely unexploited genetic base (Zohary, 1973). The genus *Vicia*, especially the species *V. benghalensis, V. monantha, V. villosa* and *V. sativa* holds considerable potential for dry areas, according to Houerou (1985).

Vetch cultivation in Mediterranean agriculture is currently accepted as a renaissance, which could well lead to a revolution in the current ley farming and other cropping systems. Vetch can be used in several ways. They can be used for either fodder conservation or immediate cash returns through hay or grain production, while at the same time providing a green manure and grazing option. Moreover, they are useful concerning weed control as crops prior to pastures. The high production potential of medics and clovers is complemented by the versatility of vetches. The biodiversity of the legume component in Mediterranean agricultural systems could be increased by them. Importance of the legumes can change according to the situations. In some cases, biomass production is considered more important than grain yield. Forage-livestock systems should be given as much priority as those for grain proction to improve the sustainability and productivity of arid land regions in developing countries (Steiner et al, 1988).

Several species of *Vicia* genus have been used in agriculture since ancient times. Some of the species have been cultivated more recently, but a few have been cultivated experimentally. In the Table 2, the geographical distribution of *Vicia* species and their use are given. The nutritive values and potential toxicity of severa Vicia species as a grain legue should be understood. Their impact on various types of livestock (pigeons, pigs, fish, poultry, sheep, horses, goats, cattle) and human might be different.

Vicia species were used as grain legumes in ancient ages. *V. ervilia* (7000 BC.) and *V. faba* (5000BC) were first used forms as grain legumes (Zohary and Hopf, 1988). *Vicia* species have been used in agriculture since catholithic times. During this time period 2-5% of cultivation area was consisted by *Vicia* species (Noy- Meir and Seligman, 1979).

Table 2. Cultivated *Vicia* species (Enneking, 1994)

Species	Synonym	English name	Use	Country
V. articulata Hornem	*V. monanthos* (L.) Desf.	One-flowered vetch	G, F	TUR, SPA, MED
V. benghalensis	*V. atropurpurea* Desf.	Purple vetch	F	IND, MENA
V. monantha Retz	*V. calcarata* Desf. (Demehi)	Bard vetch	G	LIB, MENA
V. ciliatula Lipsky	*V. ciliata* Lipsky			
V. cracca L.	*V. tenuifolia* Gren. & Godron	Tufted vetched	F	CHI, JAP
ssp.Tenuifolia (Roth) Gaudin	*V. tenuifolia* Roth		F	IRQ
V. ervilia Wild	*Ervum ervilia* L.	Bitter vetch	G, F	MENA, WA
V. faba L.	*Faba vulgaris* Moench	Broad bean	G	WİDELY
V. fulgens Battand		Scarlet vetch		MENA
V. germinea Smith	*V. selloi* Vogel		F, G[3]	S. AM
V. hirsuta (L) Gray		Hairy tare	F	IND, EUR, WA, CIS
V. johannis Taman.			G	TUR
V. narbonensis L.		Narbonne vetch	G,F	MENA
V. pannonica Crantz		Hungarian vetch	G	TUR, GRG, MENA
V. peregrina		Broad pod vetch	F	
V. pisiformis L.		Pale flowered vetch	G	EUROPE
V. sativa L. ssp. Sativa		Common vetch	G, F	WIDELY
ssp. *amphicarpa*		Subterranean vetch	F	
V. tetrasperma (L.) Schreber		Smooth vetch	F	WHITE RUSSIA
V. unijuga A. Br.	*Orobus lathyroides* L.	Two leaved vetch	F	STB, MAN, JAP
V. villosa Roth.		Hairy vetch	F	USA, ETH
ssp. *varia* (Host) Corbiere	ssp. *Dascarpa* (Ten.) Cavill	Woolly pod vetch	F	WIDELY

Abbreviations: Cover crop, G: Grain, F: Forage Country: CIS: former U.S.R.R; EUR: Europe; ETH: Ethiopia; IND: India; JAP: Japan; GRG: Georgia; MAN: Manchuria; MED: Mediterranean region; MENA: Middle East and North Africa; PRT: Portugal; SPA: Spain; TUR: Turkey; WA: West Asia and North Africa.

V. sativa has been produced for re-sowing and pigeon feed in Britain. Due to the intensification of animal production, the proportion of vetch crops sown for fodder increased in the 19th century. In the early part of the 19th century, only 40% of the 240 km^2 of cultivated *V. sativa* was used for seed production in Germany. Other *Vicia* species including *V. faba*, *V. ervilia*, *V. monantha* and *V. narbonensis* were also used as grain legumes (Fischer, 1937). In some countries, such as Austria, Bulgaria, Germany, Lithuania and Spain, fodder vetches have been cultivated as both, grain and forage

crops. In other countries such as Great Britain, Hungary, Yugoslavia, Netherlands and Sweden, vetches have only been cultivated for use as green forage. In Czechoslovakia *Vicia* species have mostly been cultivated as grain crops (Fischer, 1938). The use of *Vicia* grain in Germany was notably greater prior to the Second World War.

Vetches were used for human consumption, summer vetch and the Canadian vetch (*V. Sativa alba*) in particular. The others were considered unsuitable as human food. These vetches were used as additives. For instance in France, they were used to stretch wheat flour for bread making and for grain production *V. sativa* was used mainly. Vetch seeds are very concentrated protein source. They can be used as a supplement to volumnious feed for animal power or meat production. However, the bitter taste of these causes reluctant intake. Horses still like them best. Overload of these can lead to detrimental effect on the health of animals, especially pregnant and young animals. Therefore, the vetches should not be fed in large quantities. Feeding horses with too much vetch leads contracted brain damage.

The faba, *V. faba* is still widely used for human food and as livestock feed. This species is a major currently used grain legume in the genus. Besides *V. faba*, the major *Vicia* grain legumes used as feedstuff for farm animals include *V.sativa* L., *V. narbonensis* L., *V. villosa* Roth, *V. monantha* and *V. ervilia*.

Human consumption of vetches should be in ideal dose. In the contrary case some bad effects can be observed. Furthermore reliance on detoxification can be a potential health hazard. Incomplete processing of Cassava can cause endemic goiter and in conjunction with a deficiency of nutritional sulfur that was identified as the cause of "Konzo". Konzo is an upper motor neuron disease. It was recently diagnosed from East Africa in areas where the higher yielding bitter Cassava varieties were cultivated (Tylleskär et al., 1992).

Vicia species are the sources of food for human being but there is a lack of information about the usage of these as a food source. Except for the list of *Vicia* species presented in Table 2 (Kunkel, 1984), no detailed documented source could be found about the appropriate use of these species for human consumption.

V. serratifolia, V. tenuifolia, V. angustifolia and *V. lutea* L. grown in France, could be used along with the wheat for food, under famine conditions, due to their albumins and carbohydrates rich composition. Young stems and leaves of *V. americana* were collected and eaten as vegetable. In Turkey, wild legumes' seeds mixture was used for making bread. *V. narbonensis* seeds were eaten as a pulse in a village some 19 km N.E. of Erbil in Iraq and the leaves were fed to stock as a fodder (Townsend, 1974). In South - Eastern part of Turkey, near Diyarbakır, *V. narbonensis* was used as a pulse, after it has been boiled with some salt.

Vicia seeds are used for animal production. *V. ervilia* is one of the oldest domesticated grain legumes (Zohary and Hopf, 1988). The seeds of this species are to some extent used for human consumption. Bitterness of seeds can be removed through streaming and leaching with hot water. Generally, they are used to feed pigs and cattle for fattening and also used for the poultry.

Due to its toxicity, consumption of large quantities of bitter vetch flour affects cattle and sheep. For that reason, rations should not exceed 25% bitter vetch for ruminants. A study was done by Ergün and his collogue in Turkey shows the inclusion of wild *V. ervilia* seed at 4, 8 or 12% had a negative effect on live weight, egg production, feed conversion efficiency and egg weight. While the color of egg yolk improved with increasing vetch concentrations, other parameters, including shell breaking strength remained normal.

Table 3. *Vicia* species occasionally used for human consumption (Enneking, 1994)

Species	**Locality**	**Parts utilised, comments**
V. americana Muhl. ex. Willd	N. America	Young stems boiled or beaked.
V. amoena Fisch. ex Ser.	E. Asia	Young leaves a pot- herb
V. amurensis Oett.	Manchuria	As above (Tanaka)
V. articulata Hornem.	Medit. Region	Seeds used like lentils
V. cracca L.	Eurasia	Young shoots used as a pot – herb, leaves also used as tea,Seeds used as food (Hedrick)
V. ervilia (L.) Willd.	Medit. Region	Seeds eaten in soups
V. nigricans Hook.	California	Seeds edible
Ssp. *Gigantea* (Hook) Lass. & Gunn	Korea	Young leaves a pot-herb
V. hirsuta (L.) S. F. Gray	Eurasia, N. Africa	Weedy, young leaves and shoots eaten (boiled?) seeds cooked or roasted (Tanaka)
V. hirticalycina Nakai	Korea	Young leaves a pot herb
V. monantha Retz	Medit. Region	Weedy, seeds used in soups
V. narbonensis L.	S. Europe	"A vegetable" (Tanaka), Hedrick: Seeds eaten
V. noeana Boiss & Reut. Ex Boiss.	Asia Minor	Seeds edible
V. bakeri Ali	Himalayan Region	Cult, As above? (Hedrick)
V. pisiformis L.	Europe, cult.	Seeds used like lentils
V. pseudo-orobus Fisch. & Mey.	N. E. Asia	Young stems and leaves vegetable
V. sativa L.	Eurasia, cult.	Seedsground into flour used in soups and bread young shoots a pot herb; leaves as tea
V. sepium L.	Eurasia	Seeds used as a food (Hedrick)
V. subcuspidata Nakai	Korea	Young stems and leaves a pot-herb
V. cracca L. ssp *tenuifolia*	Eurasia	Apparently used as a pot herb
V. americana var. *sinensis*	Manchuria	Used as a pot-herb
V. unjuga A. Br.	E. Asia, widespr.	As above
V. venosa (willd.) Maxim.	E. Asia- Siberia	Used as a pot-herb
V. villosa Roth	Eurasia, weedy	"A vegetable" (Tanaka)

During the last 10.000 years, the bitter vetch has been graded as less toxicity. As a matter of fact, the content of canavanine in *V. ervilia* seed is rather low with respect to other *Vicia* L.species (Enneking, 1994)

V. sativa has been used for feeding of horses. It is considered unfit for these animals. Large amount of this species leads to brain disease with symptoms of acute brain oedema in these animals. Cracking and debittering of this plant was carried out in general. Mouldy seed had to be boiled prior to feeding. Cracked seeds of vetch were used to feed horses, beef oxen, pig and dairy cows. The grain can be used for birds, or even pigs and cattle, after it has been ground into flour. But it may cause constipation and dermatitis in pigs and lathyrism in horses. In cattle and sheep it causes somnolence, muscular paralysis and death by asphyxiation. (Enneking, 1994)

According to von Knieriem (1900) and Haubner (1845), feeding dairy cattle with seeds of *Vicia* L. has negative effect on milk production. Moreover, Piccioni (1970; cited by Gomez, 1983) pointed out the taste of milk which was bitter if diary cows were fed 2 kg of *V. sativa* grain. The taste of vicine and convicine passes into the milk could cause a problem in direct consumption and cheese production.

1.6. General Description of the Study Area

1.6.1. Location and Topography

Turkey forms a natural bridge, between the continents of Asia and Europe. The Anatolian peninsula is like an arrow head of Asia pointing Europe. Turkish Straits are detaching the peninsula from Europe. Thrace is the western part of Turkey on the European continent. From west to east geographical distances of the peninsula is 1,565 km. and from north to south is 650 km. Total land area is about 779,452 km^2, of which 755,688 km^2 are in Asia and 23,764 km^2 in Europe. Turkey is bounded by eight countries and surrounded by the seas on three sides. It is isolated by high mountains along its eastern border and the country has well-defined generally by natural borders (Geography, 10 October 2010).

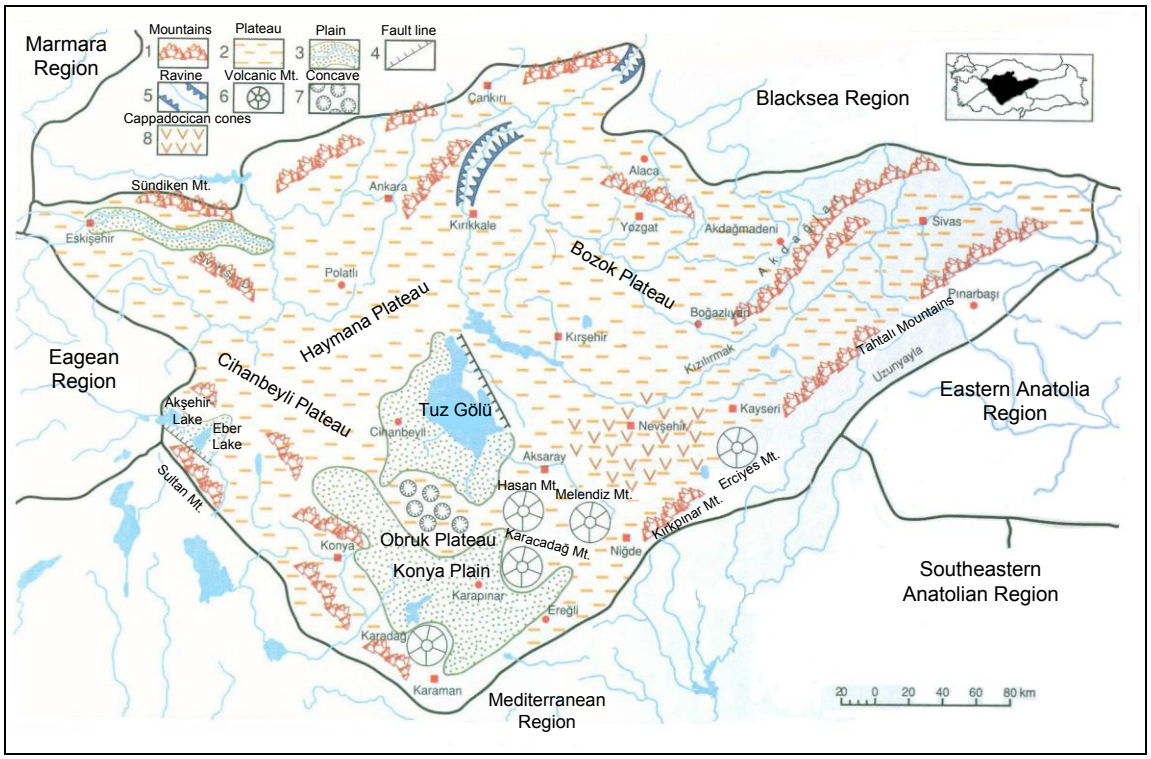

Figure 5. Morphology map of Central Anatolia (Kutupedia, 20 June 2012)

Turkey has seven geographical regions. Central Anatolia with its 151.000 km^2 of land (19.4 % of the total area of Turkey) is the second largest region of Turkey after Eastern Anatolia (Figure 5). Central Anatolian region is in between the two zones of folded mountains, reaching east to the point where the two mountain ranges converge. The plateau-like, arid highlands of Anatolia are considered the heartland of the country. By virtue of the proximity to the steppes of Russia, the region varies in altitude from 600 to 1,200 m. west to east, averaging 500 m. in elevation. On the plateau there are two largest basins. One of them is Konya Ovası and the other is a basin occupied by Tuz Gölü (Salt Lake). But both are characterized by inland drainage. The Anatolian plateau is interspersed with extinct volcanoes, the tallest of which is Mt. Erciyes (3917 m.) stands within the provincial boundaries of Kayseri. Karadağ (2771 m.) near the Karaman and Hasan Dağı (3268 m.) near Niğde are the other extinct volcanoes.

Oligocene formations of saline and gypsum, alluvial deposits, are the main formations of Central Anatolia. Since the soil salt concentration is high in the steppes, woody plants have no chance to live and grow up. Only the halophytic plants are favored (Akman *et al*., 1994; Aydoğdu *et al*., Vural *et al*., 1999).

Wooded areas are localized in the north, and cultivation is restricted to the areas surrounding the neighboring rivers where the valleys are sufficiently wide. Irrigation is performed wherever water is available; deep rivers' courses make it difficult to raise water to the surrounding agricultural land. For the most part, the region is bare and monotonous and is used for grazing (All about Turkey, 10 October 2010).

Turkey has three phytogeographic regions. These are the Euro-Siberian, Mediterranean and Irano-Turanian regions. Central Anatolia is confined to the Irano-Turanian region in terms of phytogeography (Figure 6).

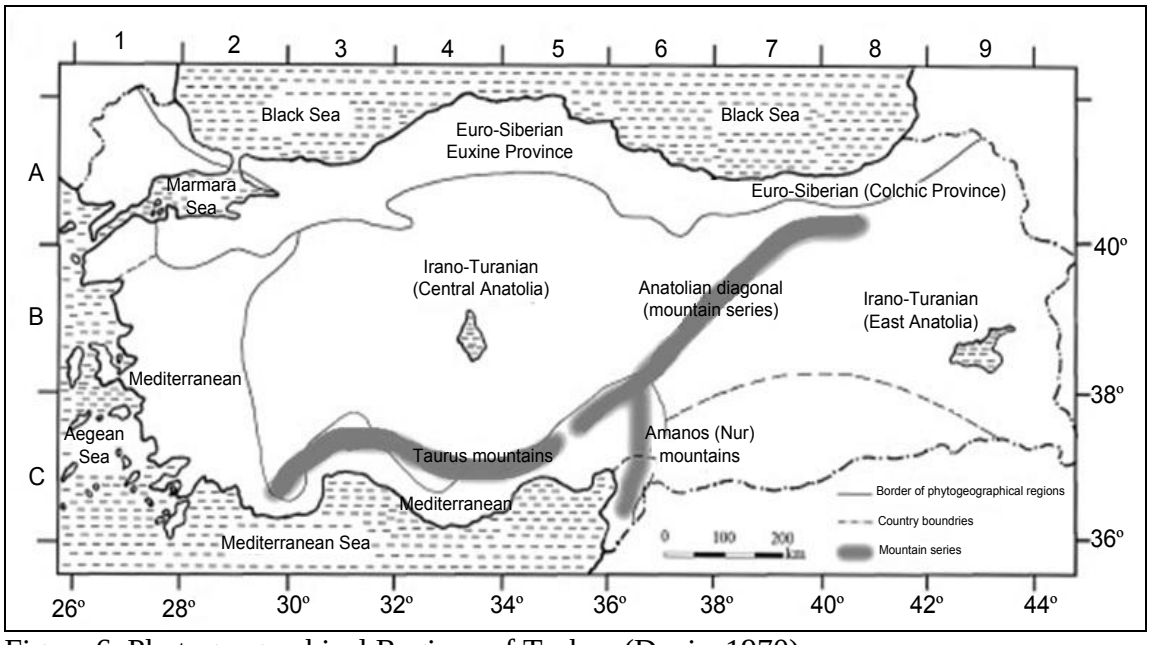

Figure 6. Phytogeographical Regions of Turkey (Davis, 1970).

1.6.2. Climate

In general view, climate is one of the most important factors that effect the distribution of plants. In the study area (Central Anatolia), temperature differences between night and day in summer and winter are sharp, and rain is relatively few and far between. Winters are long and cold with heavy snowfall while summers are short but hot. The rainiest season is spring in Central Anatolia. January is the coldest month in Central Anatolia. Average temperature of this month is - 0.7 ºC. On the other hand, the hottest month is July. The average temperature of this month is 22 ºC. The annual average temperature is 10.8 ºC (Figure 7) (Sensoy et al. 2010).

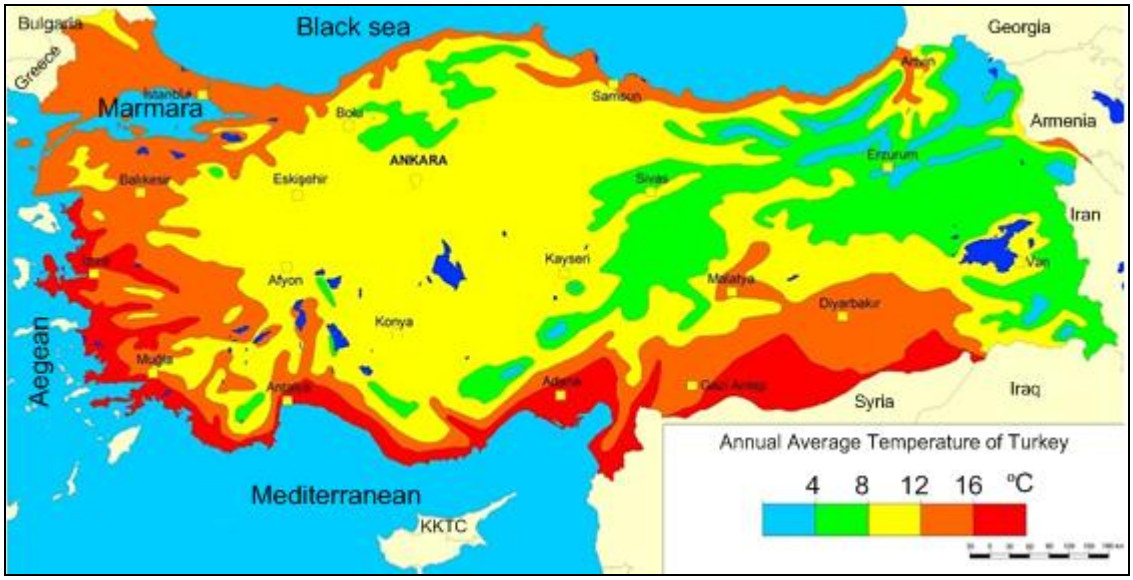

Figure 7. Annual Average Temperature of Turkey. (Atalay, 2000)

Due to the irregular topography, Turkey's diverse regions have different climates. Large mountains affect regional climates. Taurus Mountains which are close to the coast do not let rain clouds reach to the interior part of the country. Even though they can pass the mountains they usually drop most of their load on the coastal area. And those of which can reach Central Anatolia after passing over the mountains have no significant capability to produce of rain (Sensoy, 2004).

As mentioned here before, Central Anatolia receives little annual rainfall with an average precipitation of 40 cm (16 in) per year. The semiarid center of the plateau is the driest part of the region. It receives an average yearly precipitation of only 30 cm (Figure 8). However, actual rainfall from year to year is irregular and occasionally may be less than 20 cm (7.9 in); it leads to critical reductions in crop yields for both rain-fed and irrigated agriculture. Soil erosion on some parts of the plateau is the result of overgrazing. During the summers, frequent dust storms blow fine yellow silt across the plateau. Locusts occasionally ravage the eastern area in April and May. In general, the plateau experiences high temperatures and almost no rainfall in summer and cold weather with heavy snow in winter (Wikipedia, 5 May 2012).

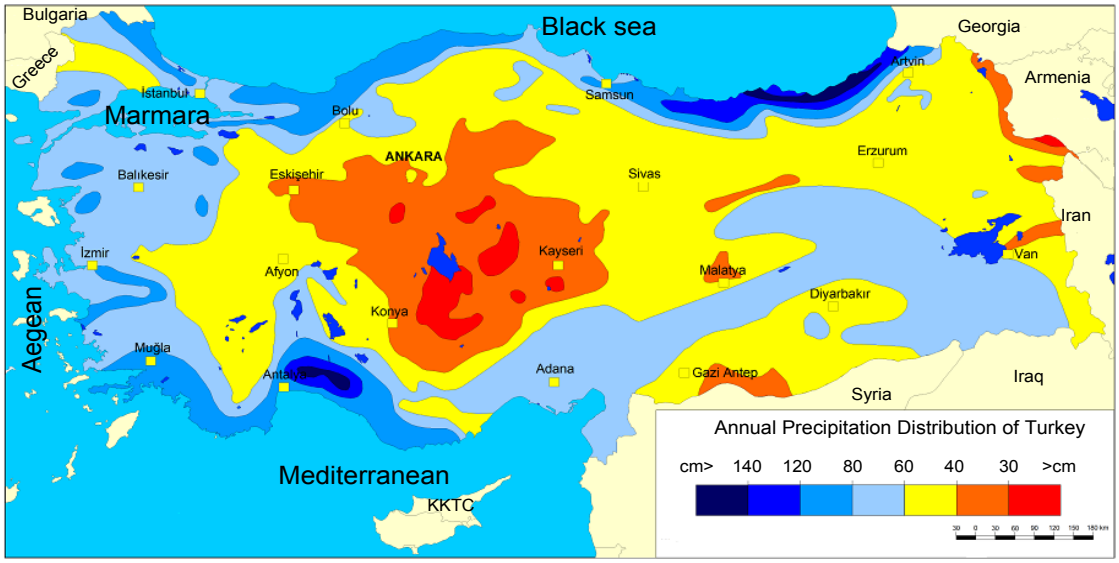

Figure 8. Annual Precipitation Distribution of Turkey (Atalay 2000).

1.7. Scope of the Study

Since Davis' *Flora of Turkey and the East Aegean Islands* vol.3 (1985), large number of specimens has been collected from different parts of Turkey. Species either new to science or new to Turkey have been discovered and the known distributions of other species have been extended.

The aims of this study are as follows:

To carry out a new taxonomic revision of *Vicia* and solve existing taxonomic problems in the Central Anatolia region of Turkey.

To determine ecological and phytogeographical properties of taxa.

To construct a new infrageneric grouping, by using numerical methods.

To construct a new identification key for the species found in the study area.

To carry out some macro-morphological and anatomical, palynological micro-morphological assessments for taxonomic reasons.

To determine threat categories of the taxa of *Vicia* recognized in Central Anatolia.

CHAPTER 2

MATERIAL AND METHODS

2.1. Materials Used

Between 2009 and 2010, by using the standard techniques given bay (Woodland, 1997) a large number of specimens were collected from all parts of the Central Anatolia region. Many herbarium specimens compiled from the region have also been examined by visiting the following herbaria ANK, GAZI, MUĞ, HUB and E.

In the field, when the specimens were collected geographical information (locations), habitat informations were recorded by means of using Global Positioning System (GPS). Distribution maps of the species were also prepared.

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

2.2. Morphological Methods

In order to make morphological studies the collected specimens and herbarium samples were examined. Leica S8AP0 stereomicroscope was used to examine the leaf, stem, inflorescence, calyx, and corolla characters for each sample, which were collected from the field (Davis, 1976).

2.3. Anatomical Methods

During the anatomical investigation part of this study the procedure described by Metcalfe (1950) was used. Dried samples were used to get the cross-sections. Samples were put in different amount of alcohol – water mixture for 1 hour.

%70 Alcohol → 1 hour

%85 Alcohol → 1 hour

%96 Alcohol → 1 hour

%100 Alcohol → 1 hour

After this step, samples were taken to Alcohol - Xylol mixture in a given ratio.

2 Alcohol + 1 Xylol → 30 minutes

1 Alcohol + 1 Xylol → 30 minutes

1 Alcohol + 2 Xylol → 30 minutes

Then paraffin method was used for the cross sections of the leaves, stems and roots. The specimens were embedded in paraffin then sectioned 5-15μm thickness with a Leica RM2125RT rotary microtome.

During the staining stage, different concentration of mixtures (200ml) also obtained to stain the samples which were in sectioned with microtome

100% Xylol → 20 minutes

2 Xylol + 1 Alcohol → 10 minutes

1 Xylol + 2 Alcohol → 10 minutes

100% Alcohol → 10 minutes

96% Alcohol → 10 minutes

85% Alcohol → 10 minutes

70% Alcohol → 10 minutes

50% Alcohol →10 minutes

25% Alcohol →10minutes

0.5 gram of safranin was solved in 200 ml H_2O →30 seconds

2 gram of fast green was solved in 200 ml H_2O → 2 minutes

All sections were stained with safranin grain-fast green and then mounted with Canada Balsam or Entella. Measurements and photos were taken by the use of Leica DM1000 binocular light microscope with a Leica DFC280 camera (Johansen, 1944; Metcalfe & Chalk 1950).

In order to prepare SEM slides, corolla, calyx, leaf upper and lower sides were embedded on double sided carbon tape affixed to aluminum stubs which were covered with gold Hummle VII sputter coater and photographed at scanning electron microscope to determine the micro morphology of the samples (Johansen, 1944; Metcalfe & Chalk, Dogan, 1986)

2.4. Palynological Methods

For palynological studies, pollen samples were collected from the specimens gathered from the field. Slides were prepared according to Wodehouse (1935) technique. For light microscope studies, pollen grains were dissected from the samples and placed on clean slides. Then glycerin-gelatin and basic fuchsin were put on slides on hot plate. After covering the slides with lamella, measurements and observations were made using Leica DM1000 binocular light microscope with Leica 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 (x1000) and P/E ratios were calculated.

Scanning Electron Microscope (SEM) slides were also prepared to investigate the pollen grains. This step was done by mounting the unacetolyzed pollen grains on double sided carbon tape affixed to aluminum stubs. Then the samples were covered with gold Hummle VII sputter coater and finally they were photographed at Scanning Electron Microscope. The Faegri and Iverson (1989) Henderson et al. (1968), and Punt et al. (2007) pollen terminology were used in palynological investigations

For statistical analysis SPSS 15.0 for windows package program was used. Anova and Post hoc analysis were done to compare the P/E value to find any significant difference at sectional an at species level for grouping the taxa.

2.5. Numerical Taxonomic Methods

38 different vegetative and reproductive character states were used to understand their taxonomic delimitations. These 38 characters were chosen according to their variability among the different taxa and their common usage with respect to taxonomic identification. During the character selection period, overlapping characters were omitted. Some characters were examined in different herbaria. Since some of the characters couldn't be observed from the samples that I collected in the field.

In order to make multivariety analysis, characters were scored according to Sneath & Socal (1973). By the use of MVSP (Multi Variate Statistic Package) statistics program, the similarity matrix was obtained with Gower General Similarity Coefficient (Sneath & Sokal, 1973). This matrix was created by Gower (1971). It can be used with a mixture of characters. These characters can be qualitative, quantitative, semi quantitative, binary or alternative. This matrix was clustered by using the Unweighted Pair Group Method Using Aritmetic averages (UPGMA). At the end, a phenogram was obtained.

2.6. Conservation Statuses, Endemism, Phytogeography and Threat Categories

Distribution of species, subspecies and varieties were given on the maps which were prepared according to Davis' grid square system. For making the detailed maps, the samples collected from the field, and herbarium samples were carefully examined. And some notes about the collection points were recorded.

The threat categories were proposed for all taxa in that study. This process was done by the help of IUCN Red List Categories 3.1(2001) and the Application of IUCN Red List Criteria at regional Levels (Gardenfors at al., 2001). According to the Broughton & McAdam (2002), details of threats were designated for all members of taxa within the study area. The findings in this study were checked with the Turkish Red Data Book (Ekim et al., 2000)

During the species collection, their habitats, levels of exploitation (in criteria A), the area of occupancy (in criteria B), and distribution (GPS locations) (in criteria B), and distribution (GPS locations) population and their size (in criteria C) and the number of mature individuals (in criteria D) were taken into consideration

The following categories defined by IUCN (2001) were used in this study.

Endangered (EN): a taxon faces a very high risk of extinction in the near future in the wild.
Vulnerable (VU): a taxon faces a high risk of extinction in the medium term future
Near threatened (NT): a taxon may be considered threatened in the near future.
Least concern (LC): there is no immediate threat to the survival of taxon.
Data deficient (DD): there is inadequate information to make a direct, or indirect assessment its risk of extinction.

CHAPTER 3

RESULTS

3.1. Gross Morphology

3.1.1. Growth Habit

Vicia species living in Central Anatolia are all herbaceous. Different from the other species *V. cassubica* has creeping rootstock. Most of the species are annual. Four of the species living in the study area, which are *V. cassubica, V. tenuifolia, V. canescens, V. truncatula* are perennial. (Table 4) Stems of *V. tenuifolia* and *V. truncatula* are slender. On the other hand, Stem of *V. canescens* is sturdy.

Table 4. Growth habit of the members of genus *Vicia.*

Annual	**Perennial**
V. villosa *V. monantha* *V. cappadocica,* *V. caesarea* *V. ervilia* *V. noeana* *V. sericocarpa* *V. anatolica* *V. pannonica* *V. hybrida* *V. grandiflora* *V. cuspidata* *V. lathyroides,* *V. sativa* *V. narbonensis* *V. galilaea.*	*V. cassubica* *V. tenuifolia* *V. canescens* *V. truncatula*

3.1.2. Stem Morphology

The stems are erect (e.g. *V. cassubica, V. canescens V. tenuifolia, V. monantha, V. ervilia V. truncatula V. noeana V. anatolica V. sativa, V. narbonensis, V. galilaea*), ascending (e.g. *V. cappadocica, V. caesarea V. sericocarpa, V. cuspidata)* or climbing (e.g. *V. grandiflora, V. hybrida, V. pannonica, V. villosa*) (Table 5).

Some of the species can grow up to 120 cm. as *V. villosa* and *V. tenuifolia.* Some of them, especially *V. ervilia, V. lathyroides, V. cuspidata* are so small. Their minimum length varies in between 5-8 cm.

Table 5. Stem type of the members of genus *Vicia*.

Erect stem	**Ascending stem**	**Climbing stem**
V. cassubica *V. canescens* *V. tenuifolia* *V. monantha* *V. ervilia* *V. truncatula* *V. noeana* *V. anatolica* *V. sativa* *V. narbonensis* *V. galilea*	*V. cappadocica* *V. caesarea* *V. sericocarpa* *V. cuspidata*	*V. grandiflora* *V. hybrida* *V. pannonica* *V. villosa*

3.1.3. Leaf Morphology

Leaves of the members of the genus *Vicia* are herbaceous. During the classification stage, leaf morphology is much important. All the members of this genus have compound leaves. Most of them have pinnate leaves ending in tendrils. However, *V. ervilia* and *V. truncatula* have no tendrils. Instead of tendrils, they have a mucro at the leaves rachis ending.

Leaves have many pairs of leaflets in *V. cassubica, V. tenuifolia, V. ervilia, V. truncatula*. Leaflet pair number goes up to the 16. On the contrary, *V. narbonensis* and *V. galilaea* have only 1-3 pairs of leaflets. Other members of the genus approximately have 3-8 pairs of leaflets.

Leaflet shape is the important diagnostic character for doing classification. It gives some clues about the similarity of some species. For example, the members (*V. sericocarpa, V. hybrida, V. anatolica, V. pannonica*) of section *Hypechusa* have the same type of leaflet shape. In section *Narbonensis*, all species have ovate leaflet shape. There are five different leaflet shapes. These are oblong, elliptical, linear, ovate and obovate. Leaflet shape is oblong in *V. villosa, V. cassubica, V. ervilia, V. noeana, V. tenuifolia*, and elliptical in *V. canescens, V. caesarea*. It is linear in *V. cuspidata, V. sativa, V. peregrina, V. truncatula, V. articulata, V. monantha.* It is ovate in *V. narbonensis, V. galilaea* and finally it is obovate in *V. cappadocica, V. sericocarpa, V. hybrida, V. anatolica, V. pannonica, V. lathyroides, V. grandiflora.*

3.1.4. Inflorescence Morphology

The inflorescences are solitary in *V. hybrida, V. cuspidata* and *V. lathyroides. V. cappadocica, V. monantha, V. caesarea, V. ervilia, V. truncatula, V. noeana, V. sericocarpa, V. anatolica, V. pannonica, V. grandiflora, V. sativa, V. narbonensis and V. galilaea* have 1 or a few flowers on their racemes. On the other hand, *V. tenuifolia, V. cassubica, V. canescens, V. villosa* have many flowers on the raceme. This number may increases up to 40 in some species (i.e. *V. tenuifolia* and *V. villosa)* (Table 6). In some sections, inflorescence is much shorter than the subtending leaf (e.g., sect *Narbonensis*, sect. *Wiggersia*, sect. *Vicia*, sect. *Hypechusa*, and sect. *Peregrina)*. Inflorescence is usually equaling or exceeding the subtending leaf in some sections of the genus *Vicia* (e.g., sect. *Ervoides* sect. *Cassubicae* sect. *Cracca*, sect. *Variegatae*, sect. *Panduratae*, sect. *Ervilia*, sect. *Lentopsis)*. Generally, second group of inflorescence structure posses many flower on their racemes.

Table 6. Flower numbers of different *Vicia* taxa.

Solitary	**Few flower**	**More flower**
V. hybrida *V. cuspidata* *V. lathyroides*	*V. cappadocica* *V. monantha* *V. caesarae* *V. ervilia* *V. truncatula* *V. noeana* *V. serİcocarpa* *V. anatolica* *V. pannonica* *V. grandiflora* *V. sativa* *V. narbonensis* *V. galilaea*	*V. tenuifolia* *V. cassubica* *V. canescens* *V. villosa*

3.1.5. Flowers

The members of the genus *Vicia* have papilionoid flowers. These flowers consist of three kinds of petals which are one dorsal petal (standart), two lateral petals (wing) and two ventral Petals (keel).

The flowers of this genus are hermaphrodite. Pollens are produced at the anther of flowers are collected as a mass round the stigma. Styles of these flowers move pollens into this position. There are some hairs on the adaxial sides of the style. These hairs cause the pollens to move.

3.1.6. Calyx

Calyces differ in shape from species to species. In some species, calyx's mouth shape is oblique. Oblique mouth shape means lower calyx teeth usually greater than the upper. *V. caesarea* is unusual in having the upper calyx teeth the lower calyx teeth. On the other hand, some species have straight mouth, in which all the teethes are subequal (Figure 9). For example, *V. peregrina, V. sericocarpa, V. cuspidata, V. sativa, V. lathyroides* have calyces with straight mouth. Most of them have oblique calyx mouth (Table 7).

Figure 9. Calyx mouth shape types of the genus *Vicia*. a. Oblique mouth shape (*V. tenuifolia* subsp. *tenuifolia*) b. straight mouth shape (*V. sativa* subsp. *nigra*).

Table 7. Calyx mouth shape of the members of genus *Vicia*.

Straight mouth shape	**Oblique mouth shape**
V. peregrina	*V. cassubica*
V. sericocarpa	*V. tenuifolia*
V. cuspidata	*V. canescens*
V. sativa	*V. villosa*
V. lathyroides	*V. cappodocica*
	V. ervilia
	V. monantha
	V. noeana
	V. anatolica
	V. pannonica
	V. hybrida
	V. galilaea
	V. narbonensis

In brief, when we look at sectional level, sect. *Vicia*, sect. *Peregrinae* and sect. *Wiggersia* have calyces with straight mouth. Calyx shape is a diagnostic character when we group the species of genus *Vicia*.

3.1.7. Corolla

There are three different shapes of corolla. These are oblong, platonychioid or pandurate and stenonychioid or obovate-spathulate. This character can be used in taxonomical studies of Vicia. For example, sect. *Cracca,* sect. *Variegatae* and sect. *Pandurate* have the platonychioid vexillium. Sect. *Ervilia*, sect. *Lentopsis*, sect. *Vicia* and sect. *Narbonensis* have stenonychioid vexillium. The other type of vexillium, which is oblong vexillium, can be observed in sect. *Cassubicae*, sect. *Ervoides*, sect. *Attosa* and some members of sect. *Hypechusa*. These are *V. anatolica*, *V. pannonica* (Table 8).

Table 8. Vexillum types of the members of genus *Vicia.*

Oblong	**Platonychioid**	**Stenonychioid**
V. cassubica *V. articulata* *V. truncatula* *V. anatolica* *V. pannonica*	*V. villosa* *V. monantha* *V. canescens* *V. cappadocica*	*V. ervilia* *V. caesarae* *V. sativa* *V. grandiflora* *V. lathyroides* *V. cuspidata* *V. narbonensis* *V. galilaea* *V. hybrida* *V. noeana* *V. sericocarpa* *V. peregrina*

Corolla colors differ within the sections and even within the species. Purple, violet, white, violet blue, pink, yellow are the color types of the corolla. When we are classifying some species, the colors may not play an important role. Since, in a species the colors may vary. For example, *V. ervilia* has in 4 different colors as white, pale yellow, lilac, and pink. However, some species of the sect. *Hypechusa* and sect. *Cracca* have same corolla colors.

3.1.8. Gynoecium

Gynoecium is the innermost whorl and is the female reproductive part of the flower. The style is part of the gynoecium of a flower, formed from the ovary wall. The tip of the style carries the stigma to which pollen grains attach; it is the part of the pistil that separates the stigma from the ovary. Style shape in this genus is divided into two types which are dorsally and laterally compressed. This character is also important when we are classifying the species for example, *V. monantha, V. tenuifolia, V. villosa* have style laterally compressed (Table 9). On the other hand, the rest of the studied species have style dorsally compressed. They are the members of sections *Cassubicae, Lentopsis, Attosa, Vicia, Narbonensis* and *Panduratae* .

Table 9. Stylar type of the members of genus *Vicia*.

Style laterally compressed	**Style dorsally compressed**
V. tenuifolia *V. villosa* *V. monantha*	*V. cassubica* *V. canescens* *V. cappadocica* *V. articulata* *V. ervilia* *V. caesarea* *V. truncatula* *V. sativa* *V. grandiflora* *V. lathyroides* *V. cuspidata* *V. narbonensis* *V. galilaea* *V. anatolica* *V. hybrida* *V. noeana* *V. pannonica* *V sericocarpa* *V. peregrina*

3.1.9. Fruit

Fruit shape differs in the genus *Vicia.* Most of the species in this genus living in Central Anatolia have linear oblong legume (e.g., *V. cappadocica, V. caesarea, V.ervilia, V. narbonensis, V. galilaea, V. monantha).* Oblong legume is forming the second largest group including four species (e.g., *V. noeana, V. pannonica, V. canescens, V. villosa*). The other groups are narrowly oblong (*V. truncatula*), oblong rhomboid (V. *sericocarpa, V. hybrida*), and oblong subrhomboid (*V. anatolica*); broadly linear (*V. grandiflora*) and linear (*V. cuspidata, V. lathyroides, V. sativa*). Glabrosity of the legume is another distinguishing character (Table 10). Some are glabrous (e.g., *V. cassubica, V. canescens, V. villosa, V. monantha, V. cappadocica, V. caesarea, V. truncatula, V. noeana, V. cuspidata, V. lathyroides*). Some of the species are pubescent (e.g., *V. ervilia, V. sericocarpa, V. anatolica, V. pannonica, V. hybrida, V. grandiflora).*

Table 10. Glabrosity of the members of genus *Vicia*

Glabrous	Pubescent
V. cassubica *V. canescens* *V. villosa* *V. monantha* *V. cappadocica* *V. caesarea* *V. truncatula* *V. noeana* *V. cuspidata* *V. lathyroides*	*V. ervilia* *V. sericocarpa* *V. anatolica* *V. pannonica* *V. hybrida* *V. grandiflora*

3.1.10. Seeds

Seeds of *Vicia* can be used as an important character in grouping species. Two main futures of seeds are useful in infrageneric classification of the genus. One is hilum length, the other is lens position. Hilum length in *Vicia* varies in between 1/16 to ¾ of the circumference of the seeds (Kupicha, 1976). Perennials have long hila. Opposite to that annuals have short hila. But some exceptional annuals, *V. grandiflora*, have long hila. Lens position is the second character that is used. This property is useful when we look relationships between the species of genus *Vicia.* In most species of *Vicia* the lens is closer to hilum. However, in members of section *Hypechusa* the hilum and lens is at opposite sides of the seeds.

3.2. Anatomy of Roots, Stems and Leaves of *Vicia* taxa

Samples for the measurements were taken from 18 different species and 3 different subspecies of *Vicia*. These species are *V. anatolica, V. caesarea, V. cappadocica, V. cassubica, V. tenuifolia, V. cuspidata, V. ervilia, V. galilaea, V. lathyroides, V. grandiflora, V. narbonensis, V. noeana, V. pannonica, V. peregrina, V. sativa, V. sericocarpa, V. truncatula, V. villosa* and from different subspecies. The measurement results were taken from the cross-sections of the roots, stems and leaves. The two species which are *V. cassubica* and *V. galilaea* have not an appropriate root structure to take the measurements.

Studies on the root, stem and leaf anatomy of the genus *Vicia* is rather limited (Metcalfe and Chalk, 1950; Rudall, 2000; Hassan and Heneidak, 2006). The root, stem and leaf anatomical characteristics of *Vicia* is given here. The main anatomical characters of the taxa studied are presented in Tables 11-12. LM micrographs of transverse sections of roots, stems and leaves are illustrated in Figures 10-54.

3.2.1. The Root Anatomy (Figures 10-27, Table 11)

The root cross-sections of *Vicia* taxa studied shows that the periderm cells on the outermost surface are squashed or breaking up. The periderm layer is dark-colored under the periderm, the cortex is 1-2-layered (e.g., *V. cappadocica*, *V. cuspidata*) or multi-layered (e.g. *V. tenuifolia*, *V. ervilia*, *V. noeana*, *V. peregrina*), with parenchymatic cells which are variable in shape and size. Above the phloem, some sclerenchymatic cells are present. Phloem and xylem elements can be separated in the vascular tissue. The xylem is composed of vessel members and tracheids. The vessel members are round or polygonal. Rays are usually composed of 1-2 rowed (e.g., *V. caesarea*, *V. cappadocica*, or more, up to 6 (e.g., *V. ervilia*, *V. narbonensis*)) (Table 11). Pith cells are polygonal or more or less orbicular. Tracheal cell diameters of the Vicia taxa show small differences. The average minimum size of tracheal cell diameter is 25.26 μm. This is the value for *V. ervilia*. On the other hand, the average maximum size of tracheal cell diameter is 65.68μm. This value was obtained from the measurements of *V. tenuifolia* subsp. *tenuifolia*. Apart from the tracheal cell diameters measurements, Pith diameter measurements also were done. These measurements support the group of some species in their sections. For example, *V. anatolica*, *V. noeana*, *V. pannonica* are closer to each other with respect to pith diameter. Their average pith cell diameters vary in between 235 μm and 318 μm.

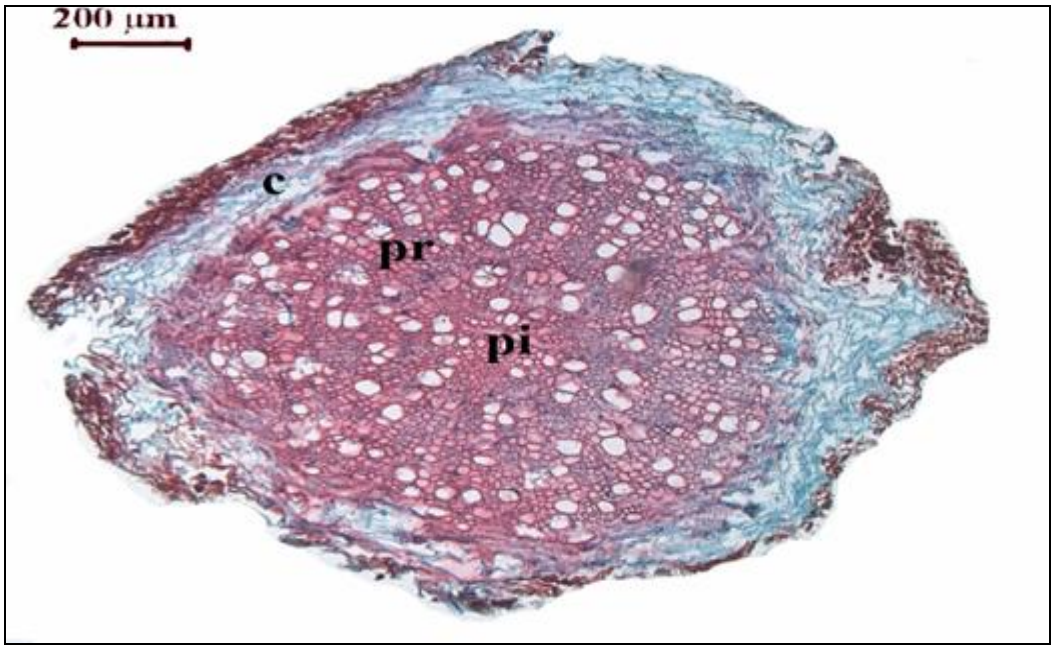

Figure 10. The transverse section of the root *V. anatolica*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

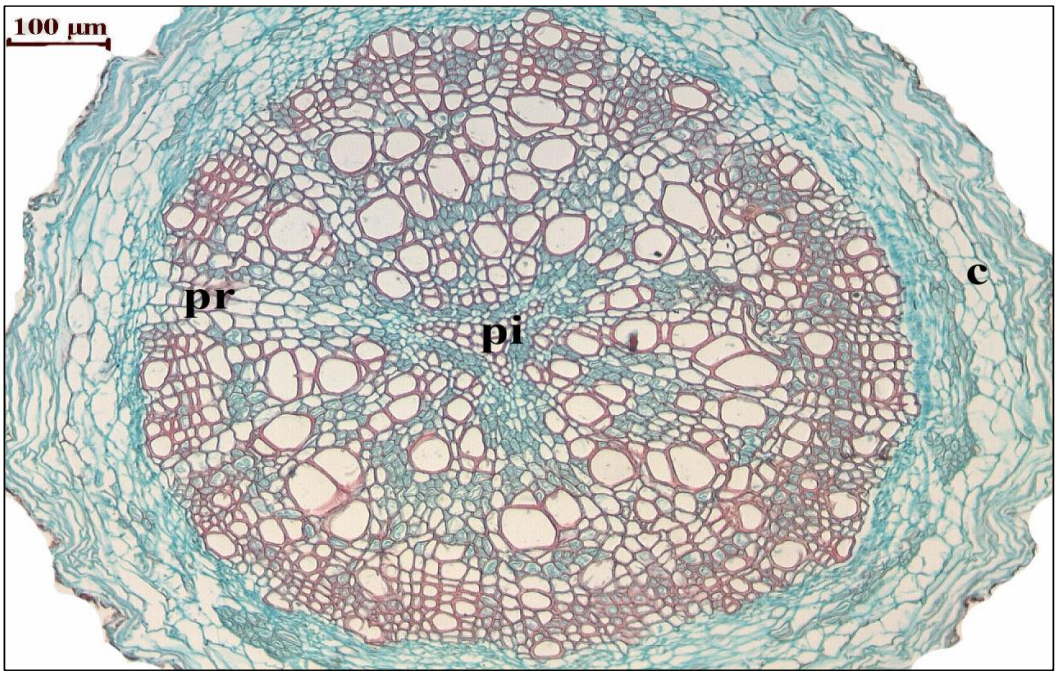

Figure 11. The transverse section of the root *V. cappadocica*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

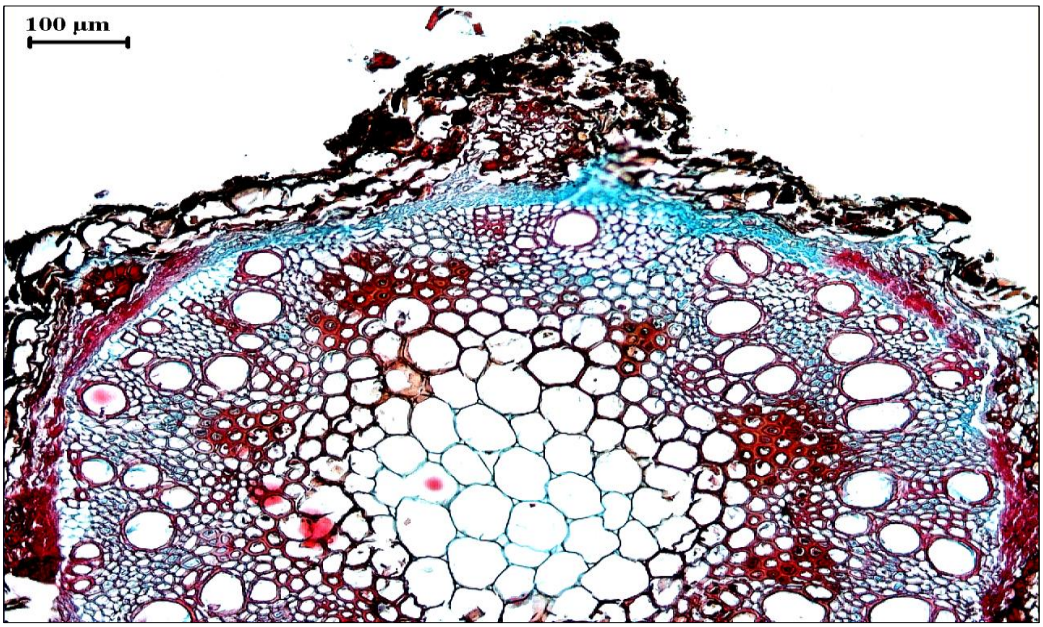

Figure 12. The transverse section of the root *V. tenuifolia* subsp. *dalmatica*, pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

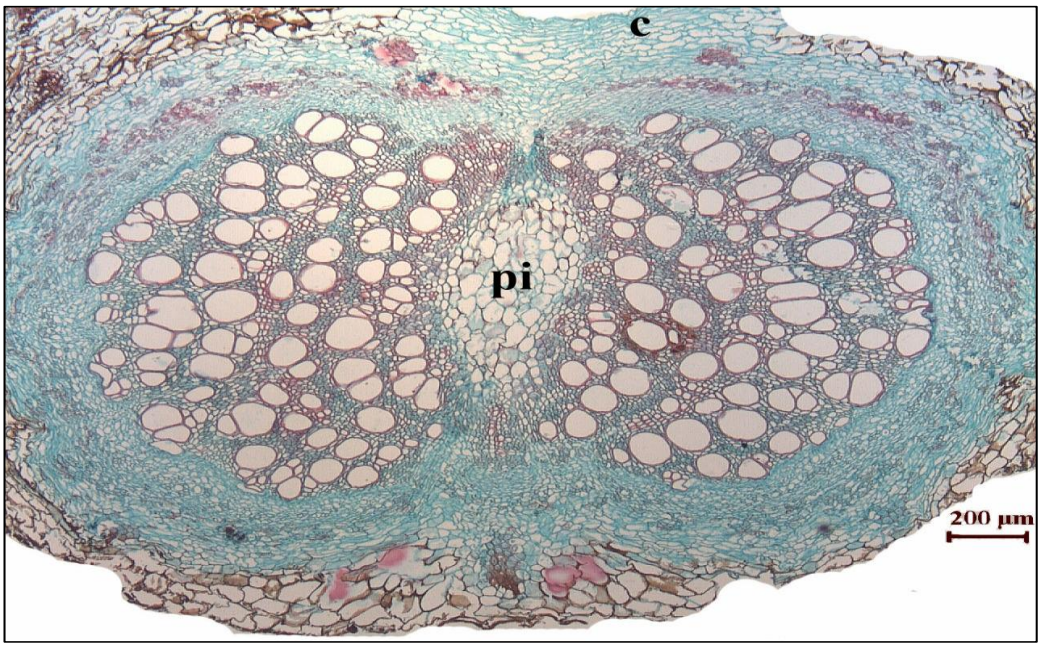

Figure 13. The transverse section of the root *V. tenuifolia* subsp. *tenuifolia*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

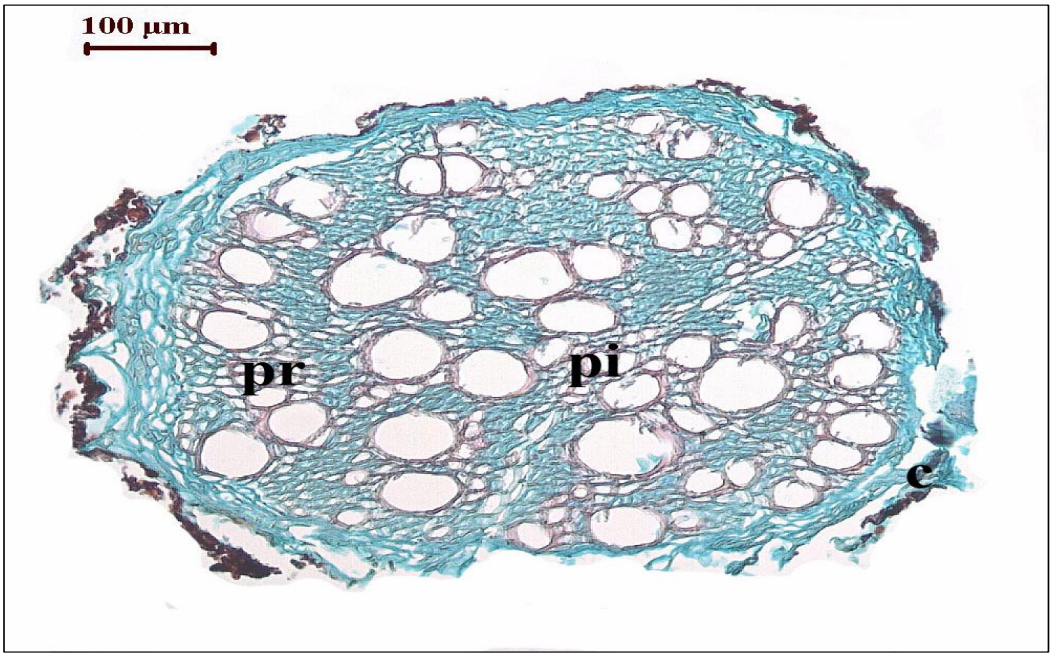

Figure 14. The transverse section of the root *V. cuspidata.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

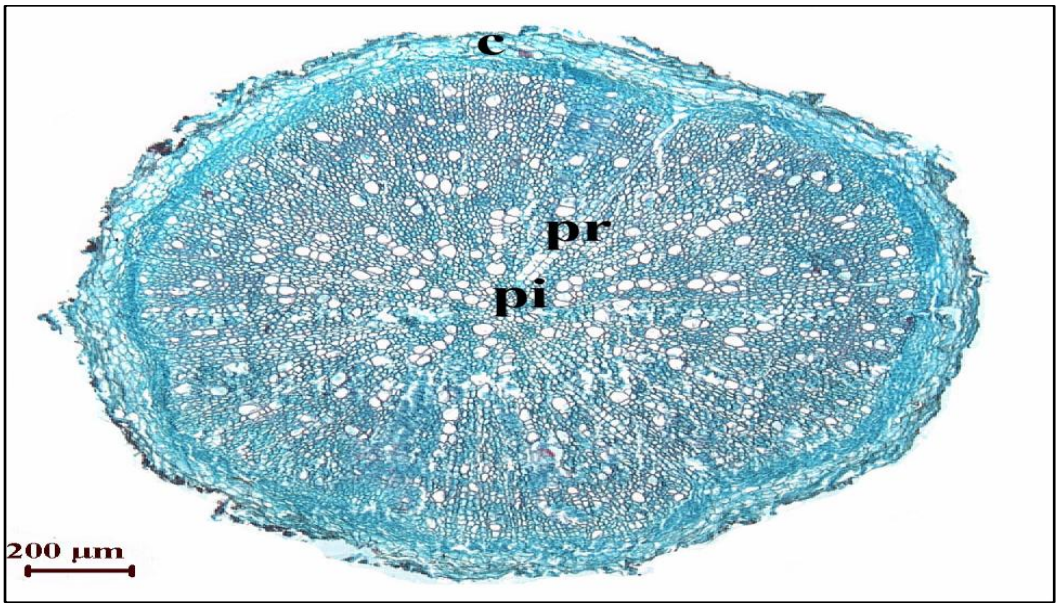

Figure 15. The transverse section of the root *V. ervilia*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

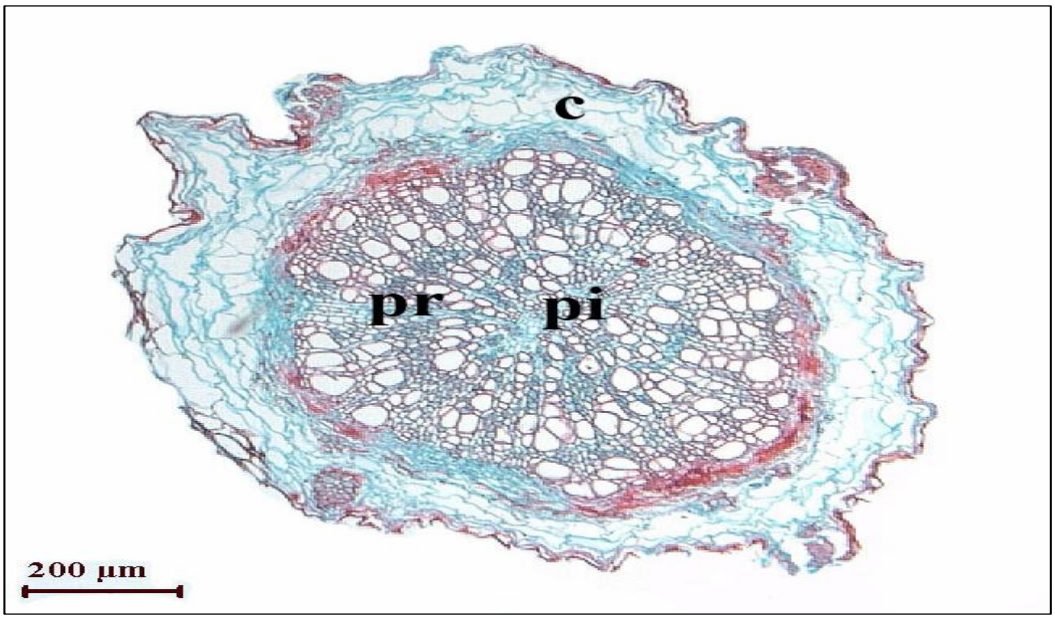

Figure 16. The transverse section of the root *V. grandiflora*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

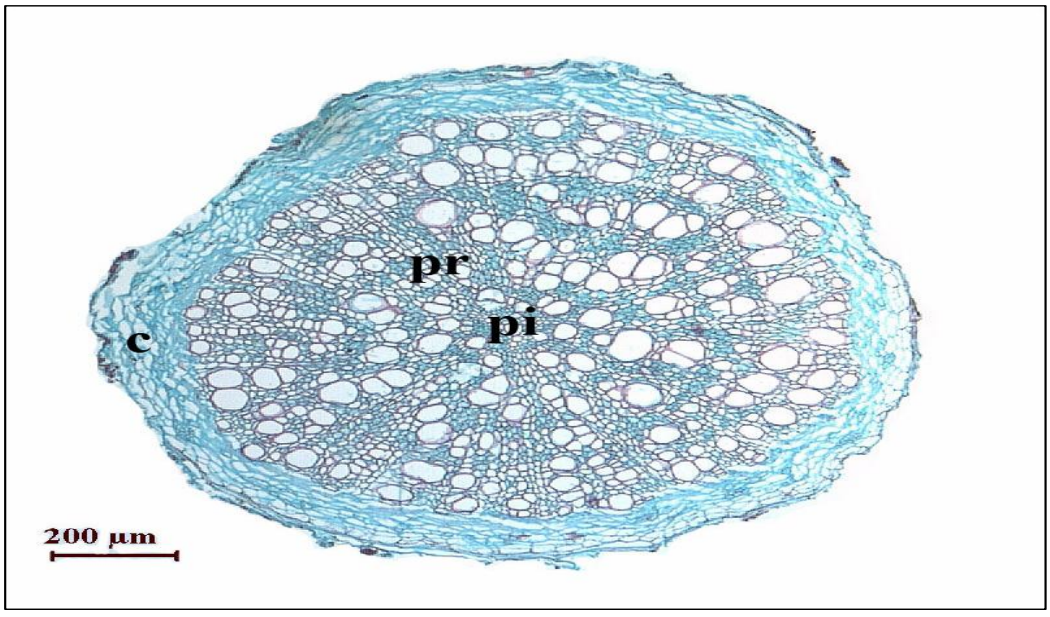

Figure 17. The transverse section of the root *V. lathyroides.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

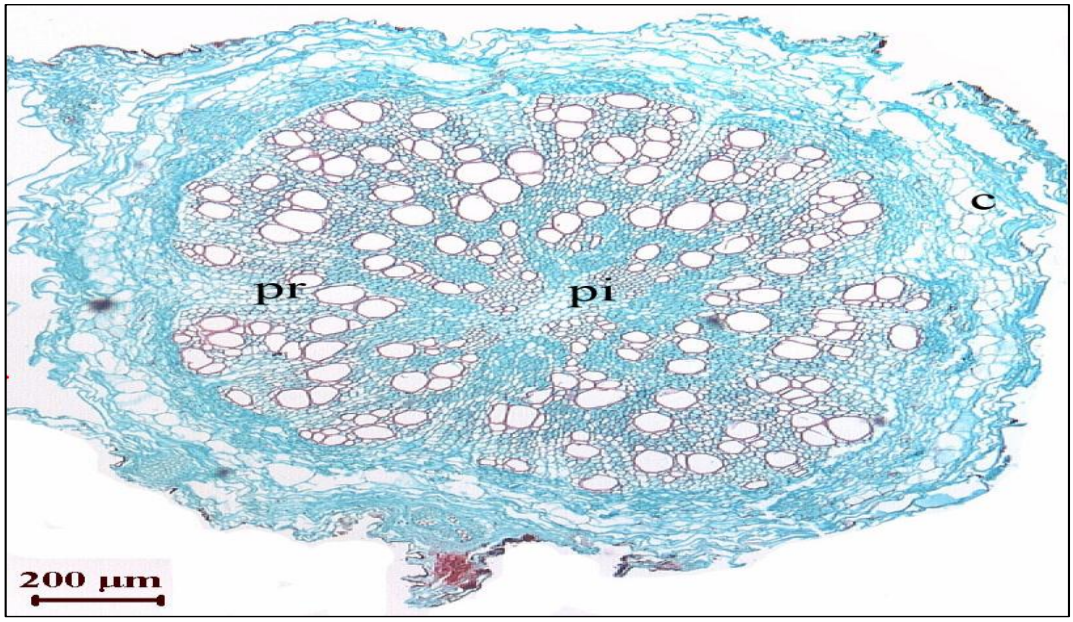

Figure 18. The transverse section of the root *V. narbonensis.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

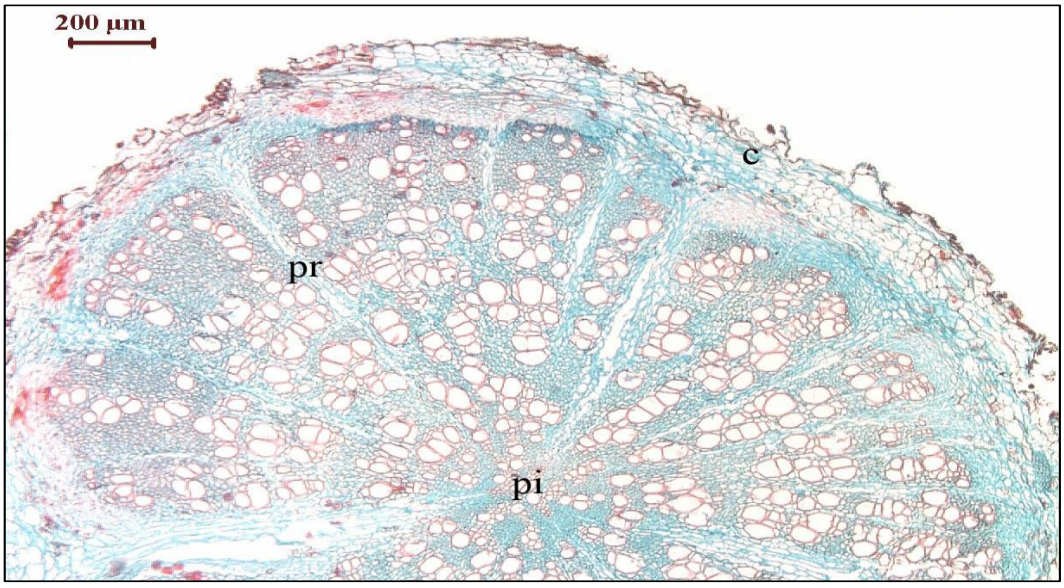

Figure 19. The transverse section of the root *V. noeana.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

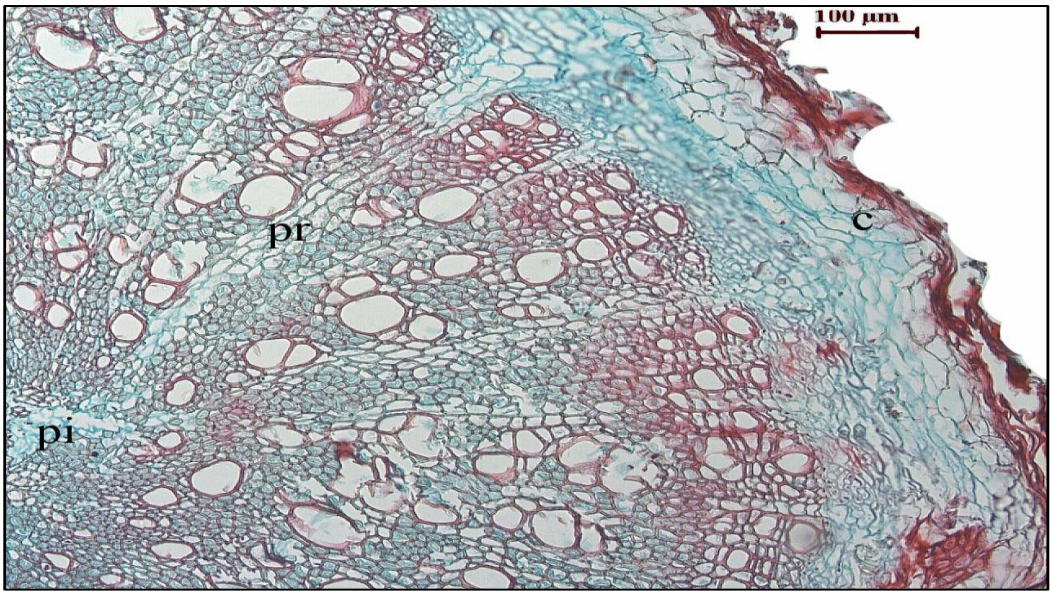

Figure 20. The transverse section of the root *V. pannonica.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

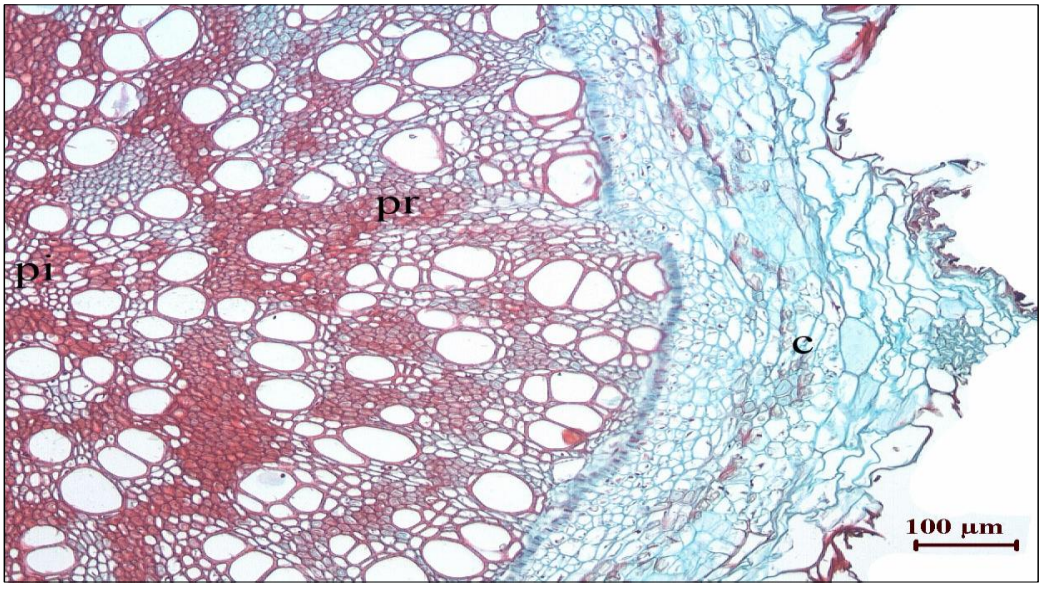

Figure 21. The transverse section of the root *V. peregrina.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

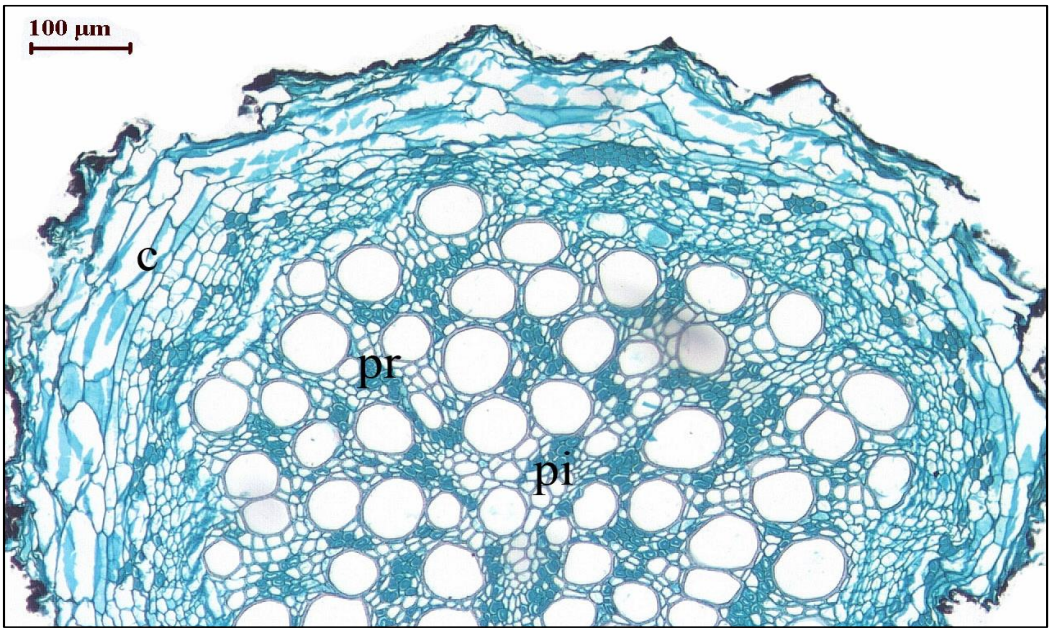

Figure 22. The transverse section of the root *V. sativa* subsp. *sativa*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

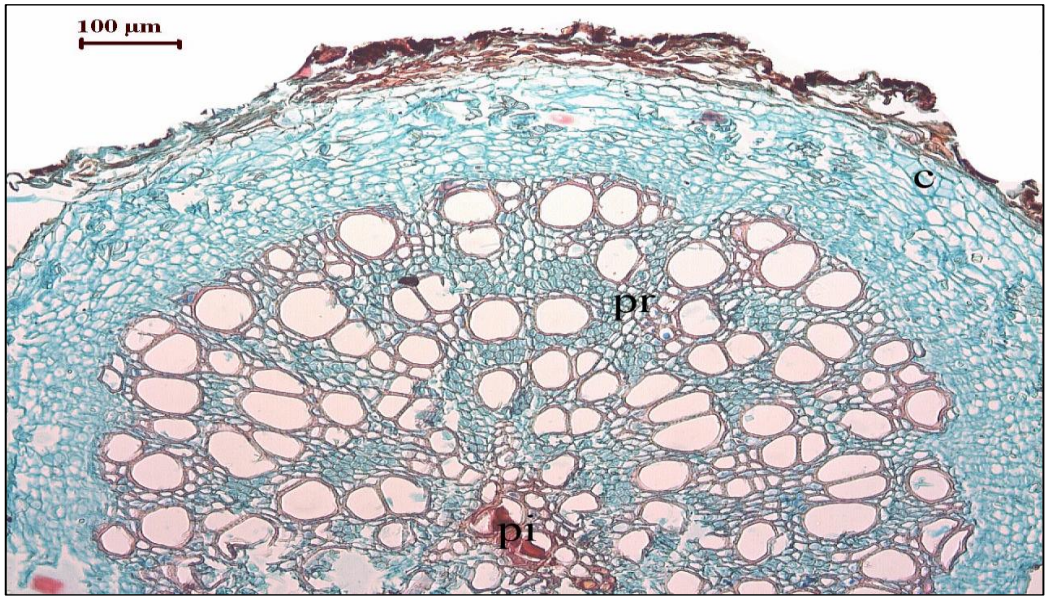

Figure 23. The transverse section of the root *V. sativa* subsp. *nigra*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

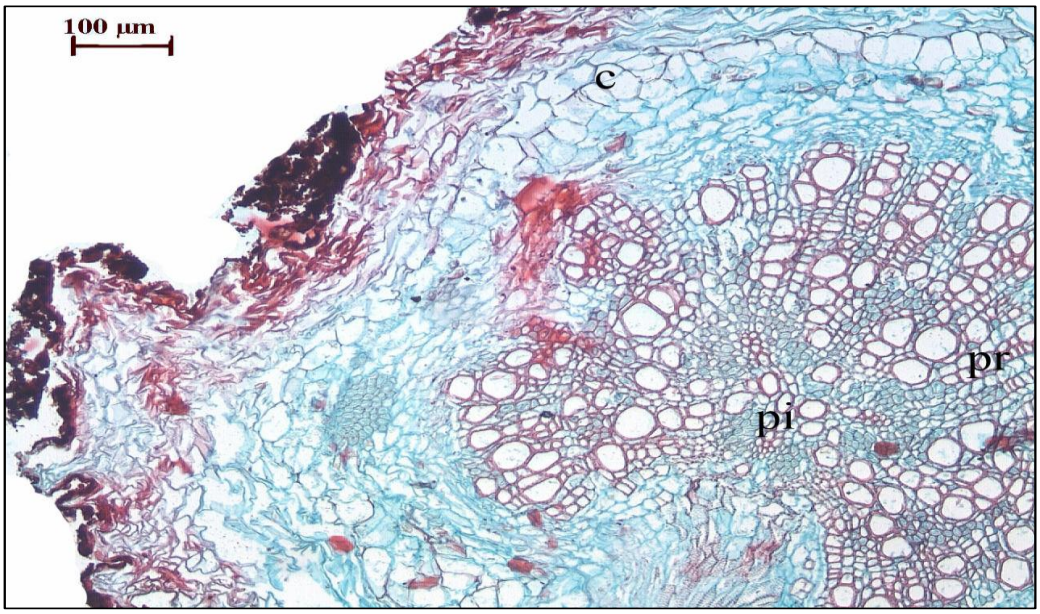

Figure 24. The transverse section of the root *V. sericocarpa.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

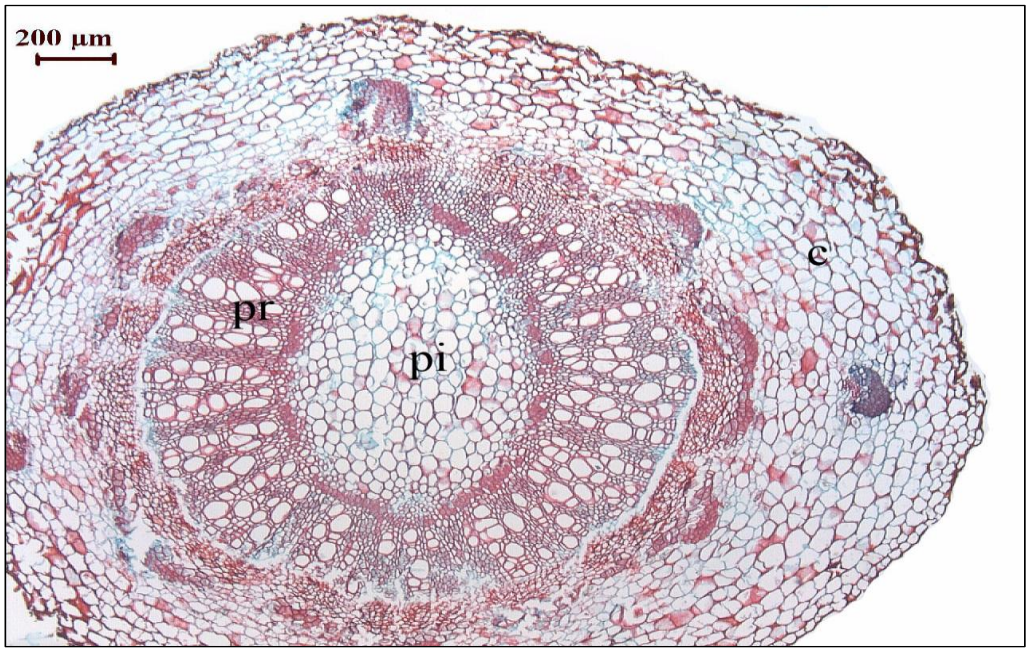

Figure 25. The transverse section of the root *V. truncatula.* pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

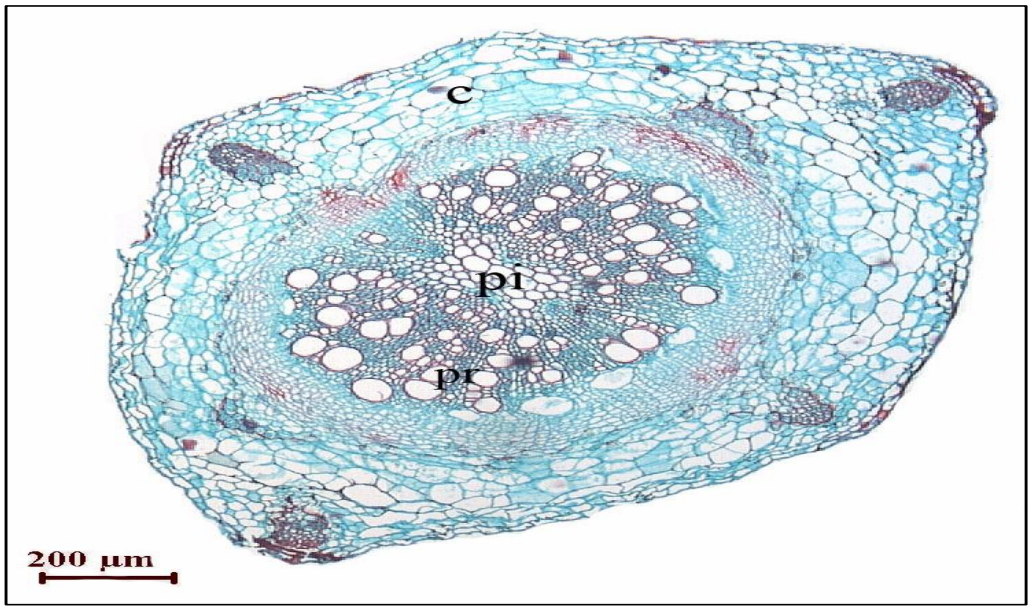

Figure 26. The transverse section of the root *V. villosa* subsp. *varia*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

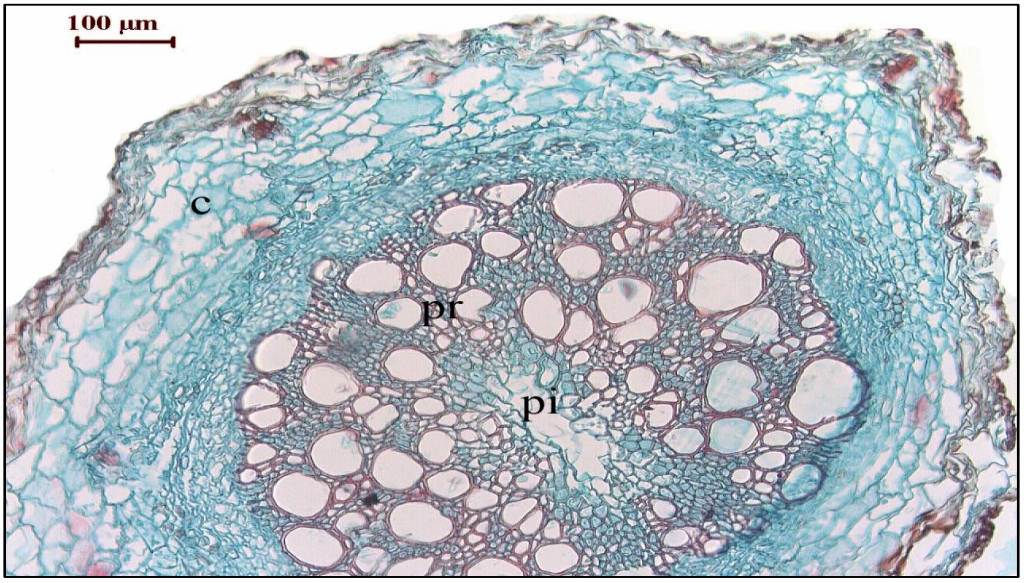

Figure 27. The transverse section of the root *V. villosa* subsp. *villosa*. pe: Periderm, c: Cortex, s: Scleranchyma, p: Phloem, x: Xylem, pr: Pith ray.

3.2.2. The Stem Anatomy (Figures 28-48, Table 11)

The stem cross-sections of *Vicia* taxa studied show that the surfaces are covered with the uniseriate epidermis, consisting of rectangular or oval cells with a cuticle. The upper and lower walls of the epidermis cells are thicker than the lateral walls. There are eglandular and glandular hairs on the epidermis of some species. The cortex is composed of one or more layers of oval and more or less rectangular parenchymatous cells. Above the phloem, many sclerenchymatous cells are present. They are found as more developed groups above larger vascular bundles. The pith consists of large hexagonal or orbicular parenchymatic cells, forming small intercellular spaces. Several species, such as *V. narbonensis* and *V. sativa*, have a large hole in the centre of the stem.

The members of sect. *Narbonensis*, including *V. narbonensis* and *V. galilaea* have greater cell size structure in the stem crossections. Epidermis is noticeably different than the other sections. The width and length measurements of the epidermal cell of sect. *Hypechusa* are similar to each other (Table 11). Besides the leaf and root measurement differences in *V. truncatula*, there are also differences in the stem measurements. Epidermal cell sizes, tracheal cell diameter, pith cell diameter are great in this taxa.

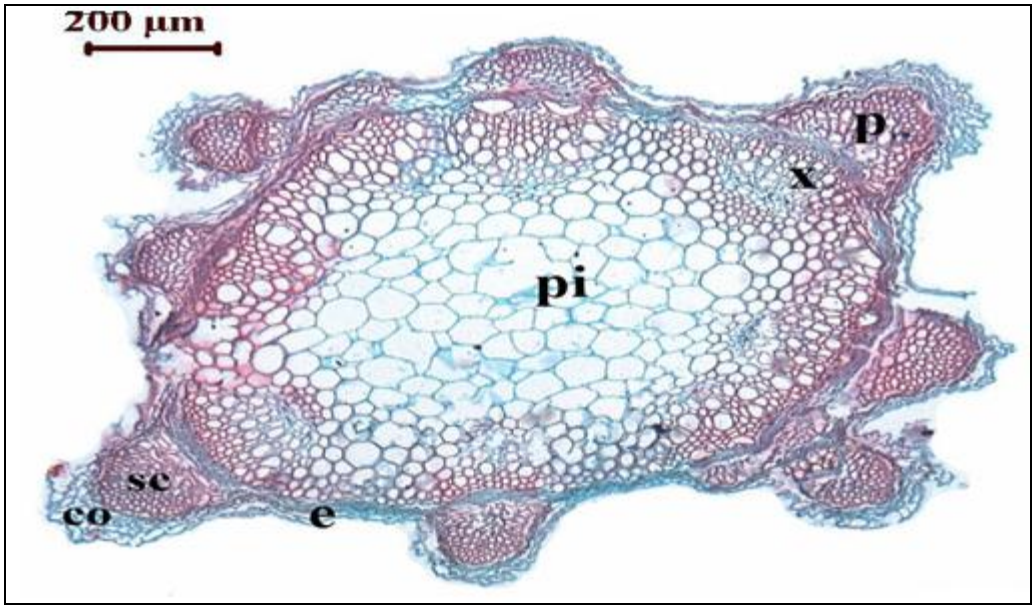

Figure 28. The transverse section of the stem of the *V. anatolica*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

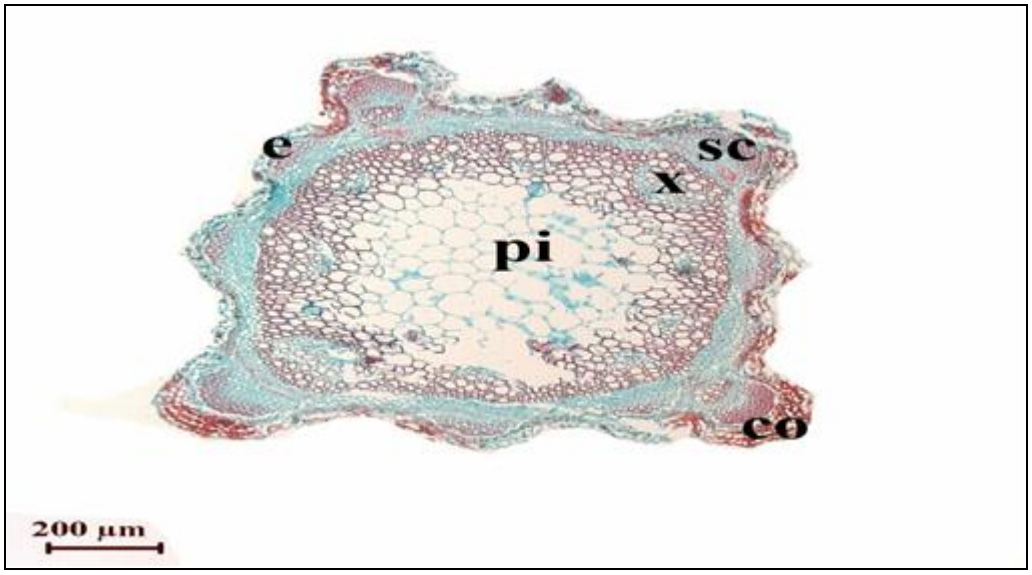

Figure 29. The transverse section of the stem of the *V. caesarea*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

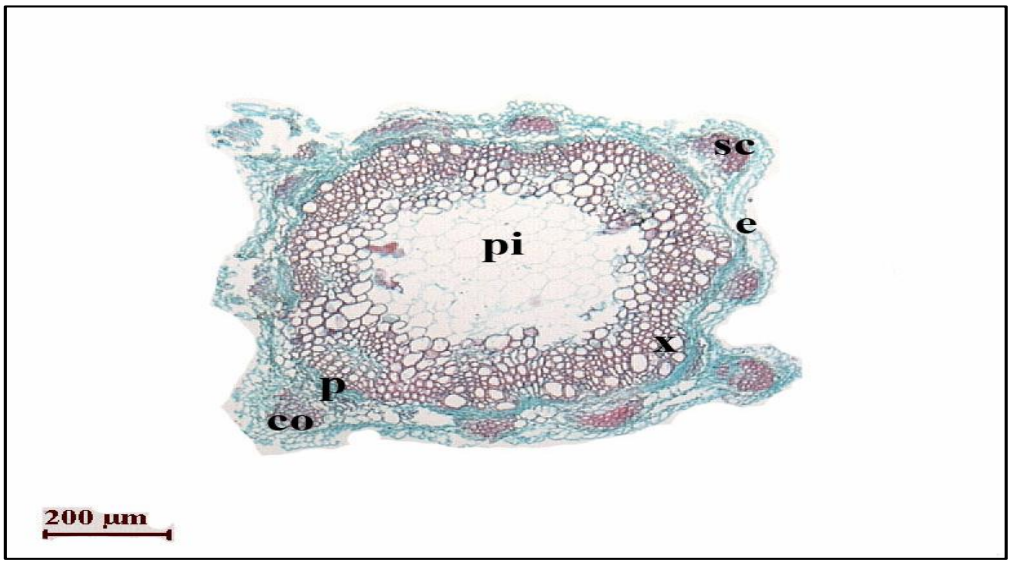

Figure 30. The transverse section of the stem of the *V. cappadocica*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

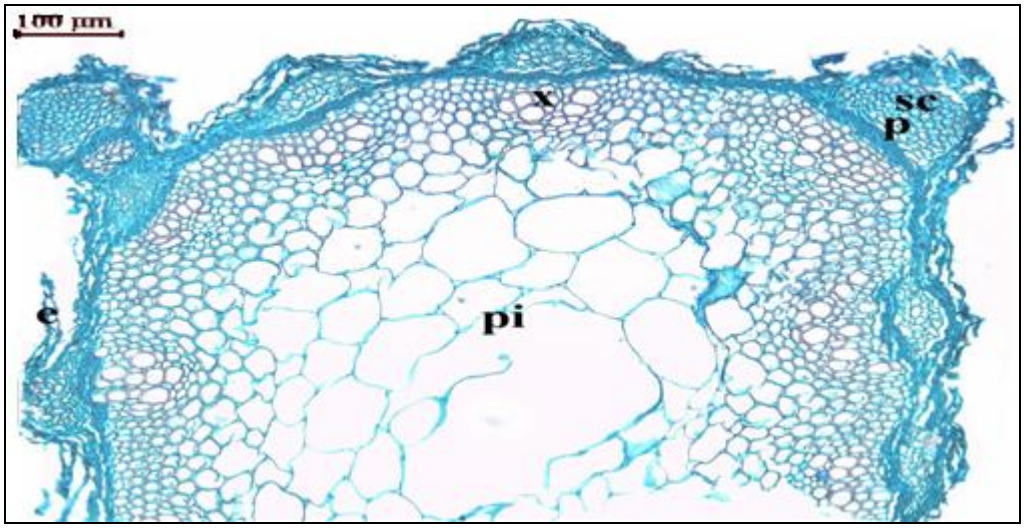

Figure 31. The transverse section of the stem of the *V. cassubica*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

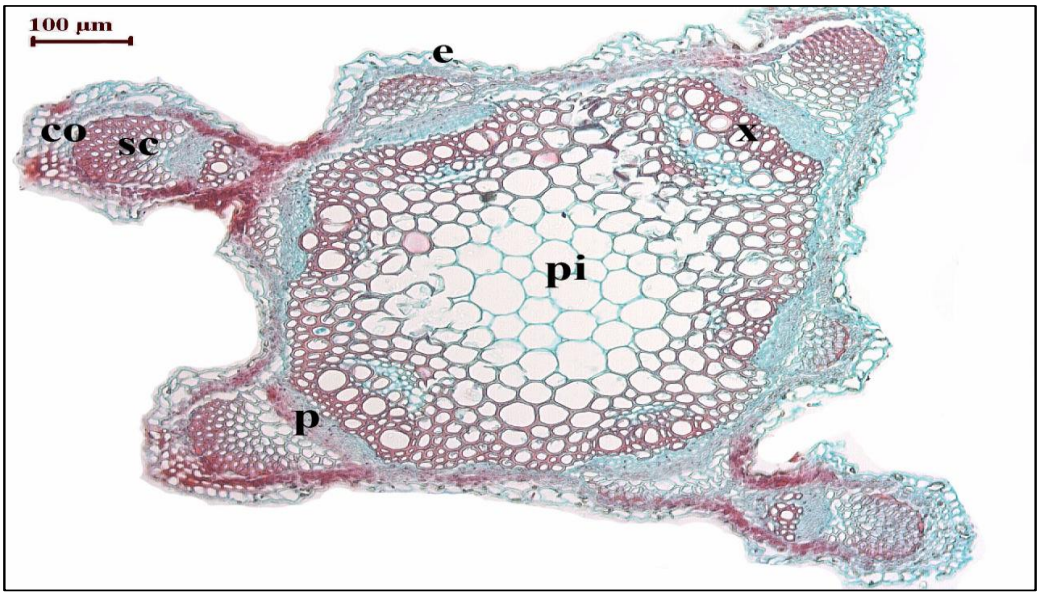

Figure 32. The transverse section of the stem of the *V. tenuifolia* subsp. *dalmatica*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

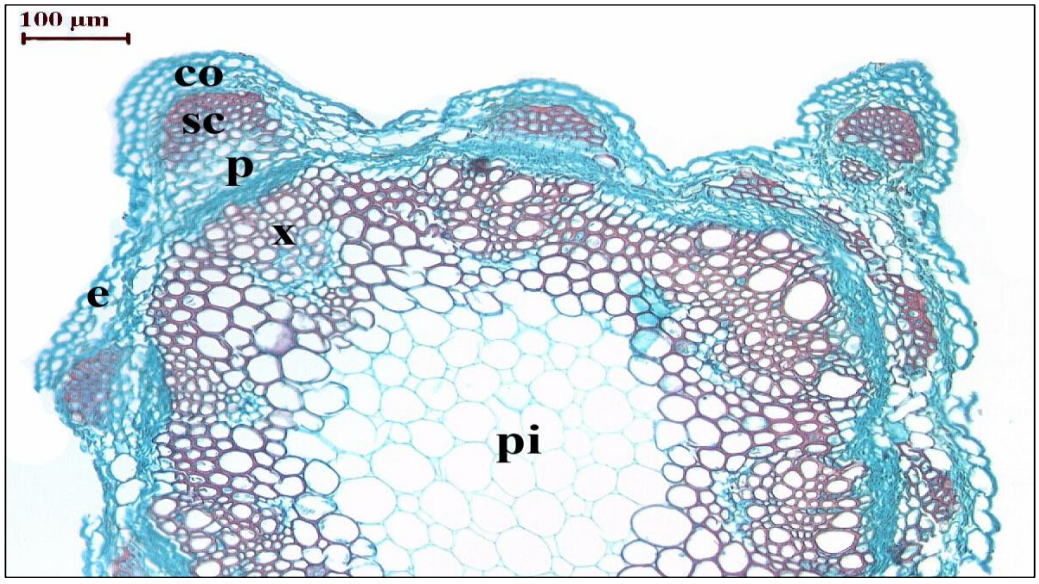

Figure 33. The transverse section of the stem of the *V. tenuifolia* subsp. *tenuifolia*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

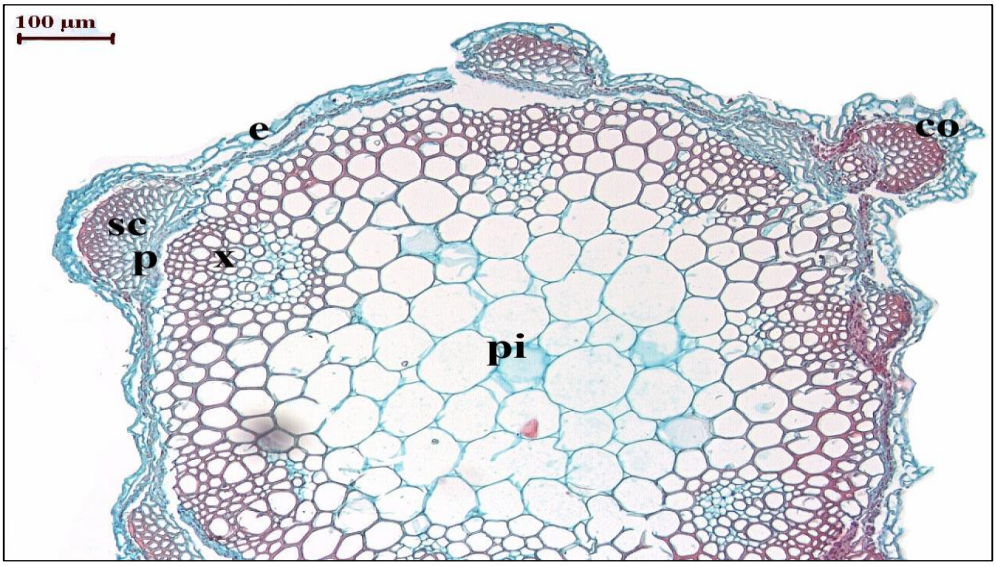

Figure 34. The transverse section of the stem of the *V. cuspidata*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

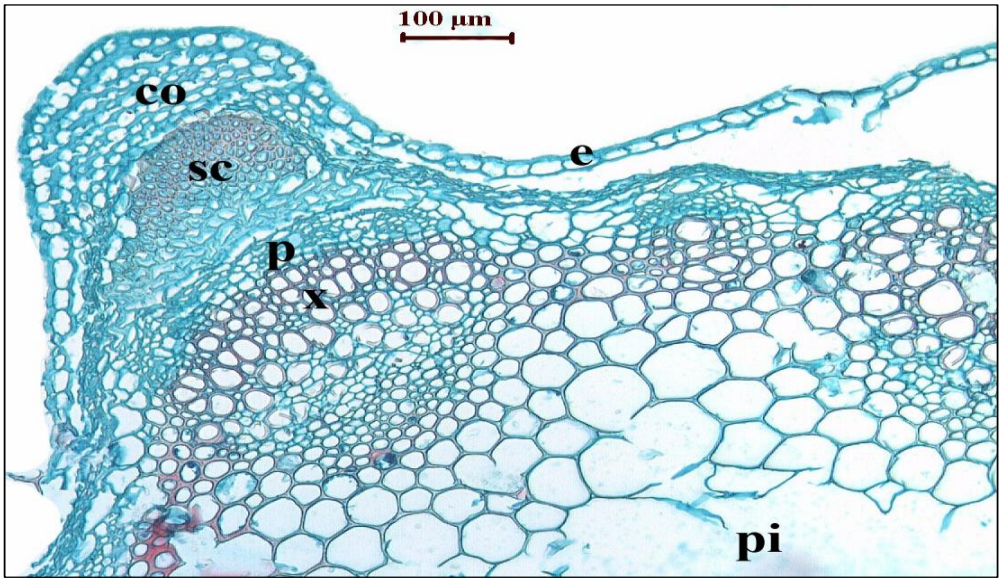

Figure 35. The transverse section of the stem of the *V. ervilia*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

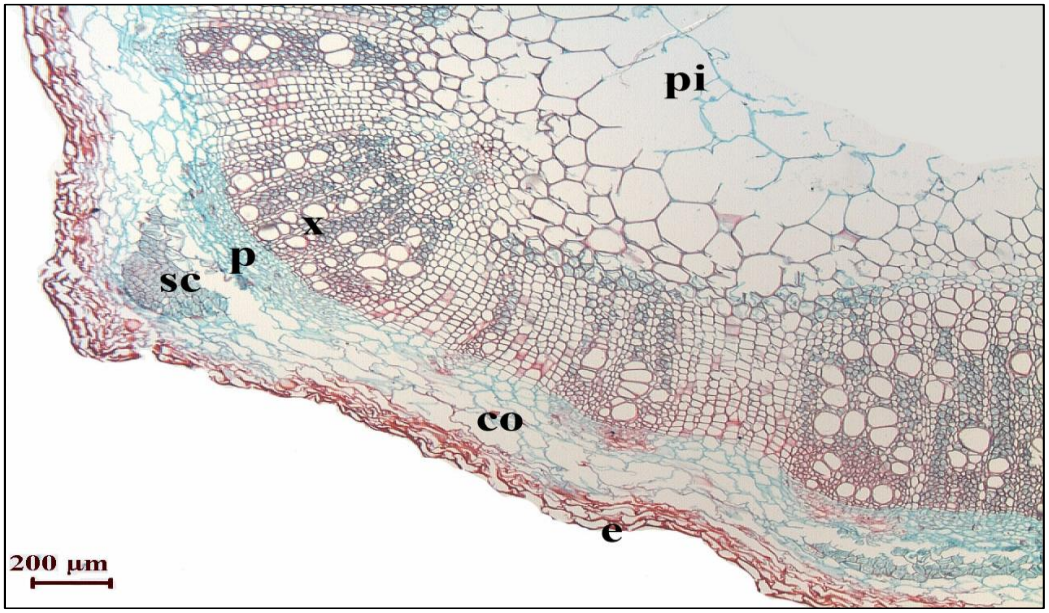

Figure 36. The transverse section of the stem of the *V. galilaea*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

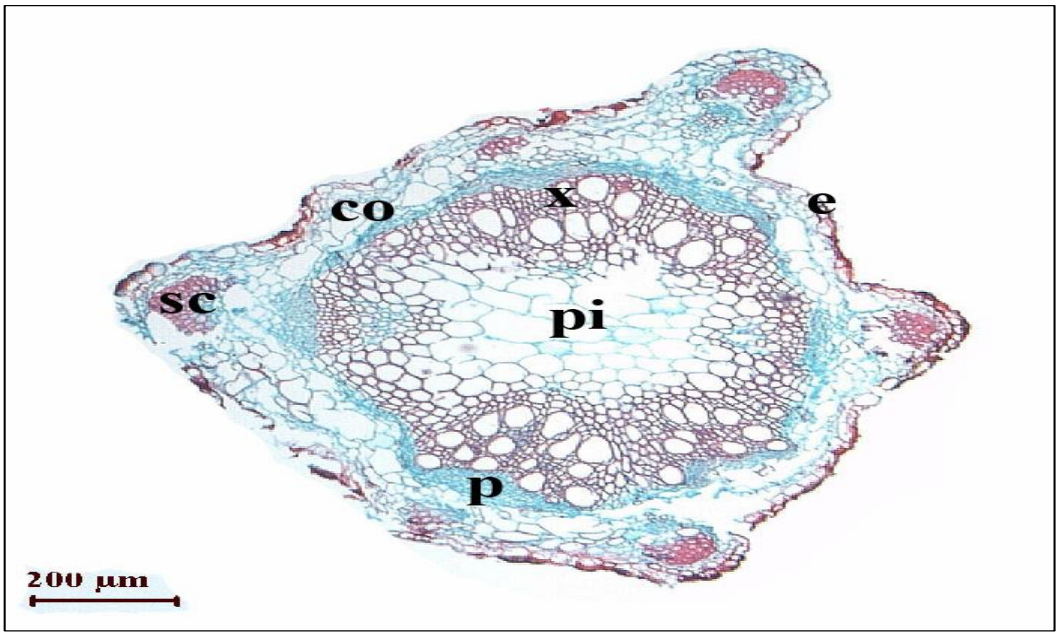

Figure 37. The transverse section of the stem of the *V. grandiflora*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

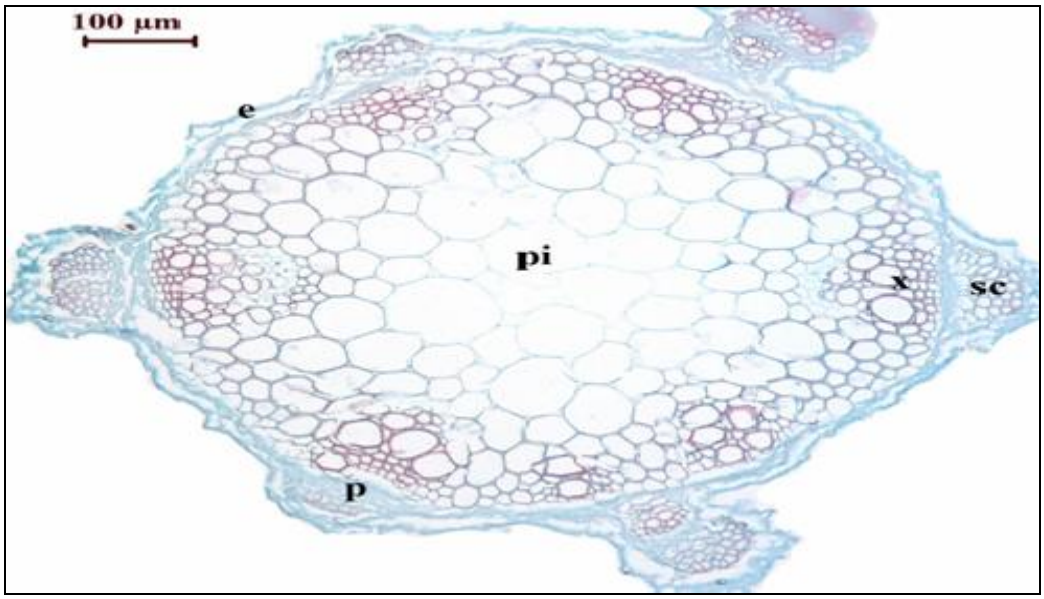

Figure 38. The transverse section of the stem of the *V. lathyroides*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

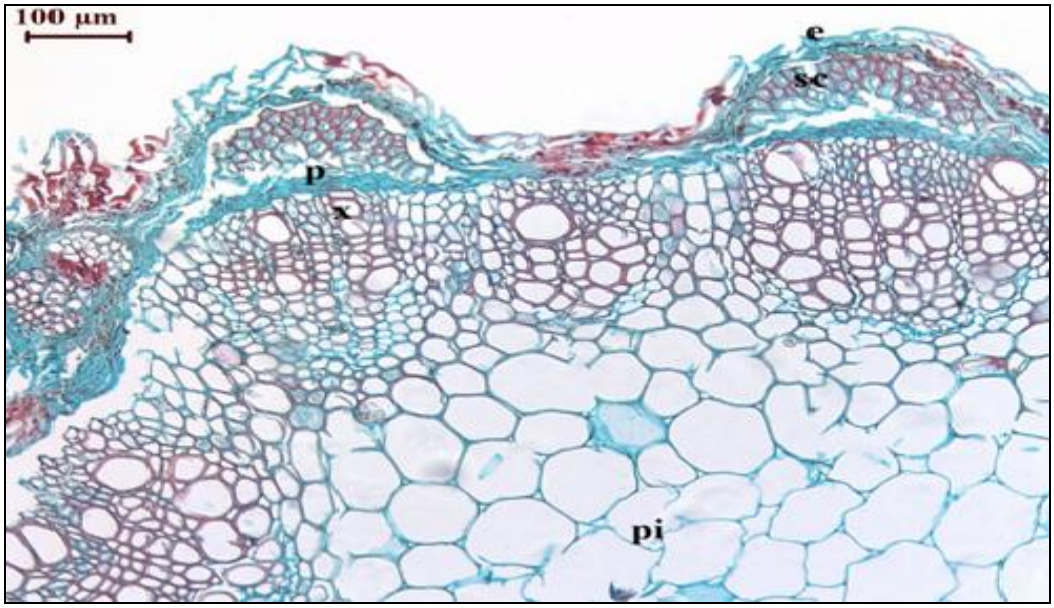

Figure 39. The transverse section of the stem of the *V. narbonensis*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

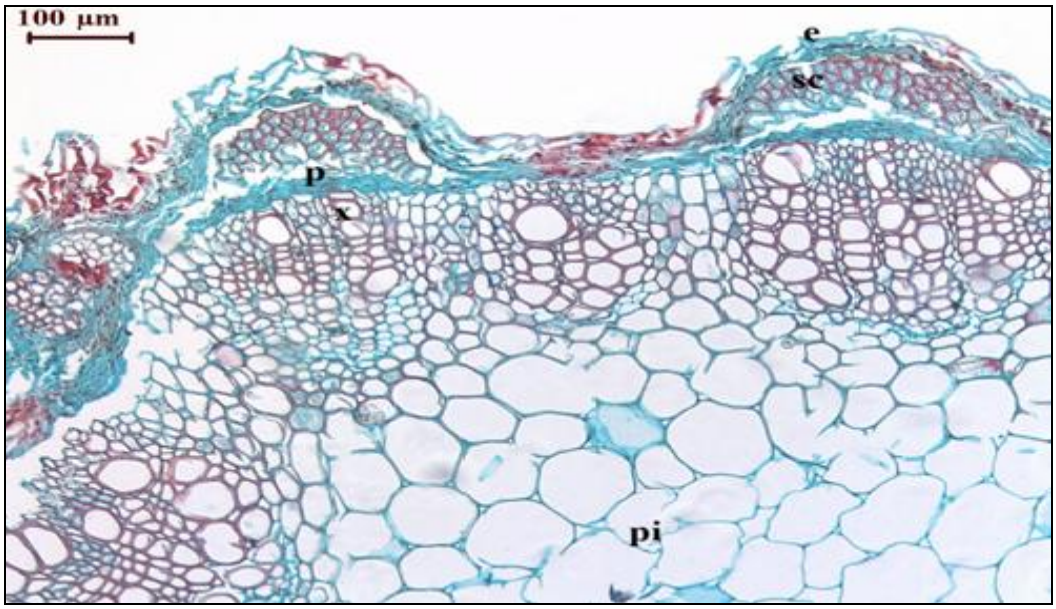

Figure 40. The transverse section of the stem of the *V. noeana*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

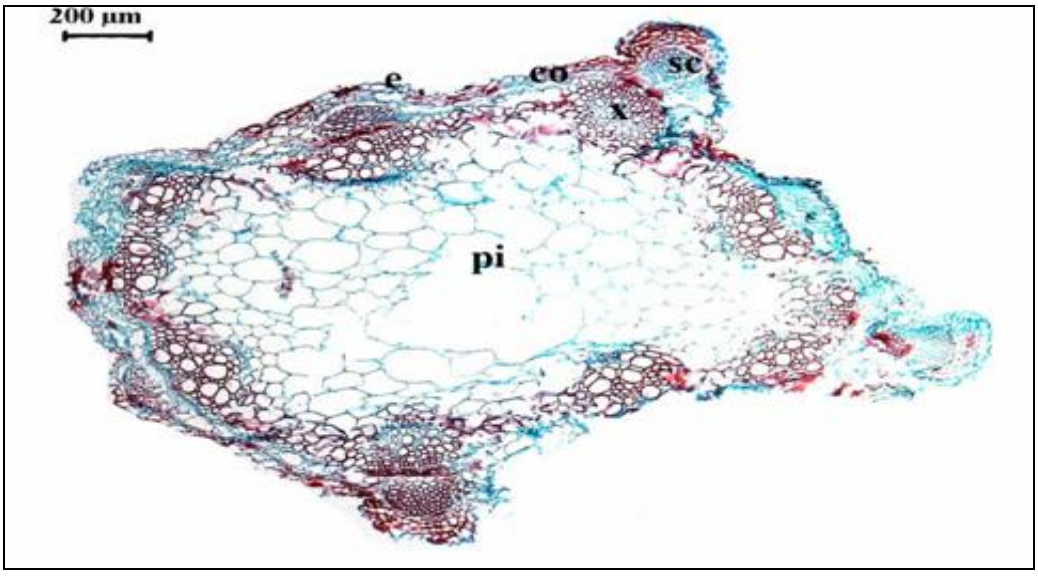

Figure 41. The transverse section of the stem of the *V. pannonica*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

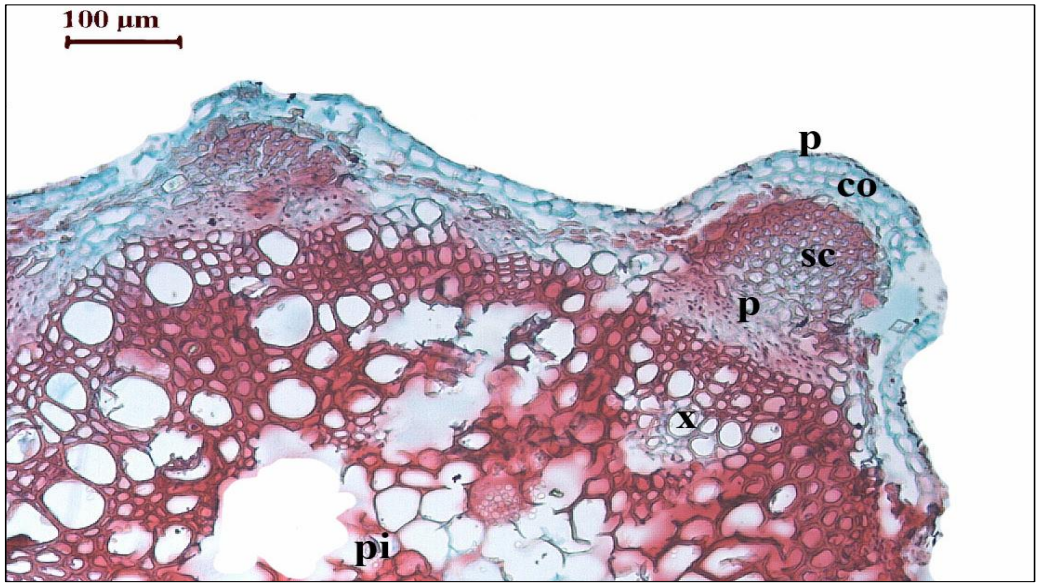

Figure 42. The transverse section of the stem of the *V. peregrina*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

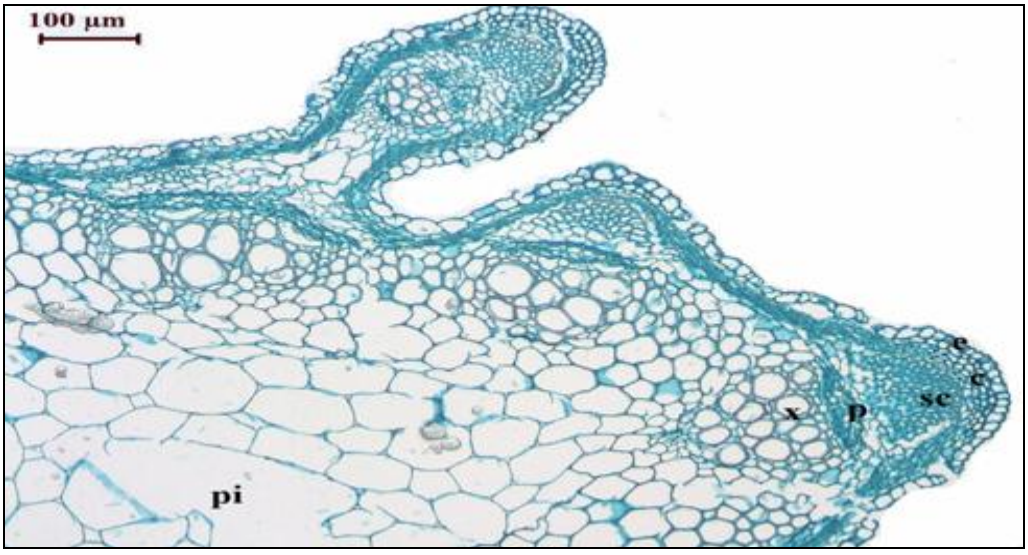

Figure 43. The transverse section of the stem of the *V. sativa* subsp. *sativa* e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

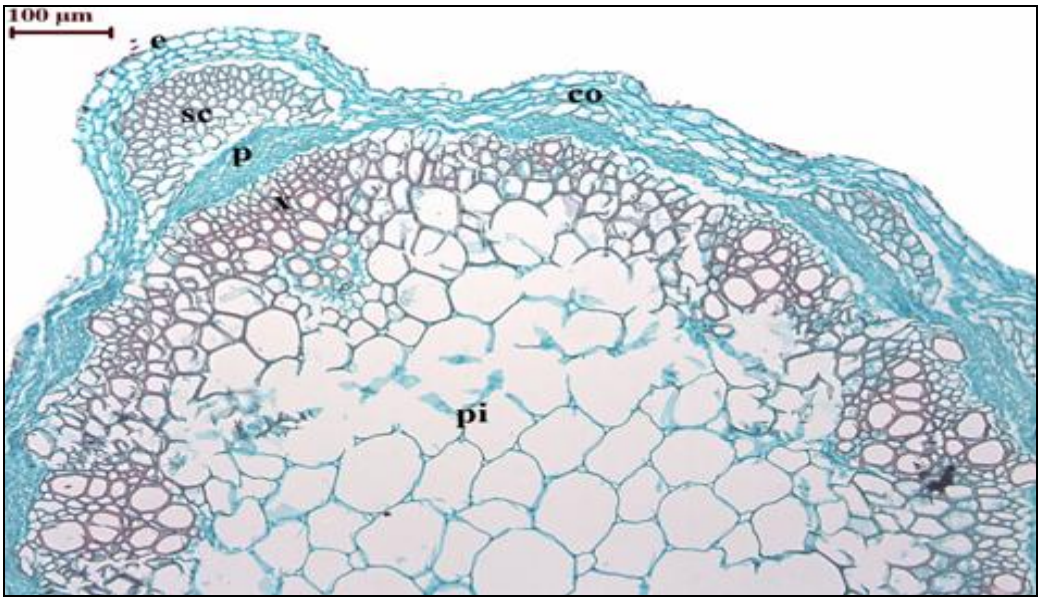

Figure 44. The transverse section of the stem of the *V. sativa* subsp. *nigra*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

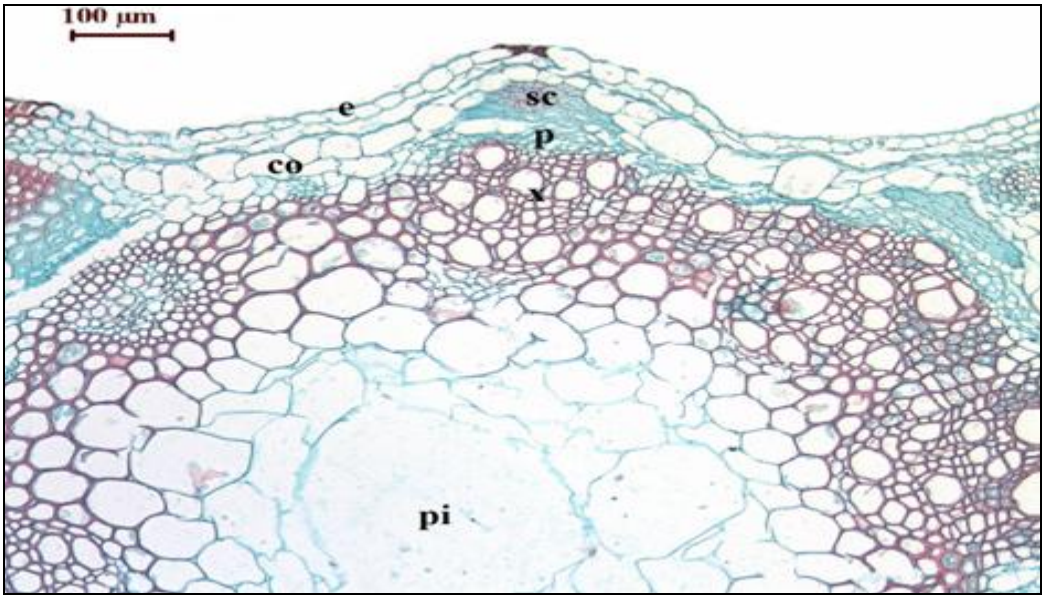

Figure 45. The transverse section of the stem of the *V. sericocarpa*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

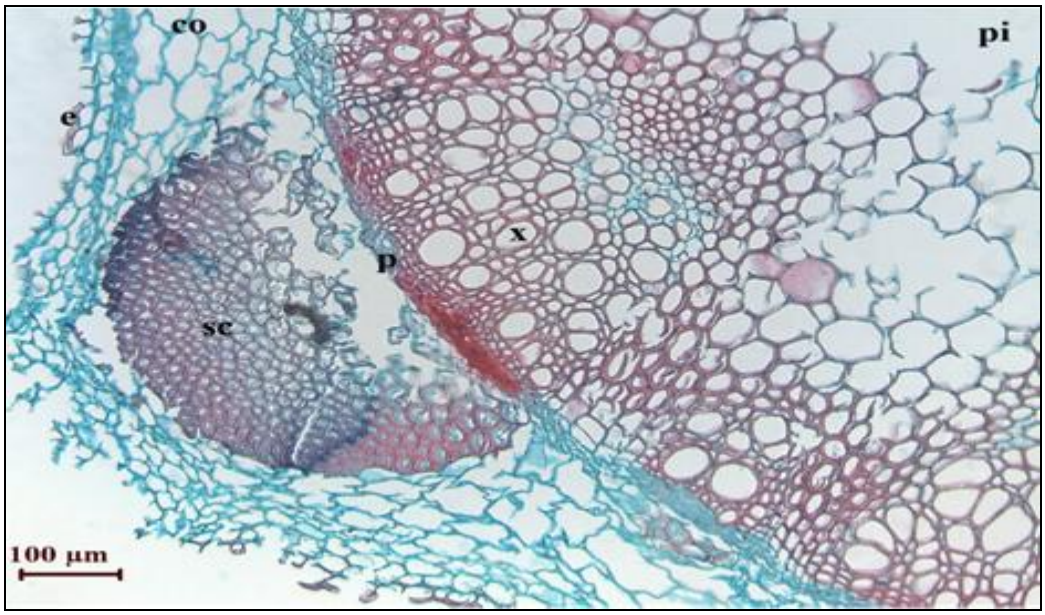

Figure 46. The transverse section of the stem of the *V. truncatula*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

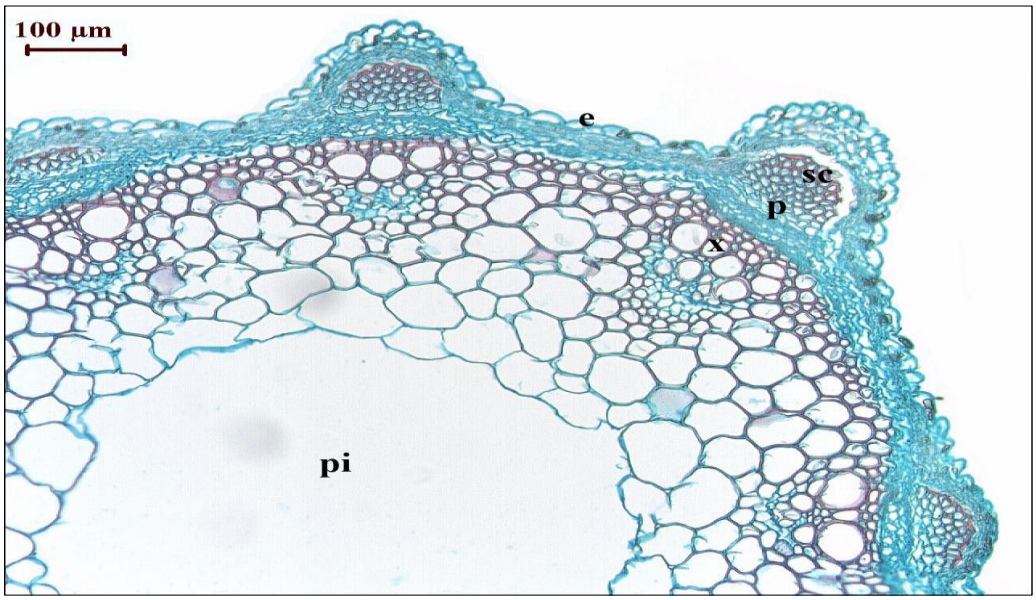

Figure 47. The transverse section of the stem of the *V. villosa* subsp. *varia*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

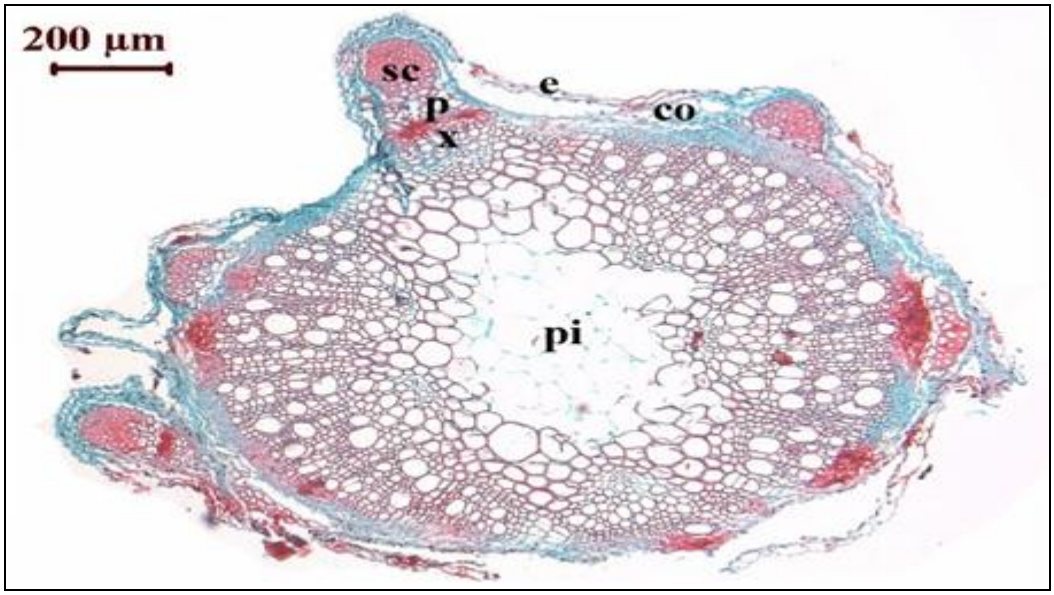

Figure 48. The transverse section of the stem of the *V. villosa* subsp. *villosa*. e: Epidermis, co: Collenchyma, c: Cortex, s: Scleranchyma, p: phloem, x: Xylem, pi: Pith region.

3.2.3. The Leaf Anatomy (Figures 49-54, Table 12)

The leaf cross-sections of *Vicia* taxa studied shows that the upper and lower epidermises are made up of uniseriate, isodiametric, oval or rectangular cells with a cuticle. Cells of the upper epidermis are equal to or wider than those of the lower epidermis. The leaf is amphistomatic and bifacial. The mesophyll consists of one layer of elongated palisade parenchymatous cells and two to four layers of nearly isodiametric spongy parenchymatous cells with large intercellular cavities. The vascular bundle is of the collateral type, occurring over a large area. Above the xylem and phloem, well-developed screnchymatous cells are present.

According to the leaf measurements; mesophyll thickness of the members of genus *Vicia* varies in length. The widest leaf measophyll (107µm) was observed in *V. villosa* subsp. v*illosa*. On the other hand, the narrowest mesophyll (24µm) was observed in the cross-section of *V. cassubica*. For the sect. *Hypechusa*, there is no correlation between the

species (*V. pannonica, V. anatolica, V. noeana*). Mesophyll widths of these species are so different from each other. However, members of the sect. *Narbonensis* have similar leaf measurement results. Mesophyll width, tracheal diameter and epidermal cell sizes are close to each other for both *V. narbonensis* and *V. galilaea*. In general, Upper and Lower epidermal cell length and width of the species have great similarity except for the members of sect. *Narbonensis* and sect. *Attosa*. *V. truncatula*, which is the member of sect. *Attosa*, is slightly different with respect to its epidermal cell length and width and mesophyll thickness.

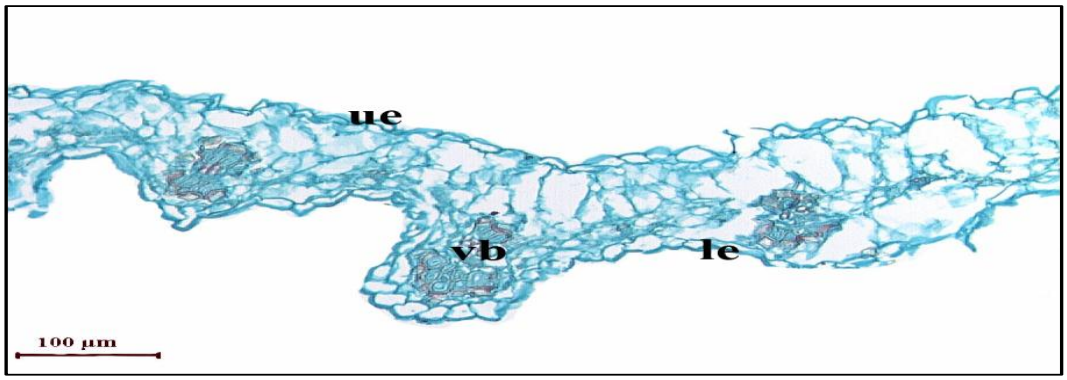

Figure 49. Leaf transverse section of the *V. ervilia*. le: lower epidermis, ue: upper epidermis, vb: Vascular bundle.

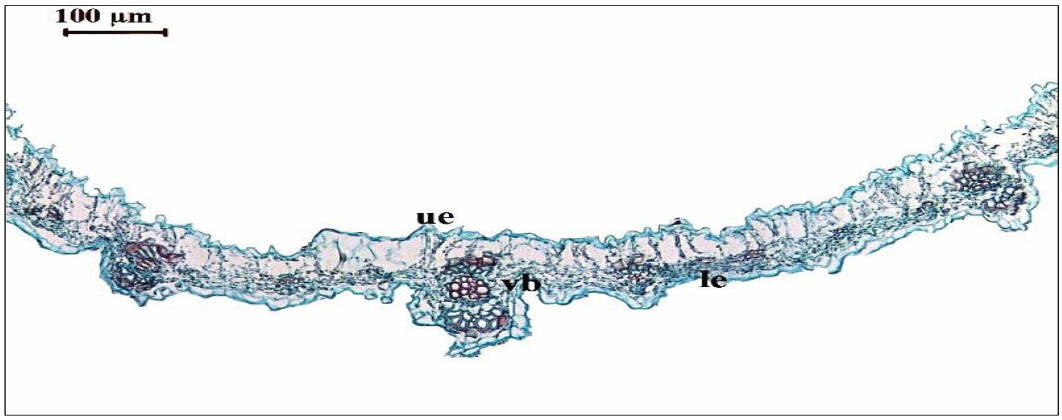

Figure 50. Leaf transverse section of the *V. cappadocica*. le: lower epidermis, ue: upper epidermis, vb: vascular bundle

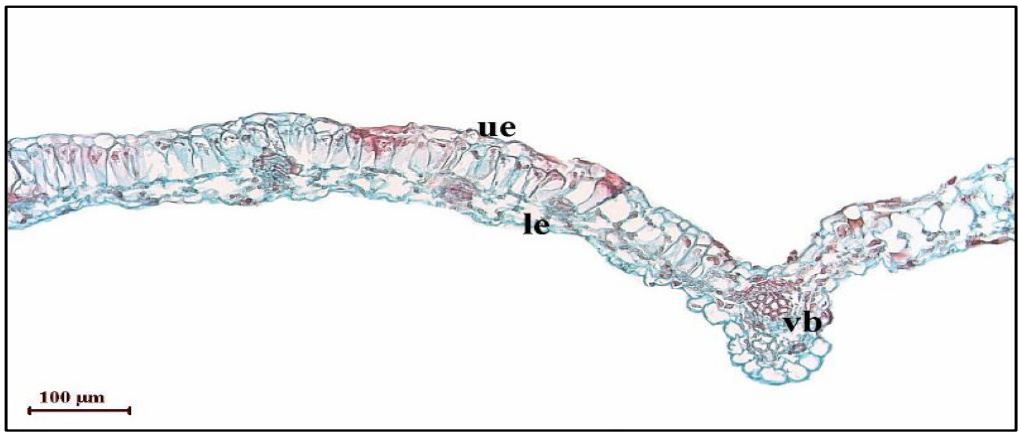

Figure 51. Leaf transverse section of the *V. grandiflora*. le: lower epidermis, ue: upper epidermis, vb: vascular bundle.

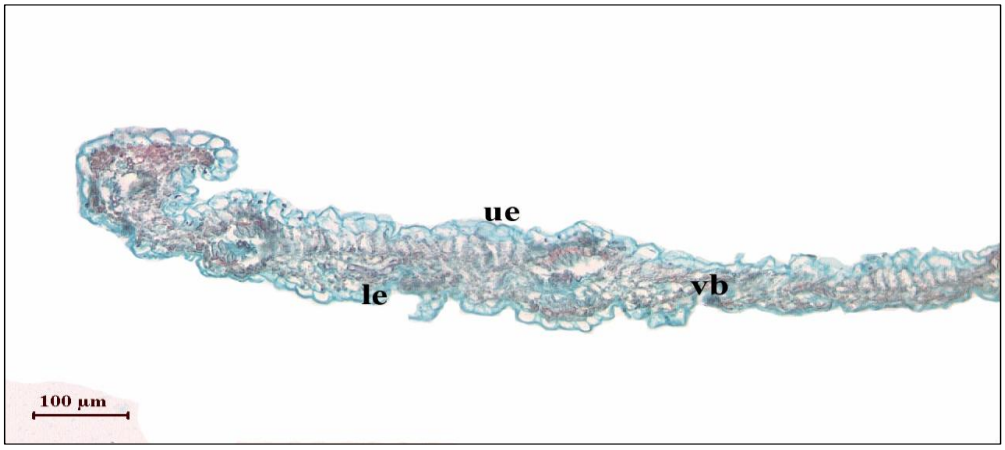

Figure 52. Leaf transverse section of the *V. pannonica*. le: lower epidermis, ue: upper epidermis, vb: vascular bundle.

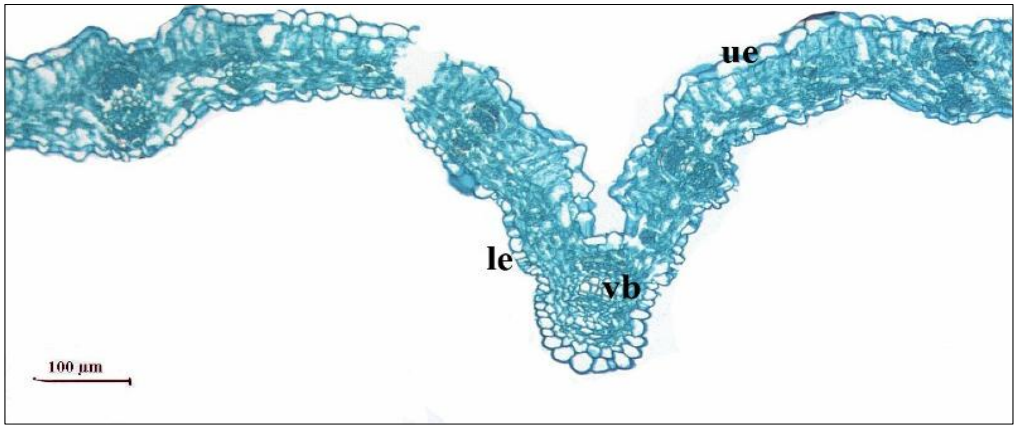

Figure 53. Leaf transverse section of the *V. sativa* subsp *nigra*. le: lower epidermis, ue: upper epidermis, vb: vascular bundle.

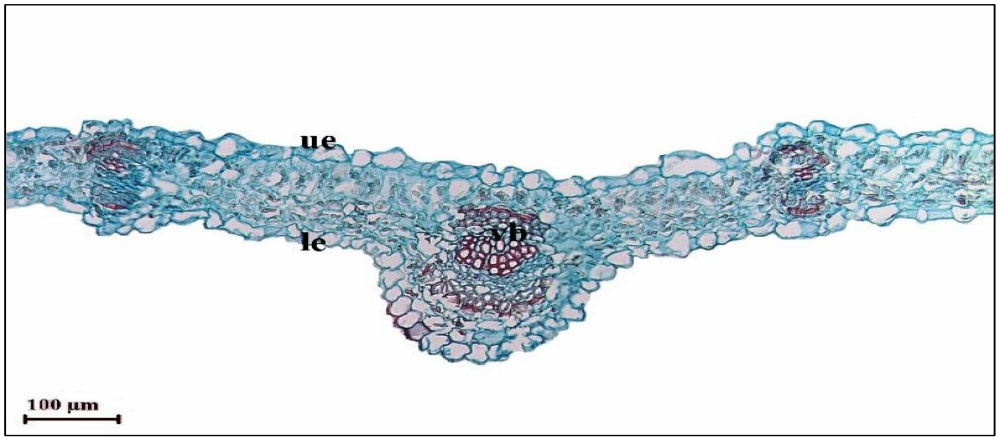

Figure 54. Leaf transverse section of the *V. truncatula*. le: lower epidermis, ue: upper epidermis, vb: vascular bundle.

Table 11. Measured anatomical characters of the stem and root of the taxa. Numbers refer to mean±standart deviation. All sizes are in µm.

	Stem anatomy (µm)				Root anatomy (µm)		
	Epidermis length	Epidermis width	Tracheal cell diameter	Pith cell diameter	Number of pith ray	Tracheal cell diameter	Pith diameter
V. anatolica	17,81 ± 3,02	9,89±2,46	23,96±3,89	46,07±4,45	2-4	29,39±3,73	235µm
V. caesarea	12,08±1,89	6,22±0,99	10,94±2,36	25,51±2,07	2	43,93±2,64	165µm
V. cappadocica	11,30±2,12	6,58±0,99	13,33±1,26	23,39±3,49	2	32,11±3,20	164µm
V. cassubica	17,43±4,40	6,91±2,05	13,98±3,82	40,03±5,16	x	x	x
V. tenuifolia subsp. *V tenuifolia*	14,06±2,95	7,35±1,99	17,76±3,22	34,98±6,39	x	42,38±3,99	447µm
V. tenuifolia subsp. *V.dalmatica*	14,05±3,01	7,03±1,68	17,02±3,21	34,37±5,90	x	65,58±5,47	345µm
V. cuspidata	16,71±2,44	8,81±1,59	19,53±3,19	47,74±3,80	x	36,88±3,14	79µm
V. ervilia	16,17±5,37	10,90±2,37	16,30±2,89	43,91±4,91	2-3	25,26±2,34	113µm
V. galilaea	52,06±6,04	27,38±3,12	39,84±3,17	74,30±6,76	x	x	x
V. grandiflora	17,85± 3,52	10,30±2,85	25,93±3,41	56,56±5,39	1-3	29,76±3,93	71µm
V. lathyroides	14,57±3,48	6,03±0,71	27,30±4,43	47,55±5,25	2-3	40,41±3,05	141µm
V. narbonensis	47,77±5,22	20,05±1,56	43,22±4,29	75,61±5,44	4-6	50,75±4,01	247µm
V. noeana	20,30±1,00	8,44±2,01	28,04±3,75	57,69±4,46	5	48,27±3,42	318µm
V. pannonica	20,18±3,50	9,84±2,78	31,00±3,04	56,19±7,00	2-3	45,69±5,39	313µm
V. peregrina	17,84±3,73	10,45±1,83	24,34±3,52	40,77±4,52	4	41,20±3,90	189µm
V. sativa	15,67±3,53	10,42±2,01	24,91±3,78	49,08±5,99	2	50,02±3,20	x
V. sativa subsp. *nigra*	24,56±3,56	10,15±2,59	24,12±3,37	57,08±4,83	4	43,51±3,75	x
V. sericocarpa	17,49±3,35	14,05±2,17	25,29±3,26	56,90±5,27	4	31,38±3,38	x
V. truncatula	23,72±3,11	12,71±2,96	38,53±3,34	63,88±6,34	5	48,12±4,37	586µm
V. villosa subsp. *varia*	16,62±5,01	10,59±2,02	32,83±5,22	45,14±7,22	4	40,14±3,78	247µm
V. villosa subsp. *villosa*	25,12±4,68	12,93±2,21	33,83±2,64	44,95±5,88	1-2	45,51±4,82	230µm

Table 12. Measured anatomical characters of the leaves of the taxa. Numbers refer to mean±standart deviation. All sizes are in µm.

	Mesophyll thickness	Tracheal cell diameter	Upper epidermis		Lower epidermis	
			Cell length	Cell width	Cell length	Cell width
V. anatolica	33,71±4,40	11,85±1,40	14,42±2,09	6,84±2,10	15,94±2,57	7,26±1,26
V. caesarea	32,54±6,69	9,24±1,24	14,12±2,47	6,59±0,73	18,66±4,40	7,90±2,18
V. cappadocica	54,02±6,44	10,22±1,03	17,49±2,38	7,71±2,07	16,77±2,54	9,45±1,85
V. cassubica	24,39±1,77	8,98±1,14	16,80±2,04	7,39±0,94	13,93±1,65	6,04±1,39
V. tenuifolia Subsp. *tenuifolia*	43,67±2,86	9,23±1,38	16,29±2,44	6,39±0,59	15,00±1,66	6,34±1,33
V. cuspidata	44,38±4,01	9,74±1,07	18,48±3,23	6,73±1,37	16,01± 3,32	6,96±1,97
V. ervilia	72,77±5,53	12,21±2,24	17,27±3,70	9,03±0,88	17,76±2,70	9,25±1,30
V. galilaea	94,02±8,75	19,57±2,57	26,40±4,74	10,83±1,87	29,95±3,44	11,12±2,12
V.grandiflora	54,21±5,24	9,51±1,94	18,28±3,86	9,87±1,67	17,43±4,01	9,58±2,33
V. lathyroides	39,38±2,31	10,09±1,27	17,33±2,62	7,60±1,67	16,93±3,56	9,41±1,31
V. narbonensis	88,59±6,71	16,38±2,46	23,44±3,91	9,24±1,84	23,14±4,34	9,51±1,51
V. noeana	87,05±5,53	9,56±1,75	15,65±2,17	7,27±2,43	15,68±1,89	7,45±1,65
V.pannonica	52,57±5,37	10,78±1,36	18,20±4,60	10,78±2,50	15,68±2,58	8,72±1,54
V.peregrina	49,57±5,25	9,62±2,02	17,61±3,41	8,90±2,02	16,86±2,86	8,78±2,16
V. sativa subsp. *nigra*	53,07±4,56	8,38±1,05	17,80±4,72	9,48±1,89	15,76±2,52	7,99±2,16
V. sericocarpa	37,92±5,48	10,22±2,42	16,58±3,11	7,33±1,72	16,15±1,96	8,21±1,92
V. truncatula	82,15±6,12	11,03±2,68	20,45±5,11	15,50±2,99	20,73±5,36	14,80±3,95
V. villosa subsp. *villosa*	107,03±4,52	8,46±1,24	17,52±2,17	6,50±1,12	17,55±1,54	6,52±1,37

3.3. Trichome Micromorphology of the *Vicia* Taxa

Three different trichome types are found on leaves and calyces of the *Vicia* taxa studied: peltate (type I), capitate glandular (type II) and non-glandular trichomes (type III) (Figures 55-58). The peltate and capitate glandular trichomes can be distinguished by head size and stalk length. The peltate trichomes appear sessile in surface view, nearly flat but with a short, usually discoid stalk cell in cross-section. The capitate trichomes has a long or short stalk and head cell. The eglandular trichomes are in turn subdivided into two subtypes on the basis of their length (1-2 celled trichomes or more) and density (rare, present or dense). The presence of the trichome types, their distribution and density on the leaves and calyces are diagnostic characters in separation of the taxa.

3.3.1. Trichomes on Leaves

1. Peltate trichomes (type I): Observed in *V. anatolica*, *V. cappadocica*, *V. grandiflora* subsp. *grandiflora*, *V. sativa*, *V. pannonica* var. *pannonica*, *V. tenuifolia* subsp. *tenuifolia*, *V. tenuifolia* subsp. *dalmatica*, *V. villosa* (Figures 55-56).

2. Capitate trichomes (type II): Observed in *V. anatolica*, *V. pannonica* var. *pannonica*, *V. sativa*, *V. tenuifolia* subsp. *tenuifolia*, *V. tenuifolia* subsp. *dalmatica*, *V. villosa* (Figures 55-56).

3. Eglandular trichomes (type III):

Subtype I: Short eglandular trichomes (1-2-celled**):** Observed in *V. grandiflora* subsp. *grandiflora* (present), *V. narbonensis* (present), *V. noeana* var. *noeana* (present), *V. peregrina* (rare), *V. sativa* (rare), *V. tenuifolia* subsp. *tenuifolia* (dense), *V. tenuifolia* subsp. *dalmatica* (dense) (Figures 55-56).

Subtype II: Long-very long eglandular trichomes (more-celled than 2): Observed in *V. anatolica* (dense), *V. caesarea* (dense), *V. noeana* var. *noeana* (present), *V. pannonica* var. *pannonica* (dense), *V. tenuifolia* subsp. *tenuifolia* (present), *V. tenuifolia* subsp. *dalmatica* (present), *V. villosa* (dense) (Figures 55-56).

There are no glandular and eglandular trichomes on the leaves of *V. ervilia*.

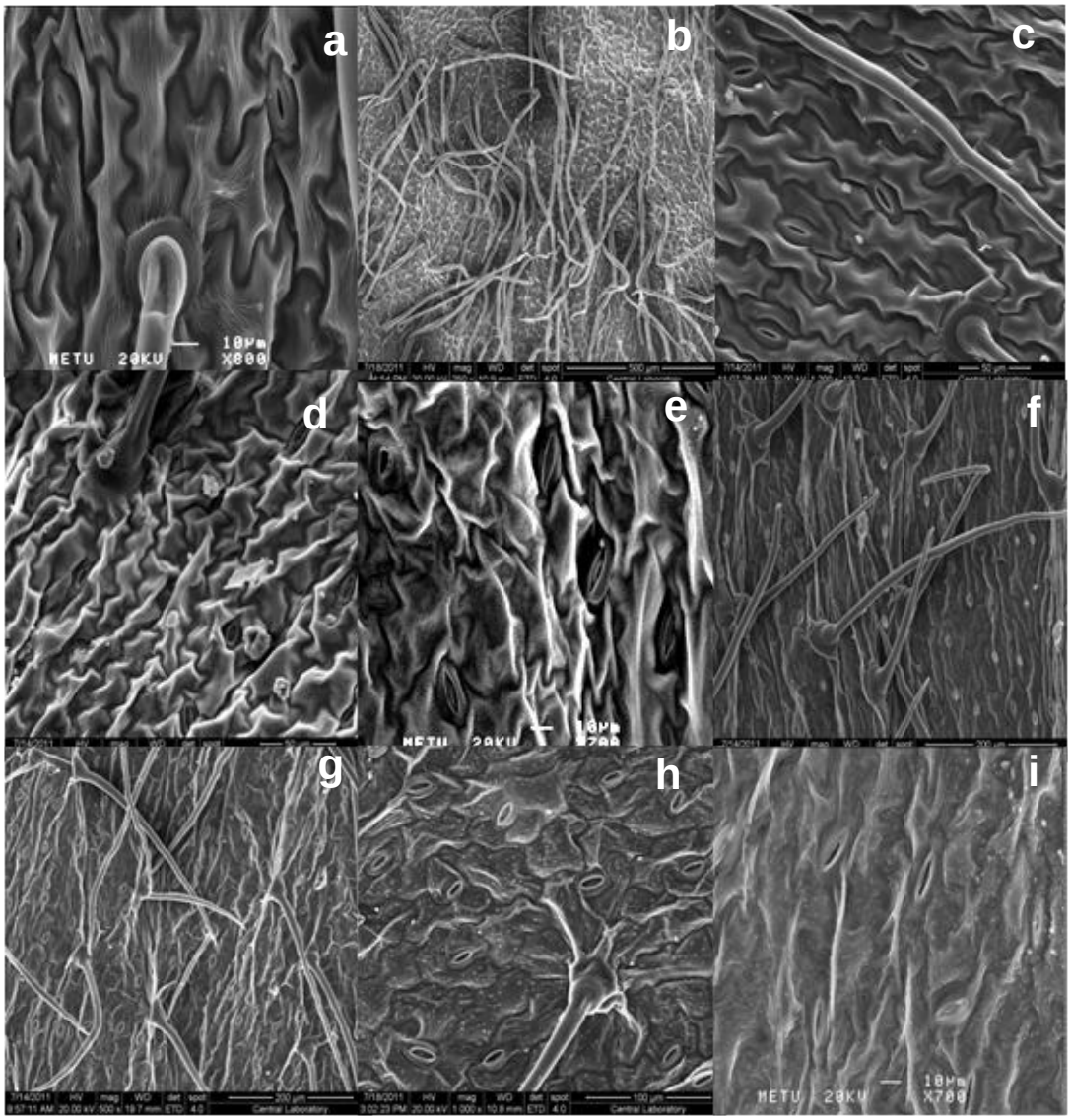

Figure 55. Leaf micromorphology of some species of the genus *Vicia* (**a.** *V. noeana*, **b.** *V. pannonica*, **c.** *V. hybrida*, **d.** *V. sericocarpa*, **e.** *V. peregrina*, **f.** *V. cuspidata* **g.** *V. lathyroides*, **h.** *V. grandiflora*, **i.** *V. sativa)*

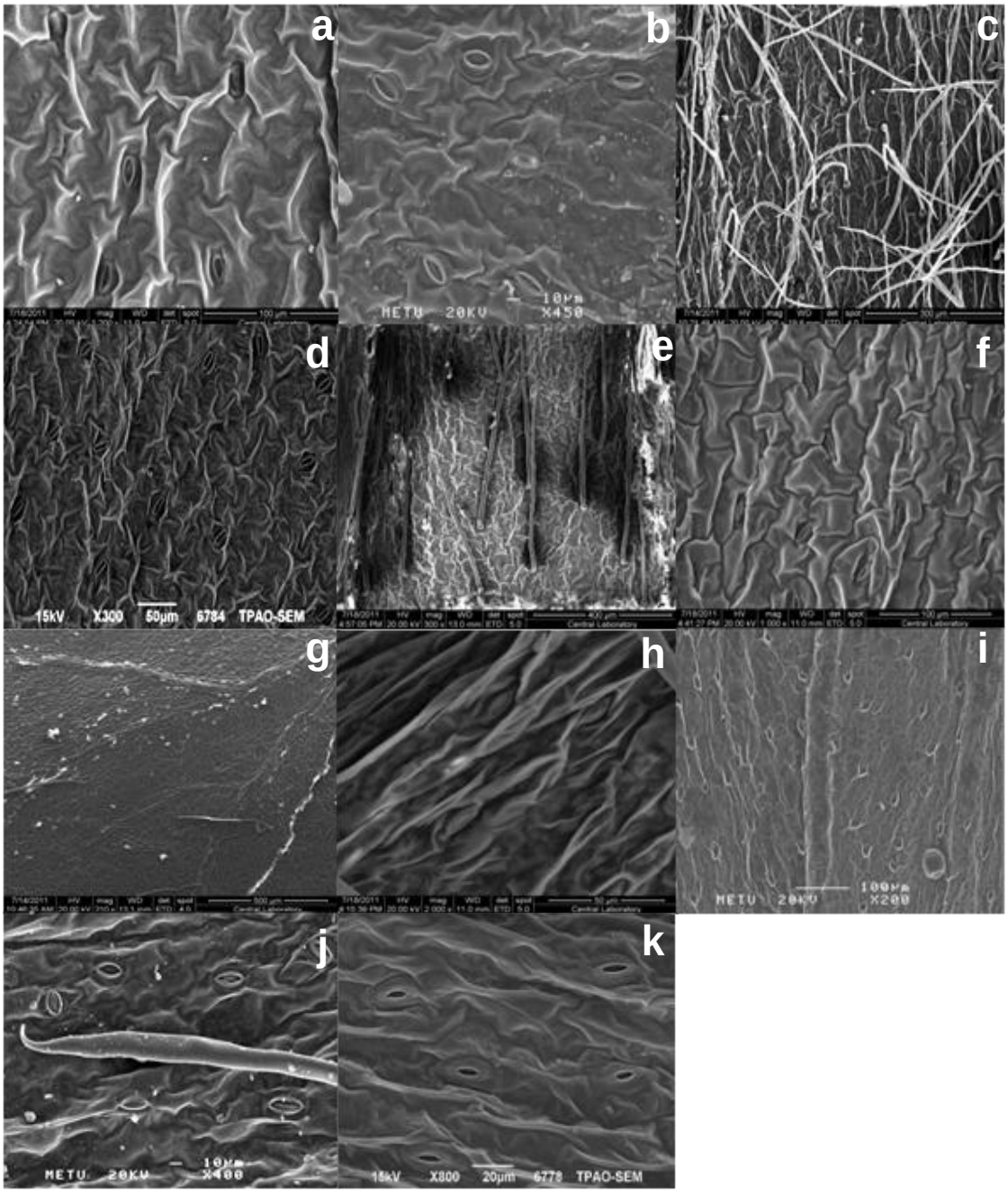

Figure 56. Leaf micromorphology of some species of the genus *Vicia* (**a.** *V. truncatula*, **b.** *V. galilaea*, **c.** *V. caesarea*, **d.** *V. ervilia*, **e.** *V. tenuifolia* subsp. *dalmatica*, **f.** *V. tenuifolia* subsp. *tenuifolia* **g.** *V. cassubica*, **h.** *V. villosa*, **i.** *V. cappadocica*, **j.** *V. narbonensis*, **k.** *V. anatolica)*

3.3.2. Trichomes on Calyces

1. Peltate trichomes (type I): Observed in *V. ervilia*, *V. grandiflora* subsp. *grandiflora*, *V. noeana* var. *noeana*, *V. pannonica* var. *pannonica* (Figures 58-59).

2. Capitate trichomes (type II): Observed in *V. ervilia*, *V. grandiflora* subsp. *grandiflora*, *V. noeana* var. *noeana*, *V. pannonica* var. *pannonica*, *V. villosa* (Figures 57-58).

3. Eglandular trichomes (type III)

Subtype I: Short eglandular trichomes (1-2-celled): Observed in *V. ervilia* (rare), *V. noeana* var. *noeana* (dense), *V. tenuifolia* subsp. *tenuifolia* (dense), *V. tenuifolia* subsp. *dalmatica* (dense), *V. sativa* (present), (Figures 57-58).

Subtype II: Long-very long eglandular trichomes (more-celled than 2): Observed in *V. pannonica* var. *pannonica* (dense), *V. sativa* (rare) and *V. villosa* (dense) (Figures 57-58).

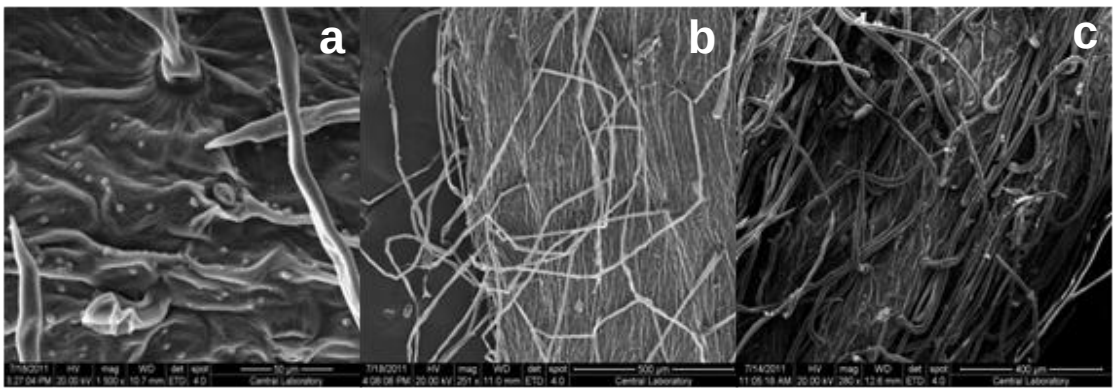

Figure 57. Calyx micromorphology of some species of genus *Vicia* (**a.** *V. noeana*, **b.** *V. pannonica*, **c.** *V. hybrida*)

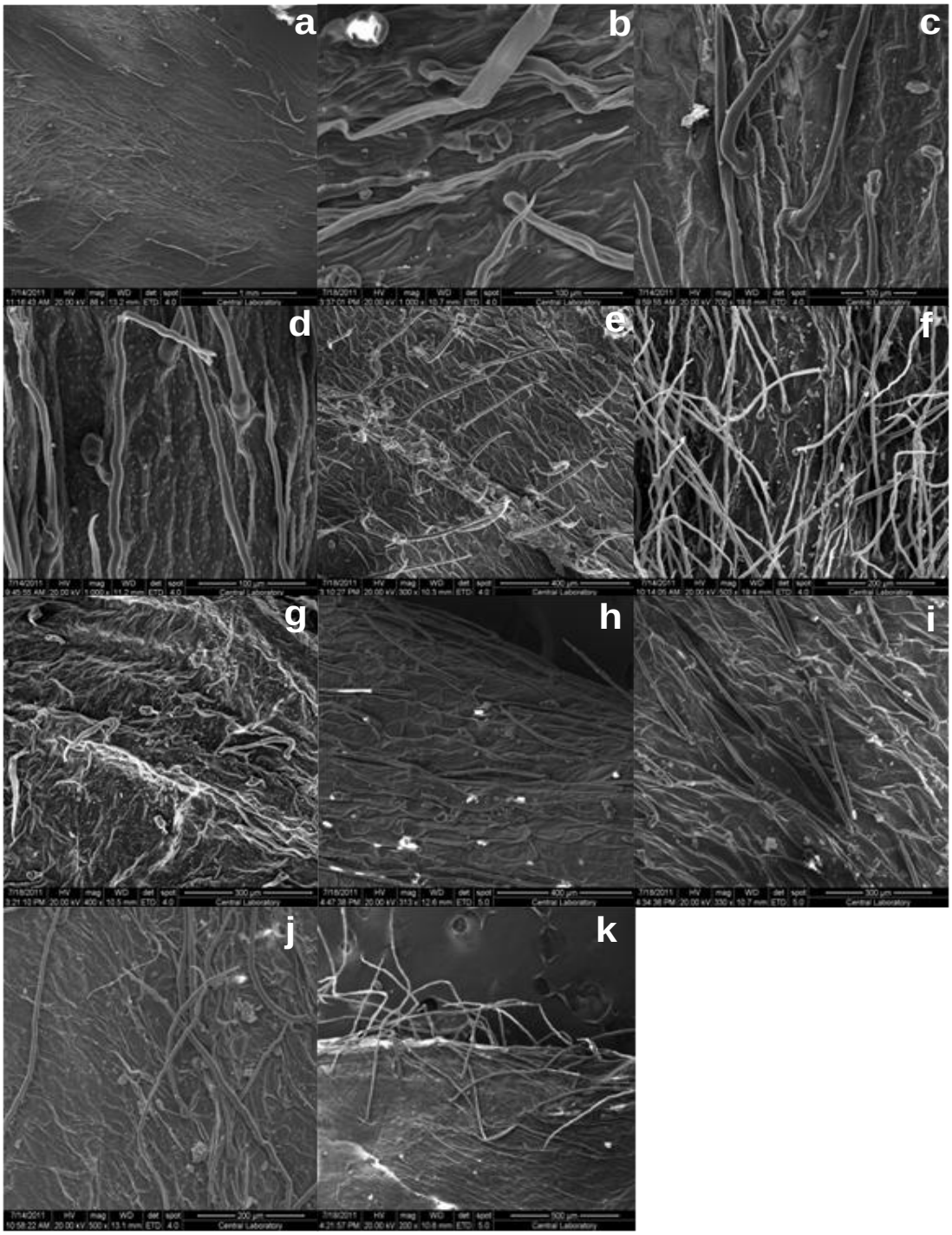

Figure 58. Calyx micromorphology of some species of genus *Vicia* (**a.** *V. sericocarpa*, **b.** *V. peregrina*, **c.** *V. cuspidata*, **d.** *V. lathyroides*, **e.** *V. grandiflora* , **f.** *V. caesarea* **g.** *V. ervilia*, **h.** *V. tenuifolia* subsp. *dalmatica*, **i.** *V. tenuifolia* subsp. *tenuifolia*, **j.** *V. cassubica*, **k.** *V. villosa)*

3.4. Petal Epidermal Micromorphology

Two kinds of petals (a dorsal petal, called a ‘standard’ and two lateral petals or ‘wings’) are examined. The epidermal types are classified based on cell-shape traits (the primary sculpture) and on the fine relief of the cell wall, using the terminology of Kay et al. (1981).

Four major epidermal types were recorded in *Vicia* taxa:

Type 1: Tabular rugose cells with longitudinal striations (e.g., standard and wing petals of *V. cassubica*, *V. ervilia*, *V. noeana*) (Figure 59).

Type 2: Tabular flat cells with longitudinal striations (e.g., standard and wing petals of *V. villosa*) (Figure 59).

Type 3: Papillose conical cells with striations (e.g., standard and wing petals of *V. pannonica*, *V. sativa* subsp. *nigra*) (Figure 59).

Type 4: Reticulate (e.g., standard and wing petals of *V. grandiflora*) (Figure 59).

Tabular rugose cells with longitudinal striations show variation in cell shape, size and density of striations on the surface. Hence, this epidermal type can be further subdivided into three subtypes:

Subtype 1a: Elongated cells with dense striations: standard and wing petals of *V. ervilia* (Figure 59).

Subtype 1b: Elongated cells with less striations: standard and wing petals of *V. noeana* (Figure 59).

Subtype 1c: More or less isodiametric cells with dense striations: standard and wing petals of *V. cassubica* (Figure 59).

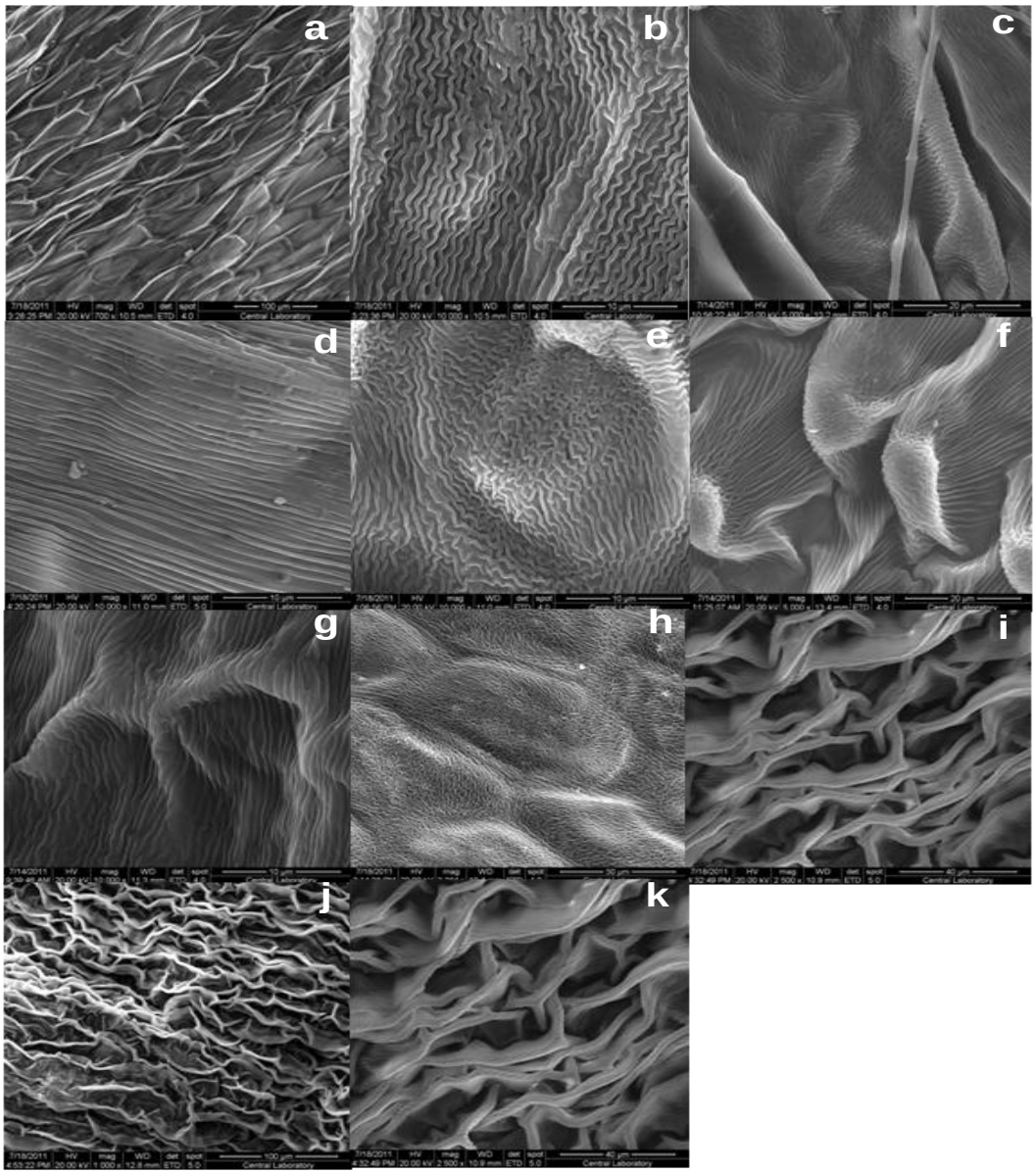

Figure 59. Petal micromorphology of some species of the genus *Vicia* (**a.** *V. noeana*, **b.** *V. ervilia*, **c.** *V. cassubica*, **d.** *V. villosa*, **e.** *V. pannonica*, **f.** *V. sericocarpa*, ***g.*** *V. lathyroides*, **h.** *V. grandiflora*, **i.** *V. truncatula*, **j.** *V. tenuifolia* subsp. *dalmatica* **k.** *V. tenuifolia* subsp. *tenuifolia)*

3.5. Pollen Micromorphology of the *Vicia* taxa

The pollen grains of the *Vicia* taxa show variation in size, shape and exine ornamentation. The main pollen characters of the taxa are summarized in Table 13. SEM micrographs of representative pollen grains studied are illustrated in Figures 60-73.

The pollen grains of the taxa examined are medium to large: polar axis (P) ranges from 28.14 μm, in *V. caesarea*, to 49.60 μm, in *V. pannonica* var. *pannonica* and equatorial axis (E) ranges from 18.08 μm, in *V. tenuifolia* subsp. *tenuifolia*, to 52.58 μm, in *V. pannonica* var. *pannonica* (Table 13).

Pollen shape ranges from prolate-spheroidal to prolate (P/E = 1.00-1.70), however is mostly frequent prolate (e.g. *V. anatolica, V. caesarea, V. ervilia, V. grandiflora, V. noeana, V. pannonica, V. peregrina, V. sericocarpa, V. tenuifolia* subsp. *dalmatica*, *V. villosa* subsp. *villosa*, *V. villosa* subsp. *varia*) (Figures 60-73).

The pollen grains can be divided into three groups based on their equatorial view.

- Elliptical polen grains (e.g., *V. ervilia*, *V. sativa*) (Figures 66).
- Elliptical to rectangular-obtuse-convex pollen grains (the most frequent) (e.g., *V. anatolica*, *V. caesarea*, *V. grandiflora*, *V. hybrida*, *V. noeana V. pannonica*, *V. peregrina*, *V. sericocarpa*, *V. tenuifolia* subsp. *tenuifolia*, *V. tenuifolia* subsp. *dalmatica, V. truncatulata, V. villosa*) (Figures 60-72).
- Quadratic-obtuse-emarginate pollen grains: (e.g., *V. lathyroides*) (Figure 73).

The pollen grains in polar view are circular (e.g. *V. anatolica*, *V. hybrida*, *V. pannonica*, *V. sativa*, V. *truncatulata*; Figures 61, 62, 66, 67), triangular (e.g., *V. noeana*, *V. villosa*; Figures 60, 71), triangular-circular (e.g., *V. caesarea*, *V. sericocarpa*; Figures 63, 68) or penta/hexangular-obtuse-convex (e.g., *V. tenuifolia* subsp. *tenuifolia*, *V. tenuifolia* subsp. *dalmatica*; Figures 69, 70).

The pollen grains are 3-zonocolporate. Ectoaperture: Colpus often long, mainly narrow or rarely large, sunken, nearly reaching at the poles, straight, widened from mesocolpium to poles, with acute ends. Colpus length (Clg) ranges from 18.06 μm, in *V. caesarea*, to 36.23 μm, in *V. peregrina* (Table 13). Endoaperture: Porus large, circular or elliptic, protruding in mesocolpium or not. Porus diameter ranges from 4.40 μm, in *V. villosa* subsp. *villosa*, to 11.70 μm (Table 13).

Three different exine ornamentation types are found at the mesocolpium of the taxa examined: finely reticulate-perforate (the most common), obscurely reticulate-perforate and psilate-perforate.

The finely reticulate-perforate pattern (type 1): Observed in *V. anatolica, V. caesarea, V. ervilia, V. grandiflora, V. hybrida, V. noeana, V. pannonica, V. peregrina, V. sativa* and *V. truncatulata* (Figures 60, 61, 62, 64, 65, 66, 67, 68, 72). This type is further subdivided into two subtypes based on the number of perforation. The perforation number is <20 as in *V. grandiflora* and *V. sativa*. The perforation number is >20 as in *V. anatolica, V. caesarea, V. ervilia, V. hybrida, V. noeana, V. pannonica, V. peregrina* and *V. truncatulata*.

The obscurely reticulate-perforate pattern (type 2): Observed in *V. cassia, V. tenuifolia* subsp. *tenuifolia* and *V. tenuifolia* subsp. *dalmatica* (Figures 69, 70).

The psilate-perforate pattern (type 3): Observed in *V. lathyroides* (Figure 73).

Four different exine ornamentation types are found at the apocolpium of the taxa examined: finely reticulate-perforate, obscurely reticulate-perforate, perforate or psilate.

The finely reticulate-perforate pattern (type 1): Observed in *V. ervilia* and *V. sativa* (Figures 66).

The obscurely reticulate-perforate pattern (type 2): Observed in *V. anatolica*, *V. hybrida*, *V. pannonica* and *V. truncatula*, (Figures 61, 62, 67, 72).

The perforate pattern (type 3): Observed in *V. caesarea*, *V. grandiflora*, *V. noeana* and *V. peregrina*, (Figures 60, 64, 65, 68).

The psilate pattern (type 4): Observed in *V. cassia*, *V. tenuifolia* subsp. *tenuifolia* and *V. tenuifolia* subsp. *dalmatica* (Figures 69, 70).

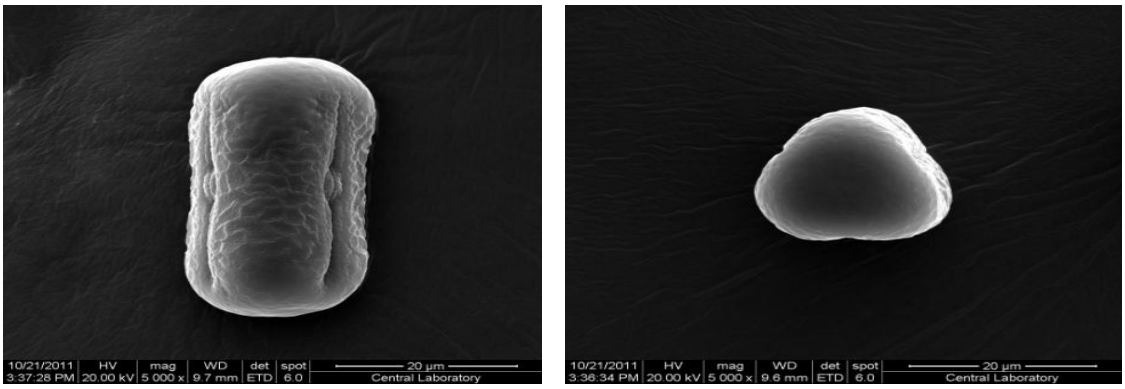

Figure 60.Equatorial and polar view of pollens of *V. noeana*

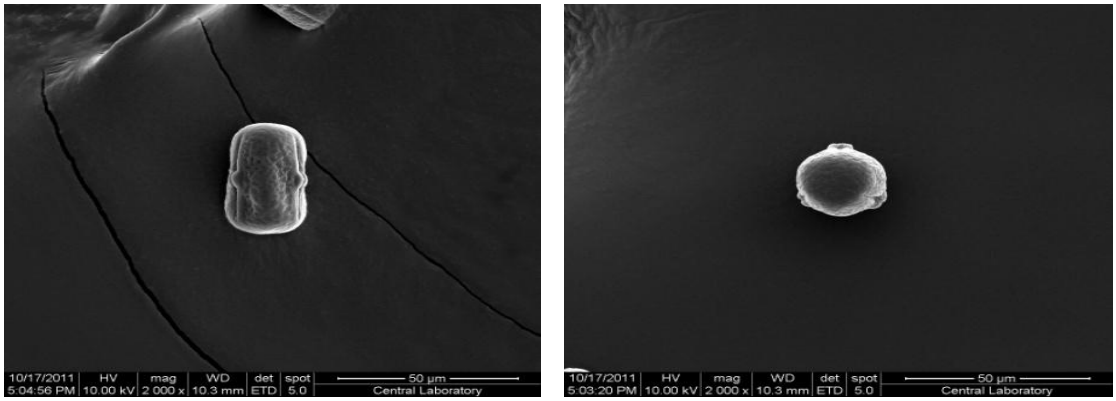

Figure 61. Equatorial and polar view of pollens of *V. pannonica*

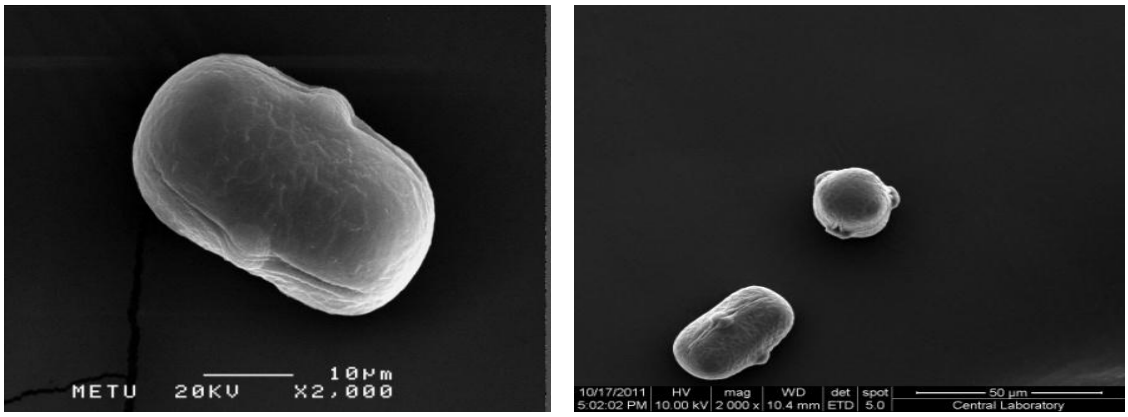

Figure 62. Equatorial and polar view of pollens of *V. hybrida*

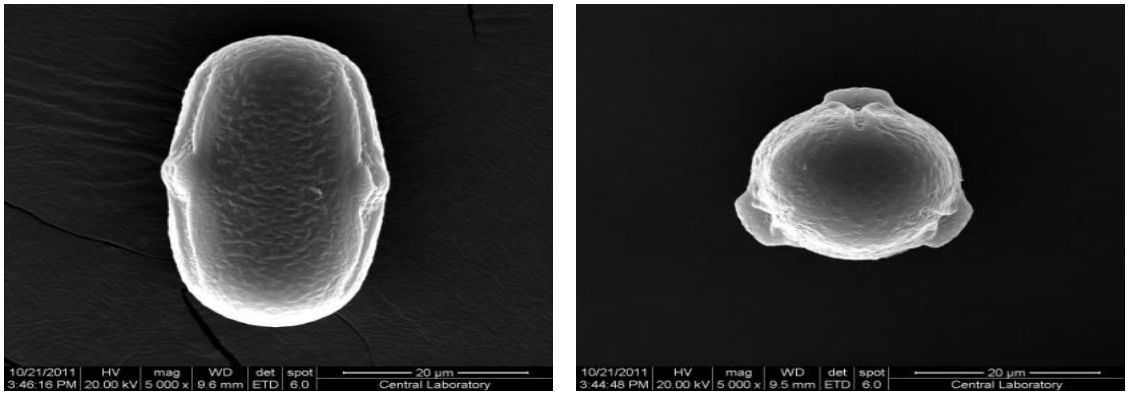

Figure 63. Equatorial and polar view of pollens of *V. sericocarpa*

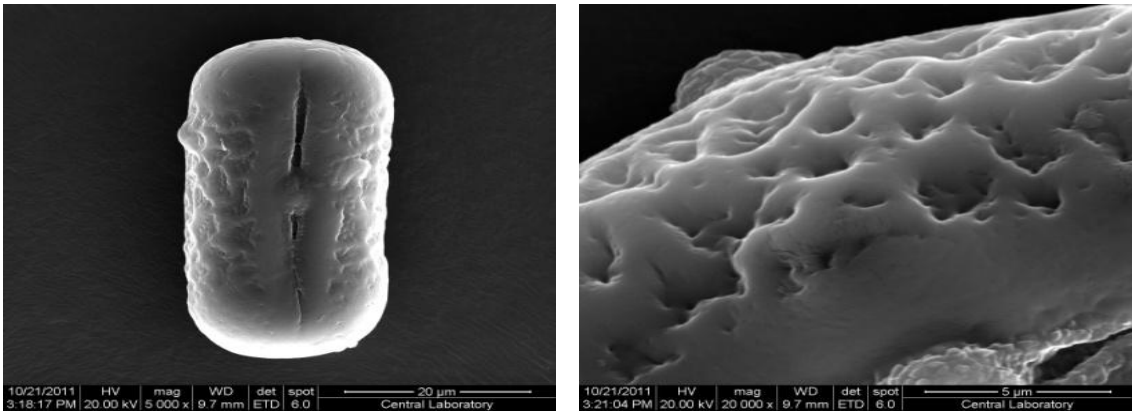

Figure 64. Equatorial and polar view of pollens of *V. peregrina*

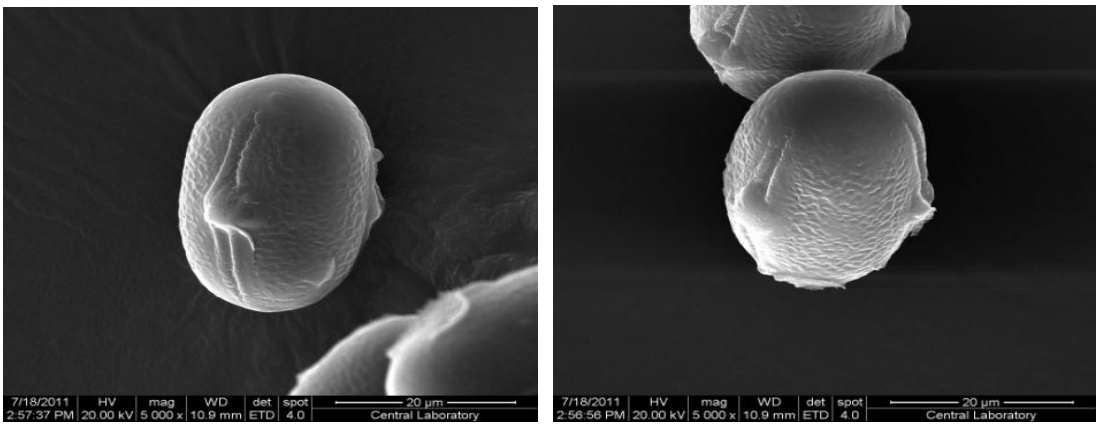

Figure 65. Equatorial and polar view of pollens of *V. grandiflora*

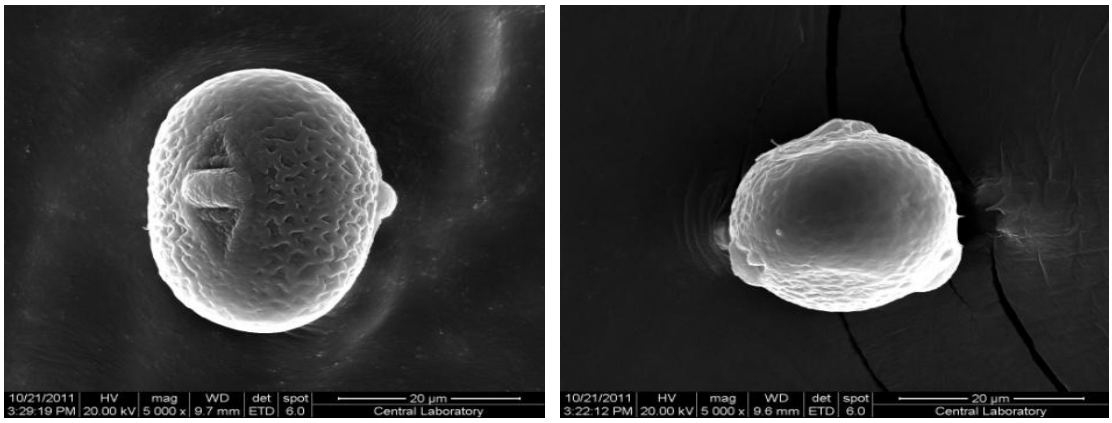

Figure 66. Equatorial and polar view of pollens of *V. sativa*

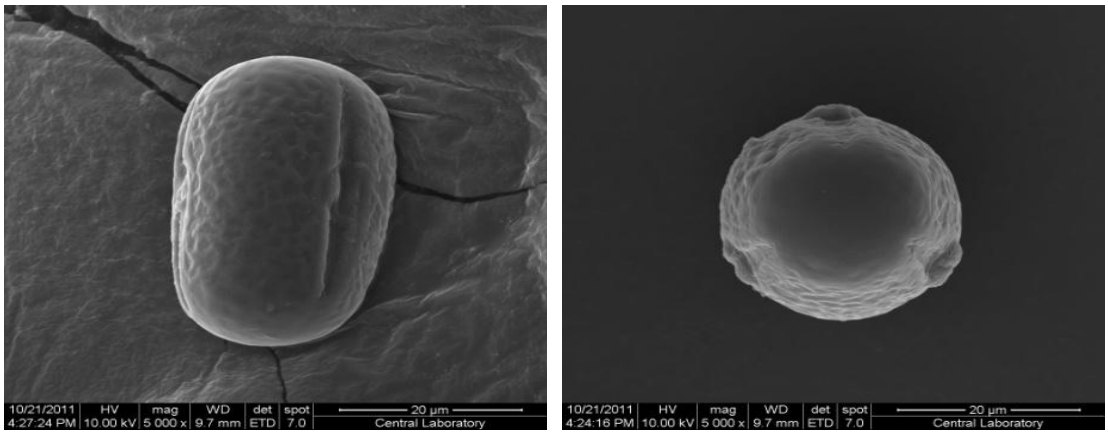

Figure 67. Equatorial and polar view of pollens of *V. truncatula*

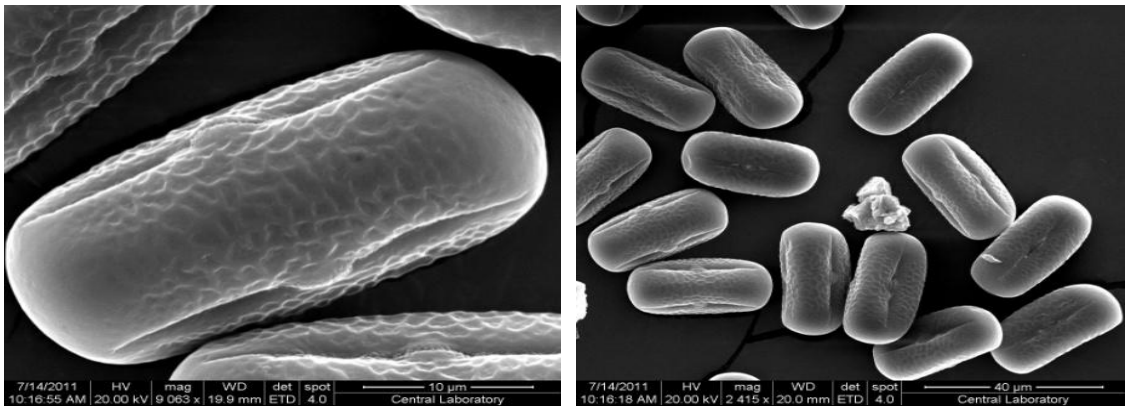

Figure 68. Equatorial and polar view of pollens of *V. caesarea*

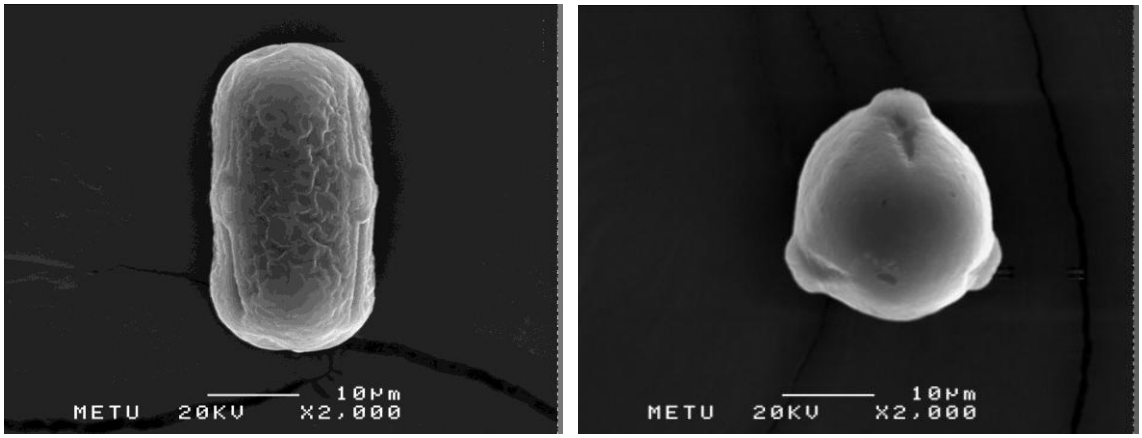

Figure 69. Equatorial and polar view of pollens of *V. tenuifolia* subsp. *dalmatica*

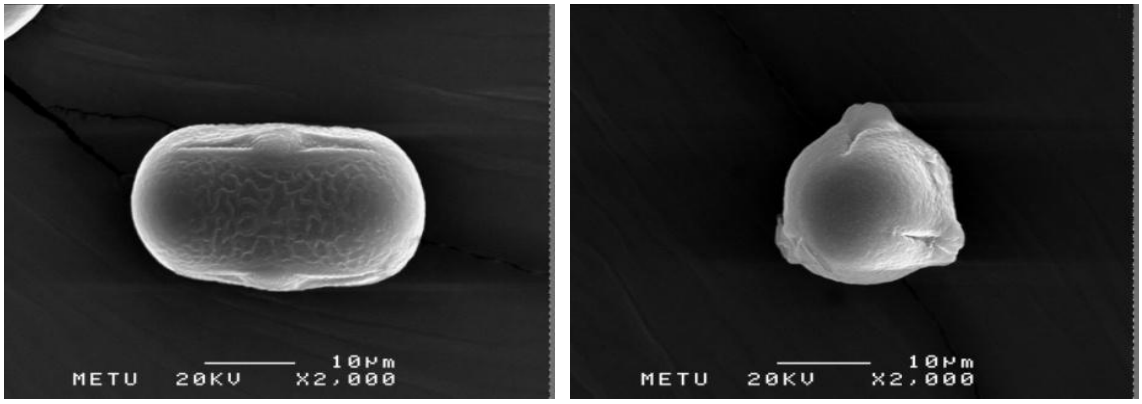

Figure 70. Equatorial and polar view of pollens of *V. tenuifolia* subsp *tenuifolia*

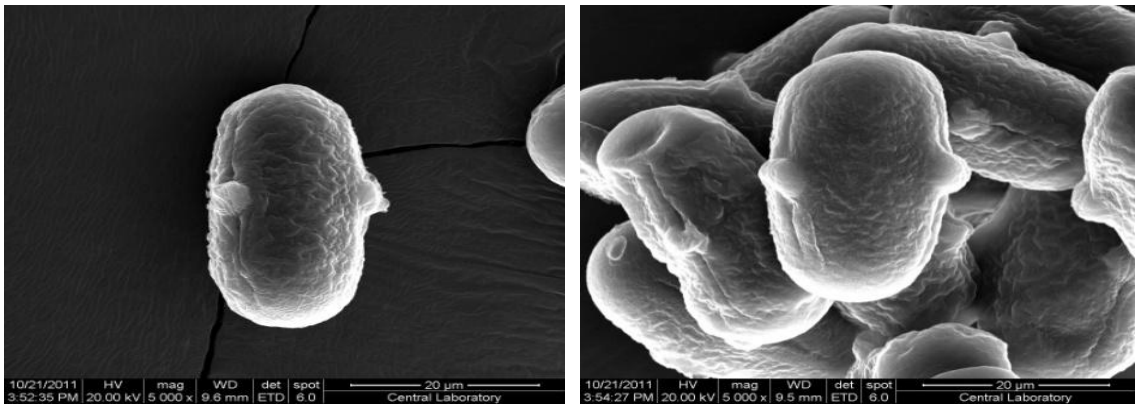

Figure 71. Equatorial and polar view of pollens of *V. villosa*

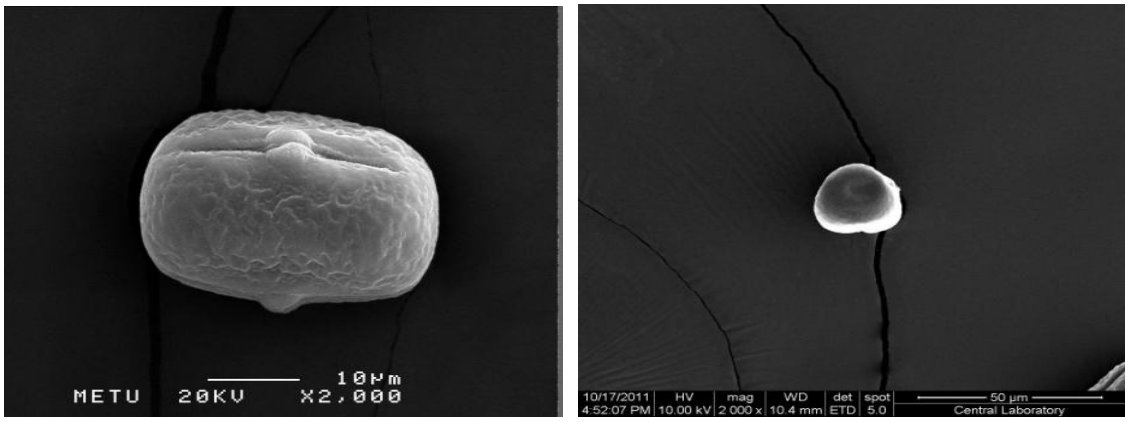

Figure 72. Equatorial and polar view of pollens of *V. anatolica*

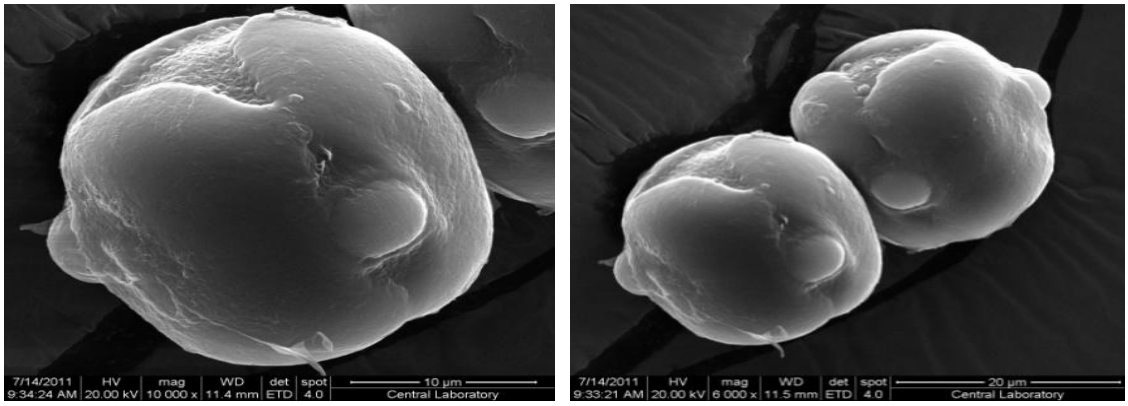

Figure 73. Equatorial and polar view of pollens of *V. lathyroides*

Table 13.Summary of pollen morphological data for the taxa studied of *Vicia* according to the infrageneric system of Kupicha (1976). All sizes are in µm. Numbers refer to (maximum-minimum) (mean±standard deviation).

Subgenus	Section	Taxa	Polar (P)	Equatorial (E)	P/E	Colpus length (Clg)	Porus diameter	Exine	Intine
Vicilla	*Cracca*	*V. tenuifolia* subsp. *dalmatica* (syn. *V. cracca* subsp. *stenophylla*)	29.85-33.50 (32.03±1.38)	18.08-23.12 (22.07±1.40)	1.30-1.77 (1.45±0.12)	21.63-27.63 (24.19±1.60)	4.52-7.38 (5.88±1.06)	-	-
Vicilla	*Cracca*	*V. villosa* subsp. *villosa*	32.38-45.58 (40.07±3.34)	21.24-32.12 (28.17±3.09)	1.28-1.62 (1.43±0.08)	18.70-30.10 (24.04±2.84)	4.40-10.46 (8.00±1.55)	0.43-1.15 (0.78±0.16)	0.48-1.04 (0.73±0.16)
Vicilla	*Cracca*	*V. villosa* subsp. *varia* (syn. *V. villosa* subsp. *eriocarpa*)	34.55-42.65 (39.77±1.89)	25.02-27.86 (25.96±0.72)	1.25-1.70 (1.53±0.10)	24.05-30.51 (26.77±1.50)	6.96-11.70 (9.24±1.10)	0.68-1.43 (1.06±0.20)	0.34-0.88 (0.62±0.14)
Vicilla	*Ervilia*	*V. ervilia*	29.75-44.81 (34.10±4.32)	22.57-32.91 (26.16±3.46)	1.23-1.38 (1.31±0.05)	19.50-27.84 (22.23±2.78)	4.91-8.88 (6.64±1.37)	0.72-1.29 (0.97±0.17)	0.40-0.73 (0.54±0.10)
Vicilla	*Lentopsis*	*V. caesarea*	28.14-34.31 (30.05±1.14)	19.66-26.14 (22.02±1.84)	1.16-1.56 (1.37±0.12)	18.06-23.62 (20.62±1.30)	5.05-7.67 (6.51±0.73)	0.73-1.12 (0.92±0.10)	0.40-0.87 (0.57±0.12)
Vicia	*Hypechusa*	*V. noeana* var. *noeana*	36.72-46.05 (39.55±2.18)	21.78-29.77 (24.89±2.07)	1.42-1.79 (1.59±0.09)	22.26-31.63 (25.59±1.92)	5.08-9.09 (7.13±0.87)	0.57-1.15 (0.88±0.15)	0.36-0.81 (0.56±0.14)
Vicia	*Hypechusa*	*V. anatolica*	38.29-47.79 (41.77±2.28)	26.53-34.42 (30.35±2.05)	1.23-1.56 (1.37±0.07)	24.64-34.69 (31.10±2.43)	6.29-9.43 (7.56±0.72)	0.70-1.23 (0.93±0.15)	0.40-0.75 (0.53±0.10)

Table 13. (continued)

Vicia	*Hypechusa*	*V. pannonica* var. *pannonica*	39.93-49.60 (44.18±2.16)	25.71-34.63 (30.06±2.28)	1.30-1.62 (1.47±0.07)	23.78-31.40 (27.94±1.82)	7.21-10.77 (9.41±0.95)	0.73-1.28 (0.96±0.14)	0.47-1.03 (0.68±0.13)
Vicia	*Hypechusa*	*V. sericocarpa* var. *sericocarpa*	35.17-41.06 (37.86±1.35)	21.90-24.77 (23.38±0.79)	1.43-1.74 (1.62±0.07)	23.04-29.84 (26.37±1.88)	5.20-9.50 (6.97±1.09)	0.60-1.20 (0.99±0.20)	0.34-0.79 (0.51±0.10)
Vicia	*Peregrinae*	*V. peregrina*	38.20-45.76 (42.87±2.30)	24.34-32.02 (29.09±1.75)	1.36-1.76 (1.47±0.08)	27.48-36.23 (31.82±2.47)	5.31-9.32 (7.78±1.07)	0.58-1.38 (1.00±0.22)	0.40-1.14 (0.60±0.17)
Vicia	*Vicia*	*V. sativa* subsp. *sativa*	29.53-37.48 (33.96±2.04)	23.16-29.72 (26.61±1.29)	1.11-1.53 (1.27±0.09)	19.76-28.22 (23.19±2.00)	5.62-10.11 (8.56±1.03)	0.57-1.21 (0.87±0.16)	0.24-0.79 (0.59±0.11)
Vicia	*Vicia*	*V. grandiflora* subsp. *grandiflora*	34.67-41.29 (37.58±1.85)	23.66-29.52 (26.31±1.48)	1.29-1.63 (1.43±0.08)	21.28-28.42 (26.08±1.73)	6.41-9.52 (7.70±0.74)	0.54-1.22 (0.90±0.16)	0.33-1.00 (0.60±0.16)

3.6. Ecology, Endemism, Phytogeography and Threat Categories

3.6.1 Habitat, Phenology and Altidutional Range of Species

The *Vicia* species existing in the Central Anatolia grow in areas extending from sea level to up to 2700 m. On the other hand, at 500 m. and 2000 m. of altitude most of the Vicia species are found. Habitats range is very wide for the members of this genus (Figure 74). These habitats include woodlands, macchie, phrygana, limestone cliffs, igneous slopes, rocky places, steppe, follow fields, dry meadows and roadsides (Figure 76). Flowering times vary between April and August (Figure 78).

Figure 74. Some habitat types of the genus *Vicia* L. (a. dry meadow b. woodland c. roadsides d.steppe).

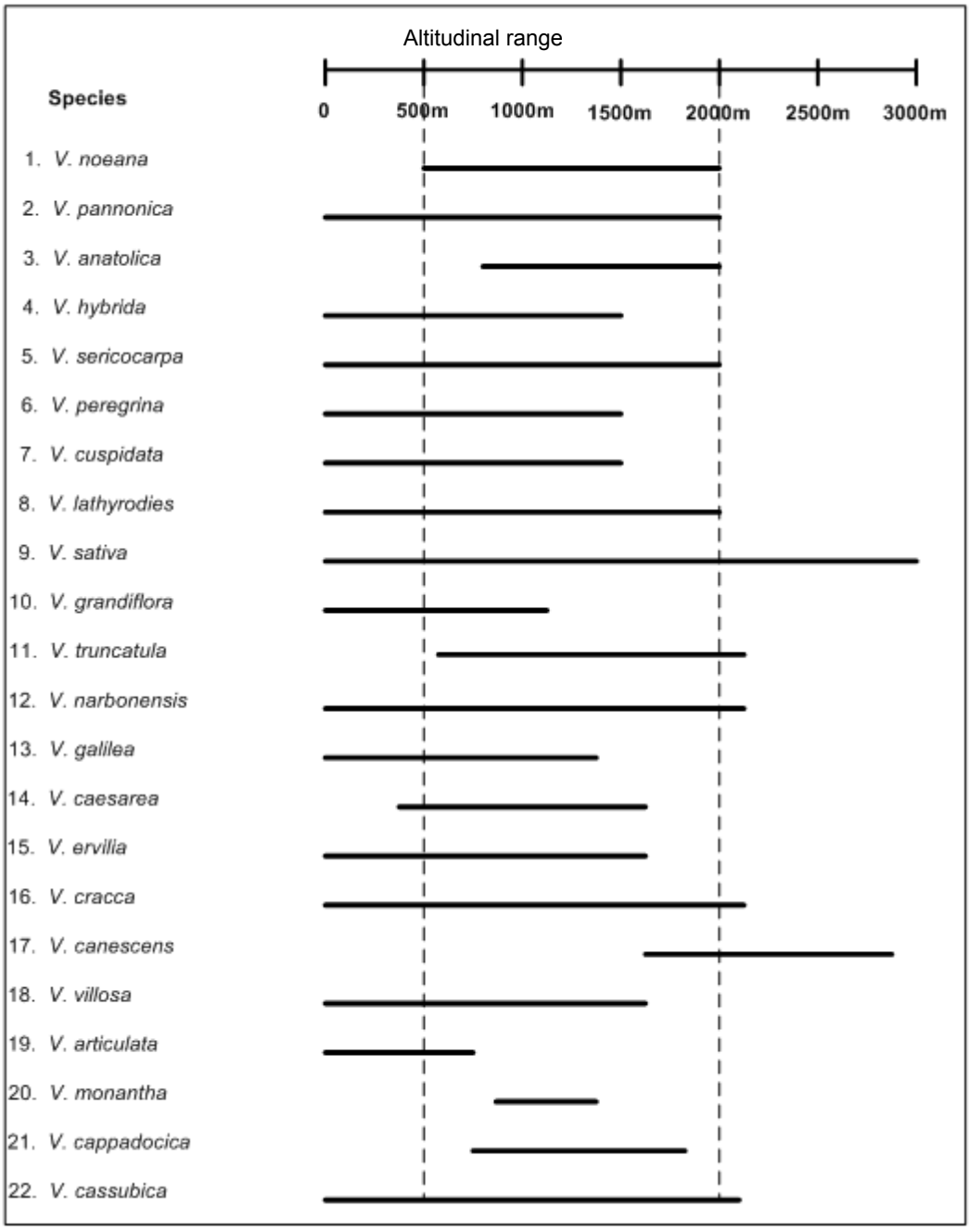

Figure 75. Altitudinal range of the genus *Vicia* L. living in Central Anatolia.

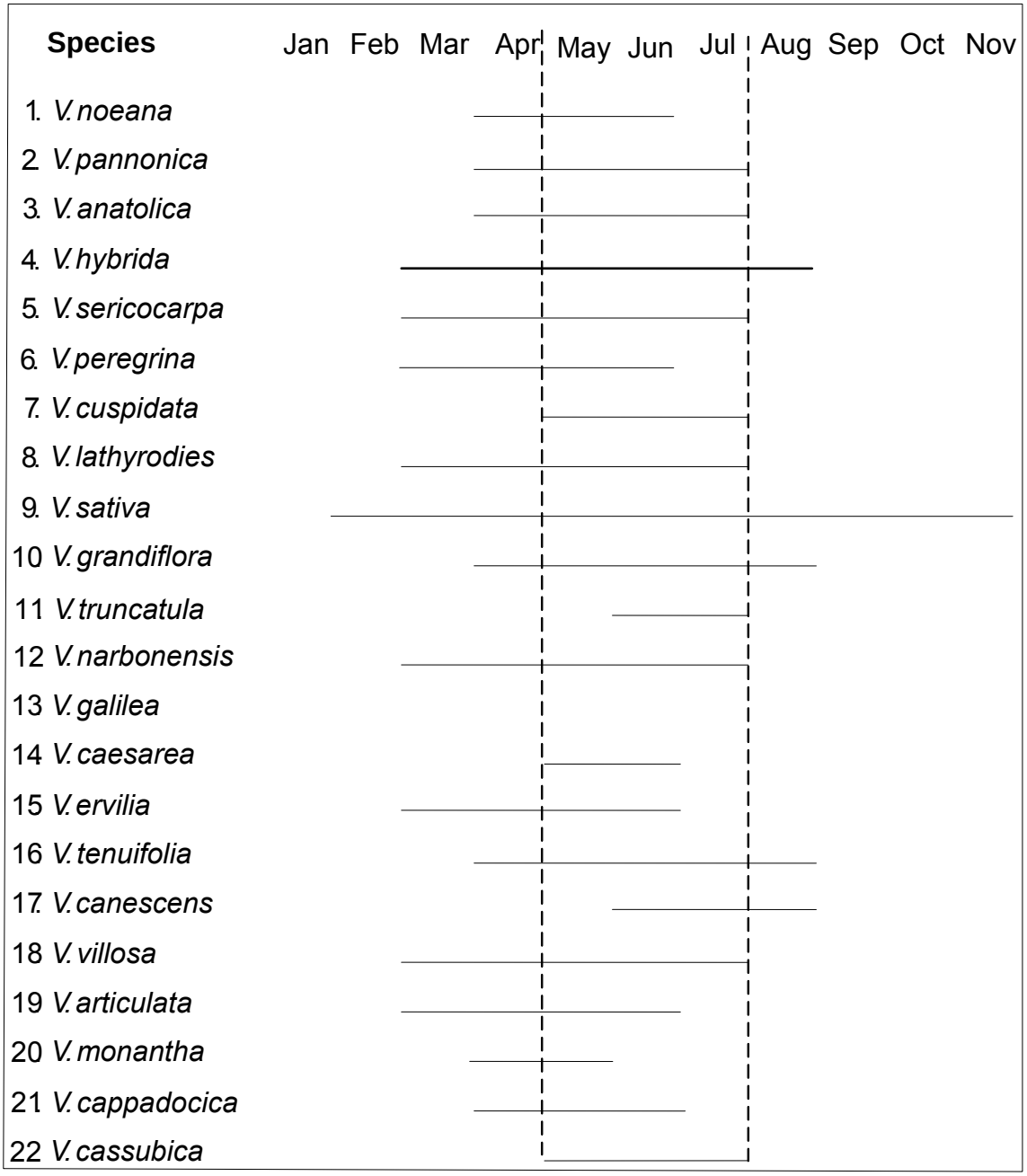

Figure 76. Flowering period of the genus *Vicia* L. living in Central Anatolia.

3.6.2 Endemism

Endemism is the state of being unique to a defined category. In order to find the rate of endemism, the number of taxa living in the study area was compared on their distribution and determines which are endemic. For this study, the endemism rate was found to be as 12% (Figure 77). This ratio is also 12% in Turkey. Endemic species of the genus *Vicia* L. are living in the B4, B5, B6, C4 and C5 grid squares in Central Anatolia (Figure 78). According to the collected specimens and different herbarium records, 26 taxa grow in this region. Just 3 of them, (*V. caesarea*, *V. canescens* subsp. *argaea* and *V. canescens* subsp. *leucomella*) are endemic. In Central Anatolia, there are 22 *Vicia* species, which are distributed to different locations in the study area. In Davis' Flora of Turkey; there were 17 species living in Central Anatolia. However, field and herbarium studies showed that the number of species and subspecies is greater than described before. Result of the study showed that the rate of endemism is high in the B5 and C5 grid squares (Figure 78).

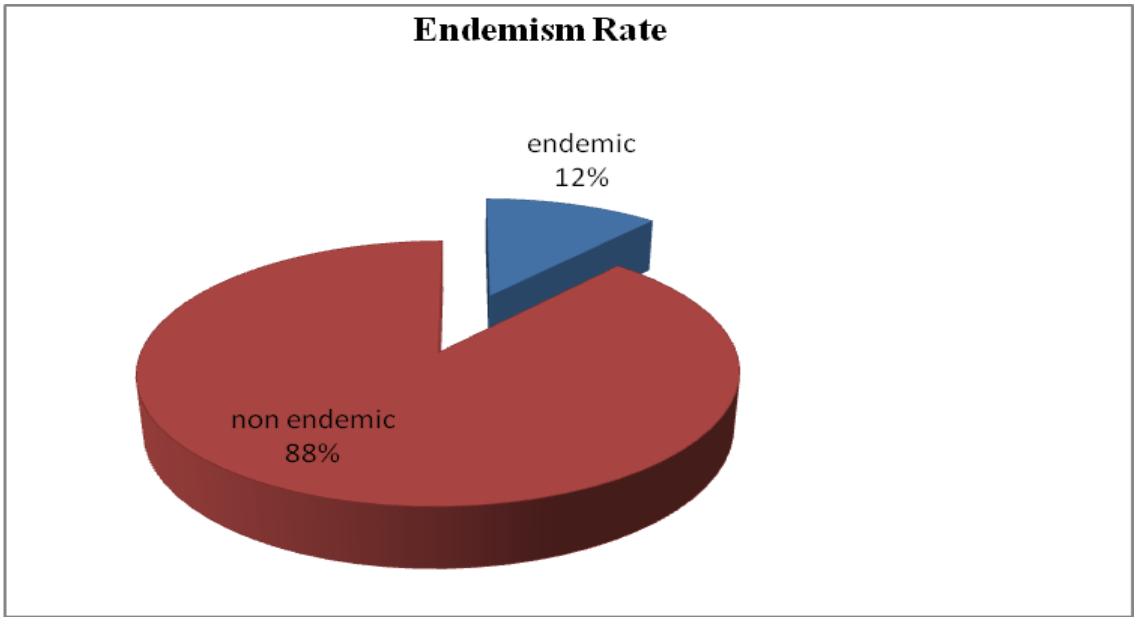

Figure 77. The rate of endemism of *Vicia* L. taxa in the study area.

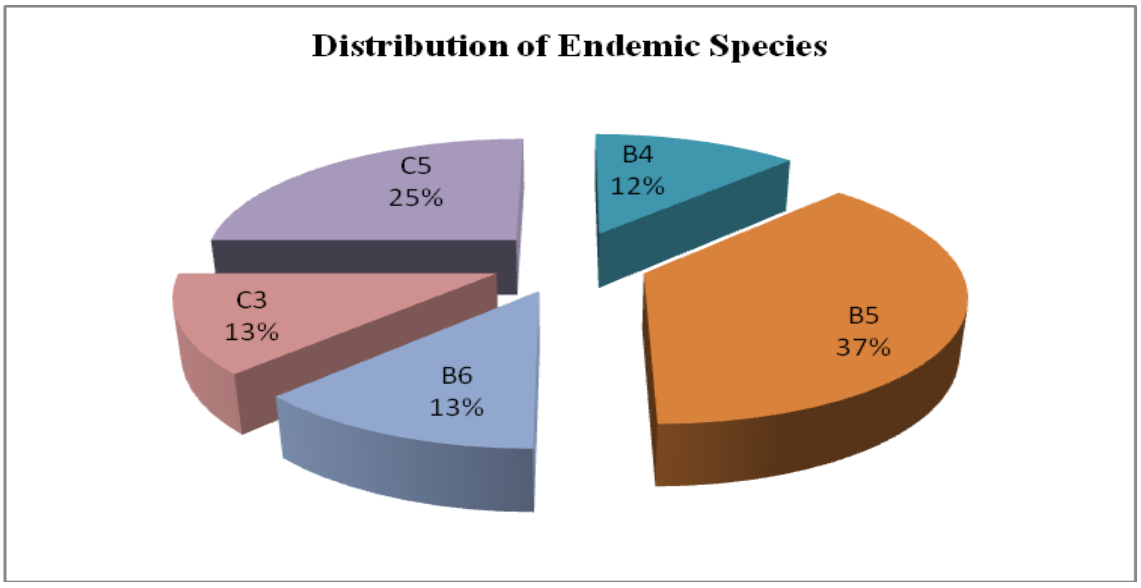

Figure 78. Distribution of endemic species in the study area according to Davis's grid square system

3.6.3. Phytogeography

Distribution of the species was given by using the Davis' grid squares. During the preparation of distribution map, specimens were collected from the research area, and the herbarium materials were also used. The Flora of Turkey has also been used as a guide during this step.

Phytogeography depends on some environmental factors. One of them is climate. Turkey has 3 types of climate which are Mediterranean, Oceanic and Terrestrial. Christiansen - Weniger (1934), Schneider (1931), Erinç (1949, 1950) prepared the climate map of Turkey. However, these studies were not detailed. Today, there are so many stations in our country to get the differences in the weather conditions. Thus detailed temperature differences can be recorded easily. Results of the measurements showed that Mediterranean climate and vegetation of Turkey cover 480.000 km^2 of the area which is 20.8% of the whole Mediterranean countries.

The distribution of precipitation shows great differences form one region to another. High precipitation occurs in the Oceanic climate of the eastern side of the Black sea region. On the other hand, Central Anatolia have Mediterranean climate. This climate has 2 subgroups in this area. They are semi-arid and arid climates. The weather of the area between the Konya, Karaman and Ulukışla is hot and dry. Climate type in this region is called as arid climate. This area is located on closer side of the skirts of Taurus Mountain which behave like a curtain. It does not give permission to the rain clouds to pass inside the region. So it is easily seen that the structure of the earth affects the precipitation. Other than these places, Ankara, Polatlı, Sivrihisar, Konya and Yozgat are also the semi-arid regions of Central Anatolia. Surroundings of Central Anatolia and a part of the Eastern Anatolia have annual average precipitation of 400-600mm per year. South of the Eastern Anatolia consisting Konya, Ereğli, Karaman, Cihanbeyli and Karapınar have cold arid climate. The annual precipitation of this area changes in between 208mm to 308mm per year. Average temperature for the hottest month changes in between 29,1 ºC to 30,3 ºC for the coldest month this value changes in between -3,8 ºC to -5 ºC (Akman, 2011). Some of the genus *Vicia* L. species which are *V. peregrina, V. truncatula, V. caesarea, V. monantha, V. canescens* subsp. *argaea, V. canescens* subsp. *leucomella* live in the arid climate. They can resist to drought. The rest of the species live in the semi arid climate of the Central Anatolia.

The phytogeography of the taxa living in the Central Anatolia was determined (Figure 81). Irano-Turanian elements 5 taxa (19%), East Mediterranean elements 4 taxa (15%), Euro-Siberian elements 3 taxa (12%), and Unknown or Multiregional elements 14 taxa (54%) (Table 14).

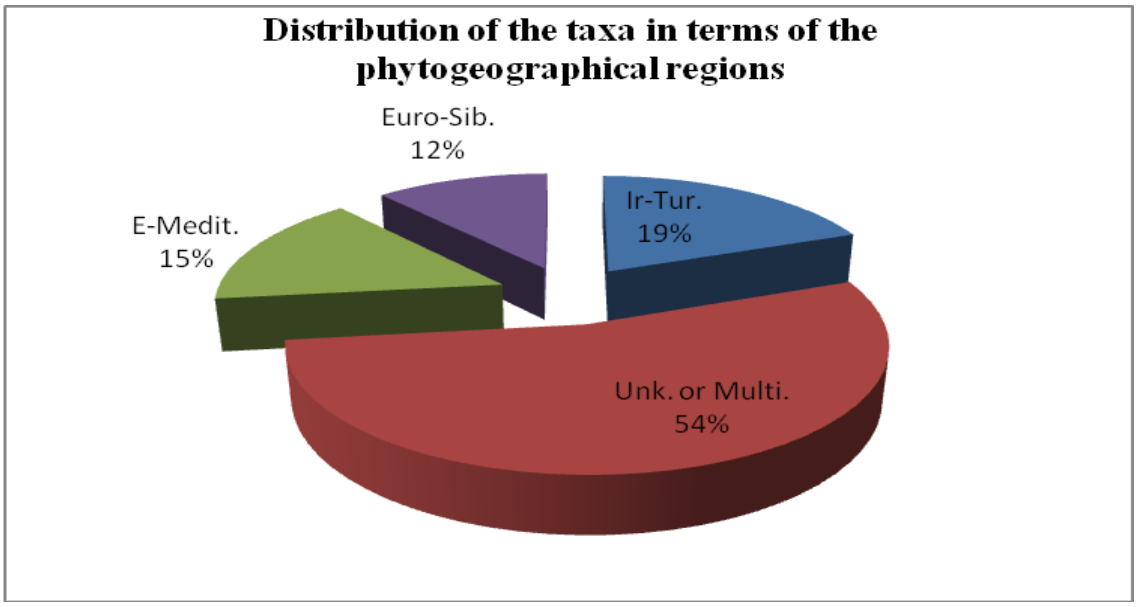

Figure 79. The distribution of the taxa in terms of the phtogeographical regions.

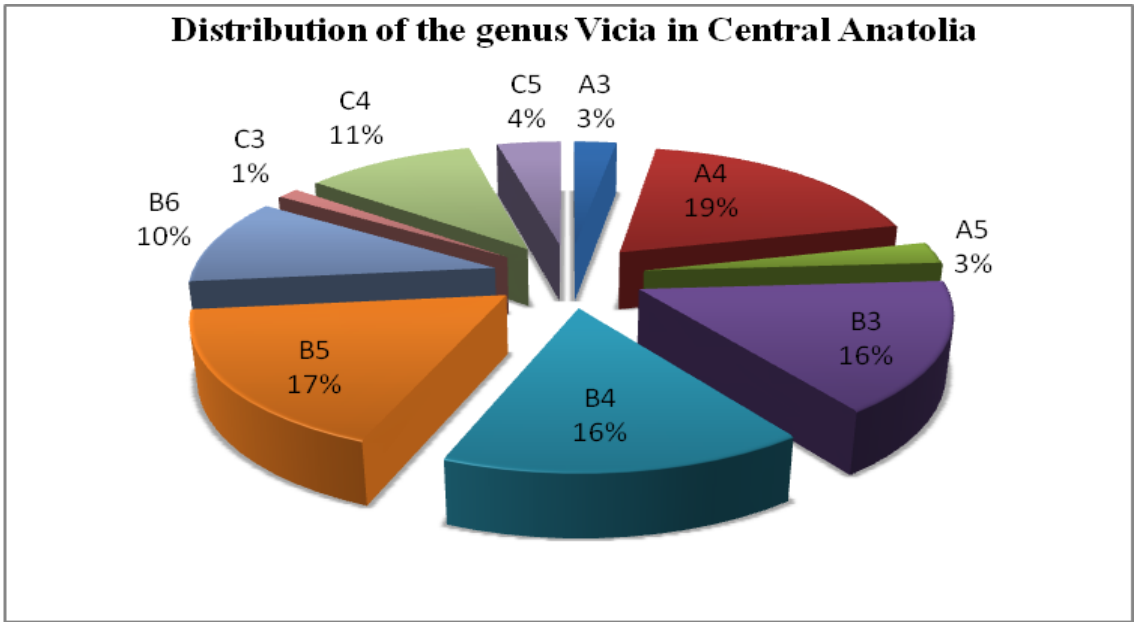

Figure 80. Distribution of the taxa in the study area according to Davis's grid square system.

There are 26 taxa of *Vicia* L. in the Central Anatolia. By the use of Davis's grid square system, we recognized that the highest number of species (19%) was found in A4 grid square. There are 13 species living in this square (Figure 80). The lowest number of species (%1) was found in C3 grid square of the study area.

Table 14. Endemism, Phytogeography, Distribution of the taxa

	Taxa	**Endemism**	**Phytogeography**	**Distribution in the study area**
1	*V. noeana*	Non-endemic	Ir.-Tur.	A4, B5, B6, C4
2	*V. anatolica*	Non-endemic	Ir.-Tur.	A4
3	*V. pannonica*	Non-endemic	Unk. or Multi.	A4, A5, B6
4	*V. hybrida*	Non-endemic	Unk. or Multi.	B3
5	*V. sericocarpa*	Non-endemic	Unk. or Multi.	A4, B3, C4
6	*V. peregrina*	Non-endemic	Unk. or Multi.	A4, B4, B5, C4
7	*V. cuspidata*	Non-endemic	E. Medit.	A4
8	*V. lathyroides*	Non-endemic	Unk. or Multi.	A3, B3, B4, C4
9	*V. sativa* subsp. *sativa*	Non-endemic	Unk. or Multi.	B3, B5
10	*V. sativa* subsp. *nigra*	Non-endemic	Unk. or Multi.	B4, B5, C4
11	*V. grandiflora*	Non-endemic	E. Medit.	A4, B3
12	*V. truncatula*	Non-endemic	Euro-Sib.	A3, B3, B4, B5
13	*V. narbonensis*	Non-endemic	Unk. or Multi.	A4, B3, B4, B5, B6
14	*V. galilaea*	Non-endemic	Unk. or Multi.	B5, C5
15	*V. ervilia*	Non-endemic	Unk. or Multi.	A4, B4, B5
16	*V. caesarea*	Endemic	Ir.-Tur.	B4, B5, B6, C4, C5
17	*V. tenuifolia* subsp. *dalmatica*	Non-endemic	Euro-Sib.	A4, A5, B3, B4, B5, B6, C3,C4
18	*V. tenuifolia* subsp. *tenuifolia*	Non-endemic	Unk. or Multi.	A4, B3
19	*V. villosa* subsp. *villosa*	Non-endemic	E. Medit.	A4, B3, B4, B6
20	*V. villosa* subsp. *varia*	Non-endemic	E. Medit.	B4
21	*V. monantha*	Non-endemic	Unk. or Multi.	B4, B6, C4
22	*V. canescens* subsp. *argaea*	Endemic	Ir.-Tur.	B5
23	*V. canescens* subsp. *leucomella*	Endemic	Ir.-Tur.	B5, C5
24	*V. cappadocica*	Non-endemic	Unk. or Multi.	B3, B4, B5, B6
25	*V. articulata*	Non-endemic	Unk. or Multi.	B4
26	*V. cassubica*	Non-endemic	Euro-Sib.	A4, B3

3.6.4. Threat Categories

Main threat factors of biodiversity are destruction and fragmentation of habitats. Because of these many plant species are in danger so that they are in smaller and isolated populations (Matthies et al., 2004). Human population increases rapidly in Turkey. As a result of this, many natural habitats have been destructed and reduced in size. To maintain the biodiversity in Turkey, establishing monitoring programs and building quantitative databases for preservation is necessary (Kaya & Raynal, 2001). The most significant way of conserving biodiversity is the assessment of conservation statuses of plant species. To state the danger in conservation, Red Data Lists play important role (Balanca et al., 1998; Broughton & Mc Adam, 2002). The threat categories of endemic and non endemic species in Turkey were firstly determined by Ekim et al. (1989). During 1995-1998, Turkish Endemic Plants Project was carried out. This project was done to re-evaluate the conservation status and distribution of the rare and endemic species of Turkey. At the end of this project, the Turkish Red Data Book (Ekim et al., 2000) was prepared. According to that book, *V. canescens* subsp. *argaea* is the one of the endangered species in Turkey. But this study results showed that the number of endangered taxa is 7. This may be because of the limitation in the study area. If all the regions of Turkey were studied, the result might show differences. Because in different parts of the country, members of investigated taxa can be more in amount. According to our observations, we made some assessments about the vulnerability of the species of genus *Vicia* L. Again according to the Turkish Red Data Book, *V. caesarea* was in the status of LR however, this taxon is widely distributed on the area. At the end of the study the distribution was revised (Table 15). The new threatened taxa is as follows: 2 taxa DD, 1 taxon CR, 7 taxa EN, 1 taxon VU, 1 taxon NT and 14 taxa LC (Figure 81).

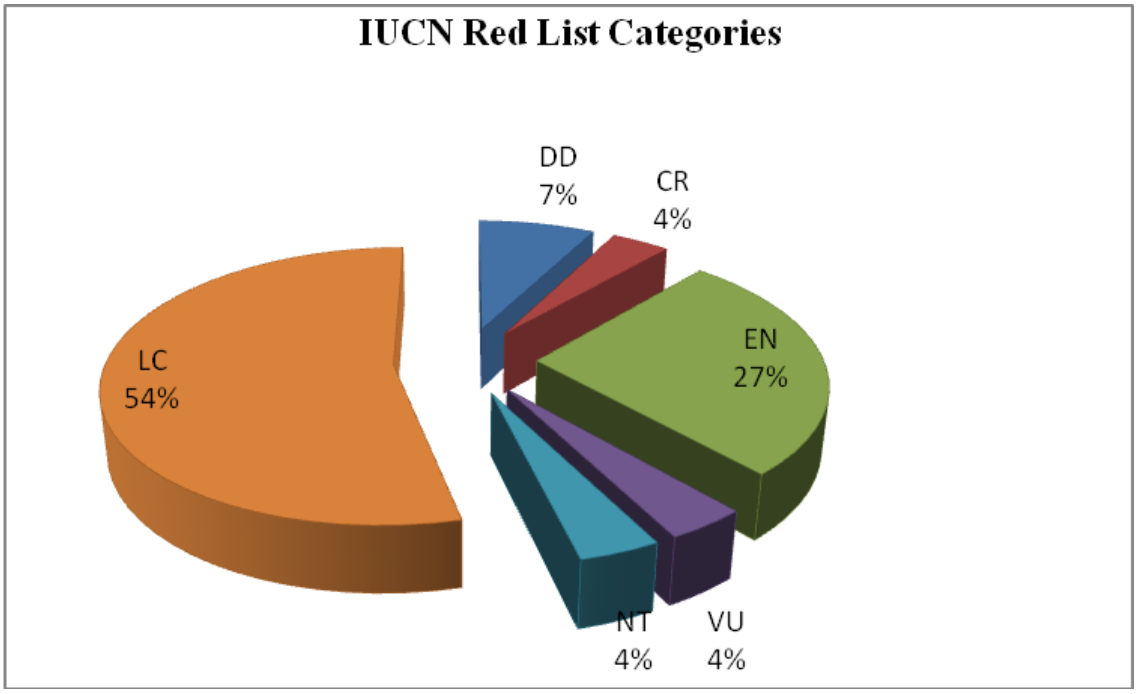

Figure 81. Distribution of studied taxa according to IUCN Red List Categoires Version 3.1 (2001).

We couldn't find any specimen of *V. monanta* and *V. articulata* so that, we haven't got adequate information to make assessment about the vulnerability of these species. The reason for this might be the urbanization of the given locality or constructions on the locality which was given in the Flora of Turkey (Davis, 1970). On the other hand, other species were observed in their locality. It was seen that some of the species' distribution area get larger than indicated by the Flora of Turkey.

The principle threats for the taxa in Central Anatolia are urbanization, constructions, overgrazing, land clearing and fire. In the future, if some conservation techniques are not considered, some species may disappear. *V. articulata* was recorded in a single point of Ankara. But, we couldn't achieve to collect the specimens of this taxon. Record has gathered from the center of Ankara, so the urbanization might be the possible reason for not to find any specimen (Table 16). The major threat for the taxa is constructions. 52% of the principle threats are constructions. Urbanizations (19%), overgrazing (17%), land

clearing (12%) are the threats with a given percentages (Figure 82). Species are either face to face with a single threat or combinations of the several threats. Without necessary steps undertaken in time, plant diversity may decrease and some of the threatened taxa with a small population size will be extinct in the near future. In order to protect the diversity in the study area, we recommend that following steps are required for their conservation. The richest regions of endemic species should be protected via in-situ conservation. The areas are to be modeled and managed via using Geographic Information System (GIS) images. Damaged habitats must be restored or rehabilated. Moreover, people awareness for protection of endemic species can be increased by some advertisements or some other activities. Some samples of endemic species can also be transferred to protected areas (national parks and botanical gardens) for conserving.

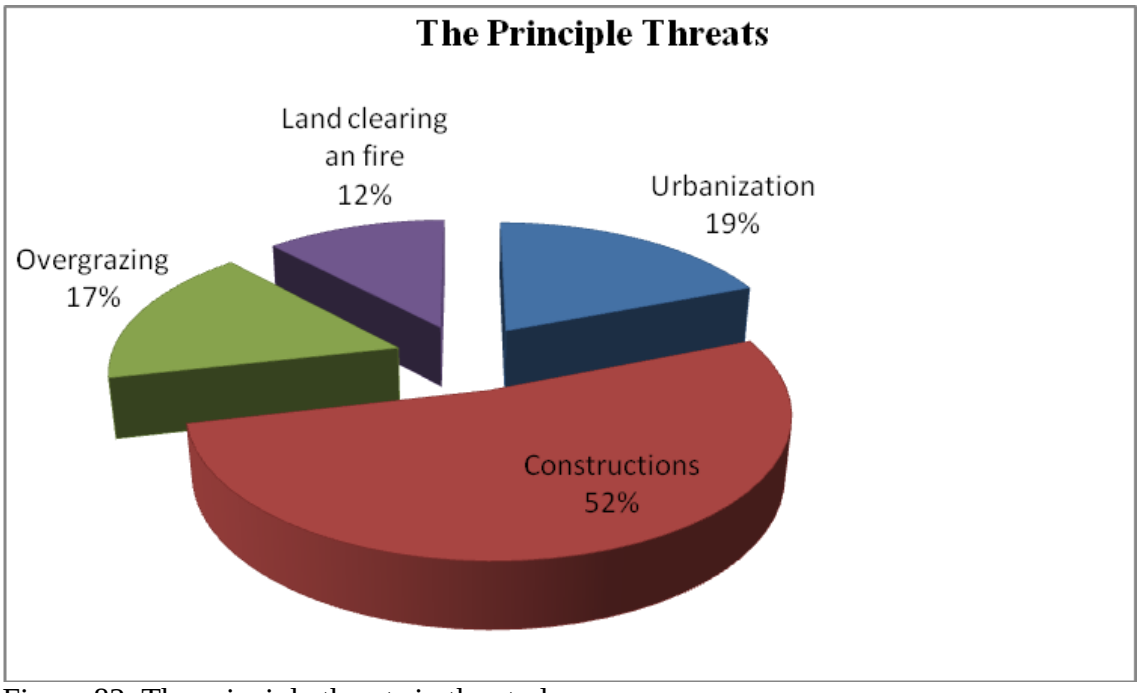

Figure 82. The principle threats in the study area.

Table 15. The species of the study area and their IUCN threat categories and criteria. (*) indicates that the taxa endemic, (Ir-Tur.) Irano-Turanian element, (Euro-Sib.) Euro-Siberian element, (E-Medit.) East Mediterranean, (Unk. or Multi.) Unknown or Multiregional. 1. According to Turkish Red Data Book 2. Recommended Threat Categories for Regional Level; 3. IUCN Red List Criteria (2001).

	Species	**1**	**2**	**3**
1.	*V. noeana* Ir-Tur.	-	LC	Widely distributed
2.	*V. anatolica* Ir-Tur.	-	EN	B1 a, b (i, ii, iv)
3.	*V. pannonica* Unk. or Multi.	-	LC	Widely distributed
4.	*V. hybrida* Unk. or Multi.	-	EN	B1 a,b (i, iii, iv)
5.	*V. sericocarpa* Unk. or Multi.	-	LC	Widely distributed
6.	*V. peregrina* Unk. or Multi.	-	LC	Widely distributed
7.	*V. cuspidata* E-Medit.	-	EN	B1 a,b (i, iii, iv)
8.	*V. lathyroides* Unk. or Multi.	-	LC	Widely distributed
9.	*V. sativa* subsp. *sativa* Unk. or Multi.	-	LC	Widely distributed
10.	*V. sativa* subsp. *nigra*		LC	Widely distributed
11.	*V. grandiflora* E-Medit.	-	VU	B1 a,b (i, ii, iv)
12.	*V. truncatula* Euro-Sib.	-	LC	Widely distributed
13.	*V.narbonensis* Unk. or Multi.	-	LC	Widely distributed
14.	*V. galilaea* Unk. or Multi.	-	EN	B1 a,b (i, iii, iv)
15.	*V. ervilia* Unk. or Multi.	-	NT	Widely distributed
16.	*V. caesarea* Ir-Tur.,*	LR (lc)	LC	Widely distributed
17	*V. tenuifolia* subsp. *dalmatica* Euro-Sib.	-	LC	Widely distributed
18.	*V. tenuifolia* subsp. *tenuifolia*	-	LC	Widely distributed
19.	*V. villosa* subsp. *villosa* E-Medit.	-	LC	Widely distributed
20.	*V. villosa* subsp. *eriocarpa* E-Medit.	-	EN	B1 a,b (i, iii, iv)

Table 15. continued

	Species	1	2	3
21.	*V. monantha* Unk. or Multi.	-	DD	?
22.	*V. canescens* subsp *argaea* Ir-Tur.,*	EN	EN	B1 a,b (i, iii, iv)
23.	*V. canescens subsp leucomella* Ir-Tur.,*	LR(cd)	NT	Widely distributed
24.	*V. cappadocica* Unk. or Multi.	-	LC	Widely distributed
25.	*V. articulata* Unk. or Multi.	-	DD	?
26.	*V. cassubica* Euro-Sib.	-	EN	B1 a,b (ii, iv)

Table 16. The principle threats and comment on the taxa. (*) indicates the endemic species. 1. Urbanization; 2. Constructions (Roads); 3. Overgrazing; 4. Land clearing and fire.

	Species	1	2	3	4	Comments
1.	*V. noeana*		x			Widespread and common where suitable habitat
2.	*V. anatolica*	x	x			In the area species is very rare
3.	*V. pannonica*	x	x			Widely distributed
4.	*V. hybrida*		x	x		In the area species is very rare
5.	*V. sericocarpa*	x	x			Restrict to west part of Central Anatolia.
6.	*V. peregrina*			x	x	Widely distributed
7.	*V. cuspidata*	x	x			Restricted to the north-west part of Central Anatolia.
8.	*V. lathyroides*	x	x			Widely distributed
9.	*V. sativa* subsp. *sativa*		x	x		Widely distributed
10.	*V. sativa* subsp. *nigra*		x	x		
11.	*V. grandiflora*		x			B1 a,b (i, ii, iv)
12.	*V. truncatula*		x	x		Widely distributed

Table 16. continued

Species	1	2	3	4	Comments	Species
13.	*V.narbonensis*		x		x	Widely distributed
14.	*V. galilaea*		x		x	B1 a,b (i, iii, iv)
15.	*V. ervilia*	x	x			Widely distributed
16.	*V. caesarea* *	x	x			Widely distributed
17.	*V. tenuifolia* subsp. *dalmatica*			x		Widely distributed
18.	*V. tenuifolia* subsp. *tenuifolia*			x		
19.	*V. villosa* subsp. *villosa*		x			Widely distributed
20.	*V. villosa* *subsp. vary*		x			
21.	*V. monantha*				x	B1 a,b (i, ii, iv)
22.	*V. canescens* *subsp argaea* *		x			B1 a,b (i, iii, iv)
23.	*V. canescens* *subsp leucomella* *		x			Widely distributed
24.	*V. cappadocica*		x			Widely distributed
25.	*V. articulata*	x	x			B1 a, b (i, iv)
26.	*V. cassubica*		x		x	B1 a,b (ii, iv)

3.7. Infrageneric Grouping

In 17th century, Tournefort (1694) proposed the name *Vicia* in his book which was named as Elements de Botanique. He grouped 6 species in the *Vicia*. In addition to that, he excluded the faba bean because it was considered as a separate genus. Kupicha (1976) made the most acceptable revision of the genus *Vicia* L. She divided the *Vicia* into two subgenera. These were subgenus *Vicia* and *Vicilla.* These two subgenera's distinction was based on relative length of inflorescence and the presence of nectariferous spots on the stipules (Kupicha, 1976). Subgenus *Vicilla* was divided into 17 sections. Because of having high variation in the subgenus, it is difficult to make sectional classification. It was considered as more diverse group than the subgenus *Vicia*. Kupicha divided the subgenus *Vicia* into 5 sections. These were containing 38 species. Maxted (1993a) reviewed the subgenus and he splitted the species of it into 9 sections.

In this study, to make infrageneric grouping, 38 characters were used. They are consisting of some morphologic traits (Table 17). These characters were coded with the numbers. The use of analyses made clear the relationships of the taxa living in Central Anatolia. Unweighted Pair Group Method Using Aritmetic averages (UPGMA) was used in a special statistical program namely MVSP. At the end, the phenogram was obtained (Figure 83). The cut off line across the phenogram 0.83 Similarity level distinguishes the 13 sections. According to the phenogram, we can differentiate two subgenera which are named as *Vicia* and *Vicilia*. Data obtained as a result of statistical analyses is supporting the studies of Kupicha (1976) and Maxted (1991). These two have totaly 13 sections. The members of subgenus *Vicia* and *Vicilia* are given (Table 18).

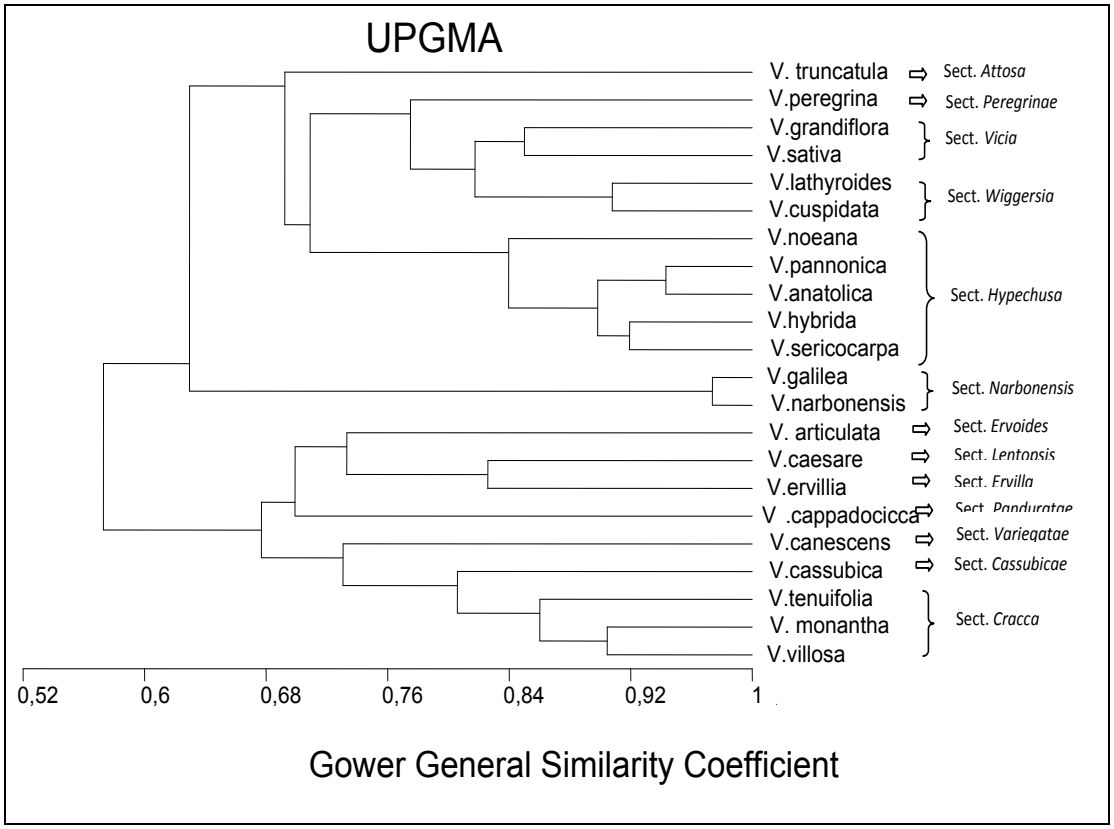

Figure 83. The phenogram obtained from the numerical analysis

Table 17. Morphologic characters used for the numerical taxonomic analysis.

Number of characters	Characters	Scoring
1.	Annual	0
	Perennial	1
2.	Stipules nectariferous spot on abaxial surface	0
	Stipules without nectariferous spot	1
3.	Inflorescence much shorter than the subtending leaf	0
	Inflorescence usually equalling Inflorescence exceeding the subtending leaf	1
4.	Few flowered	0
	Many flowered	1
5.	Calyx subregular	0
	Calyx irregular	1
6.	Style laterally compressed	0
	Style dorsally compressed	1
7.	Style glabrous adaxially	0
	Style pubescent all around	1
8.	Stem sparsely pubescent	0
	Stem densely pubescent	1
	Stem glabrous	2
9.	Leaflets 1-3 pairs	0
	Leaflets more than 3 pairs	1
10.	Leflet shape linear	0
	Leaflet shape elliptical	1
	Leaflet shape obovate	2
	Leaflet shape ovate	3
	Leaflet shape oblong	4
	Leaflet shape oblong lanceolate	5
11.	Leaflet broadest point at apex	0
	Leaflet broadest point in middle	1
	Leaflet broadest point at base	2
12.	Stipule size small	0
	Stipule size large	1

Table 17. (continued)

13.	Stipule shape lanceolate	0
	Stipule shape semi hastate	1
	Stipule shape semi sagitatte	2
	Stipule shape ovate	3
	Stipule shape palmate	4
14.	Stipule edge entire	0
	Stipule edge dentate	1
	Stipule edge 2-3 partite	2
15.	Stipules of the pair identical	0
	Stipules of the pair different	1
16.	Tendril absent	0
	Tendril present	1
	Tendril present in some leaves	2
17.	Number of flowers 1	0
	Number of flowers 1-4	1
	Number of flowers 5 or more	2
18.	Flower length 0.6- 0.9 cm	0
	Flower length 1- 2,5 cm	1
	Flower length over 2,5 cm	2
19.	Pedicel length shorter than calyx	0
	Pedicel length equal or longer than calyx	1
20.	Peduncle absent	0
	Peduncle shorter than flowers	1
	Peduncle up to as long as or longer than flowers	2
21.	Vexillum platonychioid	0
	Vexillum stenonychioid	1
	Vexillum oblong	2
	Vexillum ovate	3

Table 17. (continued)

22.	Standard color white	0
	Standard color yellow	1
	Standard color purple	2
	Standard color cream	3
	Standard color lilac	4
	Standard color lavender blue	5
	Standard color dark violet	6
23.	Standard glabrous	0
	Standard pubescent back	1
24.	Wing color pattern absent	0
	Wing color pattern wing differently colored	1
	Wing color pattern differently colored veins	2
25.	Wing color white	0
	Wing color yellow	1
	Wing color purple	2
26.	Calyx base shape not gibbous	0
	Calyx base shape slightly gibbous	1
	Calyx base shape strongly gibbous	2
27.	Calyx mouth shape straight	0
	Calyx mouth shape slightly oblique	1
	Calyx mouth shape strongly oblique	2
28.	Calyx hairness glabrous	0
	Calyx hairness calyx teeth only	1
	Calyx hairness general coverage	2
29.	Calyx hair density sparse	0
	Calyx hair density dense	1
30.	Calyx color green	0
	Calyx color purple at base	1
	Calyx color teeth purple	2
	Calyx color purple	3
	Calyx color dark at base	4

Table 17. (continued)

31.	Legume shape rhomboid	0
	Legume shape oblong	1
	Legume shape oblaceolate	2
	Legume shape linear	3
32.	Legume glabrous	0
	Legume pubescent on entire coverage	1
	Legume pubescent only on suture	2
33.	Legume torulose	0
	Legume shape linear	3
	Legume not torulose	1
34.	Legume beak absent	0
	Legume beak short	1
	Legume beak long	2
35.	Legume beak shape straight	0
	Legume beak shape curved up	1
	Legume beak shape curved down	2
36.	Seed number 2	0
	Seed number 4	1
	Seed number 5 or more	2
37.	Seed size 3,5(6) mm	0
	Seed size over 6 mm	1
38.	Lens of seed opposite to hilum	0
	Lens of seed close to hilum	1

Table 18. The subgenus and sections of collected specimens

Subgenus	**Section**	**Taxa**
Vicilla	*Cracca*	*V. tenuifolia* Roth. *V. villosa* Roth agg. *V. monantha* Retz.
	Cassubicae	*V. cassubica* L.
	Variegatae	*V. canescens* Labill. agg.
	Panduratae	*V. cappadocica* Boiss. & Ball.
	Ervilia	*V. ervilia* (L.) Willd.
	Lentopsis	*V. caesarea* Boiss. & Ball.
	Ervoides	*V. articulata*
Vicia	*Hypechusa*	*V. noeana* (Reuter in Boiss.) Boiss. *V. anatolica* Turrill *V. pannonica* Crantz *V. hybrida* L. *V. sericocarpa* Fenzl
	Peregrinae	*V. peregrina* L.
	Wiggersia	*V. cuspidata* Boiss. *V. lathyroides* L.
	Vicia	*V. sativa* L. *V. grandiflora* Scop.
	Narbonensis	*V. galilaea* Plitm. & Zoh. in Plitm. *V. narbonensis* L.
	Attosa	*V. truncatula* Fischer ex Bieb.

3.8. Revision of the Genus *Vicia* L.

Description of the genus *Vicia* L.

Annual, biennial or perennial herbs, eglandular. Stems wingless, often climbing. Leaves usually paripinnate, ending in a mucro or tendril, rarely imparipinnate; leaflets 1-many-paired, entire or rarely toothed, with anastamosing lateral veins. Stipules entire or toothed, with or without a dark nectariferous blotch. Flowers in axillary racemes or solitary. Calyx regular to bilabiate, gibbous or not: teeth equal or unequal, not leafy. Wings free or coherent to the keel. Style towards apex pubescent all round, or bearded only on the lower side, or rarely with a line or hairs along the upper side or glabrous. Legume ± compressed, 1-many-seeded. suture not winged. Seeds subglobrose or sometimes compressed, hilum often elongate.

3.8.1 Key to Sections

1. Inflorescence much shorter than the leaf, usually 1 or few flowered.
    2. Calyx subregular; sutures of legume parallel
        3. Wing limb without basal folding **4.**sect. *Vicia*
        3. Wing limb with slight or strong basal folding **3.**sect. *Wiggersia*
    2. Calyx irregular; sutures of legume not parallel
        4. Inflorescence several flowered; vexillum oblong
            5. Perrennial; lens of seed close to hilum **5.**sect. *Attosa*
            5. Annual; lens of seed opposite to hilum **1.**sect. *Hypechusa*
        4. Inflorescence 1-2 flowered; vexillum stenonychioid
            6. Leaflets more than 2 cm long **6.**sect. *Narbonensis*
            6. Leaflets less than 2 cm long **2.**sect. *Peregrinae*

1. Inflorescence usually equalling or exceeding the leaf, usually many flowered.
   7. Vexillum oblong
      8. Perrenials with many flowered inflorescences; if stipules dimorphic, neither of the pair laciniate **13.**sect. *Cassubicae*
      8. Annuals with few-flowered inflorescences; stipules strongly dimorphic, one of the pair lacinate **12.**sect. *Ervoides*
   7. Vexillum platonychioid, stenonchioid or ovate
      9. Style laterally compressed **9.**sect. *Cracca*
      9. Style dorsally compressed
         10. Perrennials **10.**sect. *Variegatae*
         10. Annuals
            11. Style pubescent all around, tufted on abaxial side **11.**sect. *Panduratae*
            11. Style evenly pubescent
               12. Seeds subglobose; calyx teeth equal; leaves mucronate **7.**sect. *Ervilia*
               12. Seeds lenticular; upper calyx teeth longer than lower; leaves have a simple tendril **8.**sect. *Lentopsis.*

3.8.2. Key to Species

1. Inflorescence much shorter than subtending leaf, usually I-few flowered
   2. Calyx subregular; sutures of legume parallel
      3. Leaves usually with more than three pairs of leaflets (if fewer then leaflets less than 1 cm long)lateral veins of leaflets prominent and straight
         4. Wing limb without basal folding
            5. Flowers 10-14 mm; legume with a long, nearly straight but subuncinate beak seeds ruminate- reticulate, 2.5-3.5 mm **7. cuspidata**
            5. Flowers 6-9 mm; legume with a short recurved beak; seeds tuberculate, smaller. **8. lathyroides**
         4. Wing limb with slight or strong basal folding
            6. Flowers purplish; peduncle usually absent **9. sativa**
            6. Flowers cream or yellow; peduncle very short
               7. Leaves all ending in a mucro; leaflets (5-) 10-16- paired, linear oblong **11. truncatula**
               7. Leaves with branched tendrils; Leaflets (2-) 3-7 paired, obovate to oblong or even linear **10. grandiflora**
      3 Leaves with 1-3 pairs of leaflets which are more than 2 cm long; lateral veins of leaflets not prominent, curving towards apex
         8. Leaflets 2-4 paired, up to 2cm broad; corolla purple or violet throughout **12. narbonensis**
         8. Leaflets 1-2 paired, some usually larger than above; corolla paler and bicolored, lilac or bluish wings and keel purple violet at apex **13. galilea**
   2. Calyx irregular; sutures of legume not parallel
      9. Infloresecence several flowered; vexillum oblong
         10. Flowers yellow or white; lens of seed opposite hilum

11. Standard hairy on the upper surface

12. Peduncles at least as long as pedicels, 2-4 flowered; flowers (14-) 16-22 mm **3. pannonica**

12. Peduncles very short or absent, flowers 1-2 in leaf axils, longer or shorter than above

13. Flowers (-18) 20-31(35) mm, sulphur yellow throughout; limb broad as long as claw **4. hybrida**

13. Flowers 15-18 mm, the wings with dark brown tips; limb narrow, shorter than claw **2. anatolica**

11. Standard glabrous throughout, fruits hairy or glabrous

14. Pubescent to glabrous annual, leaflets 5-7 paired, (7-)8-35(-40) x 2-5(-8) mm, standard with a wide emarginated limb c. as long as claw, peduncle shorter than the flowers **1. noeana**

14. Adpressed-pilose annual, Leaflets 3-8 paired, (3-)5 18(-22) x 1-3 mm, standard with limb broad, longer than claw, peduncle usually much longer than calyx **5. sericocarpa**

10. Flowers purplish; lens of seed close to hilum **6. peregrina**

1. Inflorescence usually equaling or exceeding the subtending leaf, usually many flowered

15. Vexillum oblong

16. Annual, with few-flowered inflorescences; stipules strongly dimorphic, one of the pair finely laciniate **21. articulata**

16. Perrennials with many-flowered inflorescences; if stipules dimorphic, neither of the pair lacinate

17. Leaves hypostomatic, usually with few pairs of leaflets, style dorsally compressed **22. cassubica**

17. Leaves epistomatic, usually with many pairs of leaflets

15. Vexillum platonychioid, stenoychioid or ovate

18. Vexillium platonychioid

19.Style laterally compressed

20.All the stipules monomorphic

21.Plants annual or biennial; calyx very strongly gibbous at base, leaflets 4-10 paired; flowers 12-22 mm **17. villosa**

21. Plants perennial; calyx weakly gibbous at base, leaflets (5-) 8-16(-22)-paired; flowers 13-18(-20) mm **16. tenuifolia**

20. Stipules bipartitate to sparsely dentate **18. monantha**

19. Style dorsally compressed

22.Perennials; style glabrous adaxially, densely bearded on abaxial side, leaflets 5-12 paired, raceme closely 3-18 flowered, Flowers large 17-25 mm **19. canescens**

22. Annuals; style pubescent al round, tufted on abaxial side, leaflets 2-4(-5) – paired, 1(-2)- flowered, Flowers (10-)12-14(-15) mm **20. cappadocica**

18. Vexillum stenonychioid to ovate

23. Seeds subglobose; calyx teeth equal; leaves mucronate, **14. ervilia**

23. Seeds lenticular; upper calyx teeth longer than lowermost one; leaves with a simple tendril **15. caesarea**

3.8.3. Species descriptions

Sect. *Hypechusa* (Alef.) Aschers, & Graebner,

Synonym: Mitteleur, Fl., 6.2:957 (1909).

Description: Annual, climbing. Stem slender. Stipules entire or semi hastate; 1-5.5 x 0.5-4 mm; edge entire or with 1-2 teeth, Leaf 14-105(-115)mm; apex tendrilous; 2-20 leaflets per leaf; leaflet 5-35(-40) x 1-15 mm; symmetric; margins entire. Peduncle 1-10(-28); with 1-4 flowers. Calyx mouth oblique; lower tooth longer than upper; base gibbous; pedicel 1-4. flowers 12-35 mm; all petals approximately equal length; standard cream or yellow, rarely blue or purple; shape platonychioid or stenonychioid; claw bowing absent; upper standard surface glabrous or pubescent. Wing marking absent or present; wing limb with slight or strong basal fold, Legume 14-40 x 6-12 mm; oblong; round in cross section; sutures curved; valves glabrous or pubescent; hairs simple or tuberculate; septa absent; 1-6 seeds per legume. Seeds 2-5.5 x 2-6.5 mm; round or oblong; not laterally flattened; hilum less than quarter of seed circumference; lens positioned opposite to hilum; testa surface smooth.

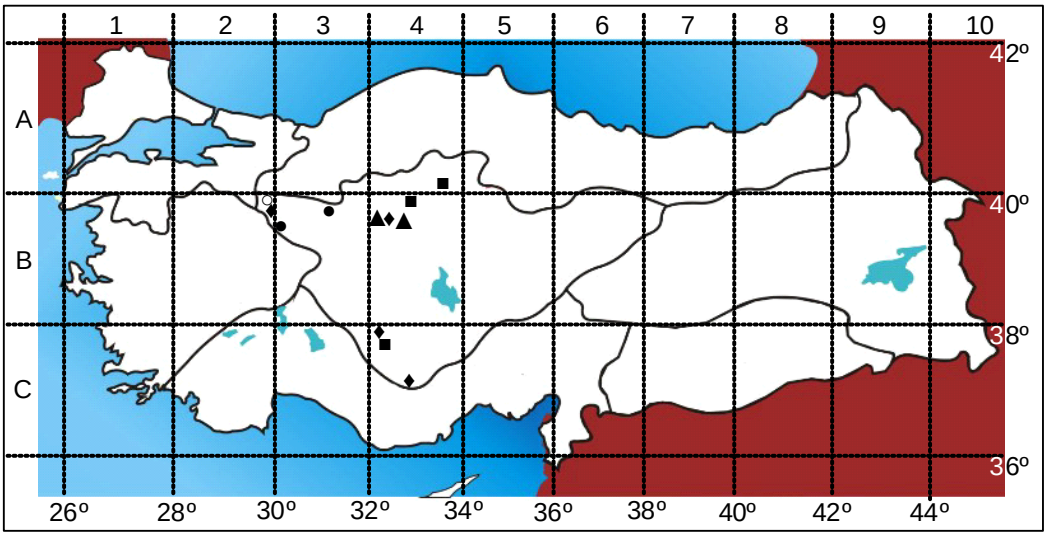

Figure 84. Distribution map of section *Hypechusa* (■) *V. noeana* var. *noeana*, (▲) *V. anatolica*, (●) *V. pannonica* var. *pannonica*, (○) *V. hybrida*, (♦) *V. sericocarpa* var. *sericocarpa*

1. *V. noeana* Reuter ex Boiss., Fl. Or. 2:572 (1872). Map 63, p. 309.

Annual. Stem pubescent to glabrescent 20-65 cm, erect or scrambling. Leaflets 5-7-paired, (7-)8-35(-40) x 2-5(-8) mm, linear to oblong-oblanceolate, obtuse to retuse, sometimes acutish or notched or tridenticulate. Stipules 2-3 mm, semihastate to lanceolate-triangular; tendrils ± branched. Peduncle shorter than the (l-)2-4-flowers. Flowers 17-24(-26) mm, cream to pinkish buff. Calyx 7-15 mm, tubular, gibbous, with an oblique mouth, finely pubescent, violet or rarely greenish; teeth unequal, shorter than tube or sometimes longer. Standard with a wide emarginate limb c. as long as claw. Legume oblong, 20-30 × 8-10 mm, with convex edges, glabrous. Seeds (2-)3(-5). hilum 1/6 of perimeter. *Fl. 4-6.*

Habitat and phenology: Flowering time is in between April and July. *Vicia noeana* species are living in altitude 500-2000 m; habitats of this plant are localized minor cultivated crop and weed of disturbed and agricultural lands.

Type: [Turkey C6 Gaziantep] inter segetes prope Aintab (Gaziantep) 610 m, 25 iv 1865. *Haussknecht* (W! G!).

Distribution in Central Anatolia: **A4** Çankırı: Çankırı to Kalecik, *D.* 21754! **B4** Ankara: Ankara, *Frères E.C.* ibid., *Kotte* 251! **C4** Konya:N of Çumra, 40 km E of Konya, 1000 m, *Ledingham et al.* 4362! **B5** Sivas: Hafik road, 1397 m, 22.06.2010 O. Binzat 196! Kayseri: Küçük Süveğen village 38.33.652K 35.55.429D 1349 m. 19.06.2010 O. Binzat179! **B6** Sivas: Divriği to Kangal, 1887m. 21.06.2010, O. Binzat 184!

Distribution in Turkey: Mainly Inner Anatolia.

General distribution: Iran, N. Iraq, Syrian Desert, Transcaucasia, Cyprus.

Phytogeography: Ir.-Tur. element.

Figure 85. General appearences of *V. noeana*

2. *V. anatolica* Turrill in Kew Bull. 1:8 (1927).

Synonym: *V. hajastana* Grossh. In Beih. Bot. Centr. 44(2): 224 (1928).

Annual. Stem densely adpressed-pilose, 12-40 cm, ascending to erect. Leaflets 4-8 paired, 5-20x1-3 mm, obovate to linear, truncate, retuse or obtuse. Stipules c. 2 mm, ovate; tendrils simple. Peduncle obsolescent. Pedicels shorter than calyx. Flower l(-2), 15-18 mm, ± bicoloured; Calyx 7-8 mm, with an oblique mouth, rather gibbous, adpressed-pubescent; teeth almost as long as or shorter than tube, narrowly linear lanceolate. Standard with the limb adpressed pubescent on the upper surface, yellow, narrow, c. 2/3 as long as claw; wings dark brown (sepia) at apex. Legume oblong-subrhomboid, (20-)25-30 x 7-8 mm, densely adpressed-pilose-villous. Seeds (3-)6.

Habitat and phenology: Flowering time is in between April and July. This plant lives in the altitude range of 800-2000 m. The habitats of this species are disturbed lands, orchards and mountain pasture.

Holotype: [Turkey B4 Ankara] Chankaya (Çankaya) nr. Angora (Ankara), 10-20 v 1926, *Lindsay* 51 (K!).

Distribution in Central Anatolia: **A4** Ankara: Ayaşbeli, pınaryaka köy üstü. Q. Pubescens altı. Ca: 1300m. 9.6.1975 Y. Akman! Ayaş, Pınaryaka village, 1090 m, 06.07.2010, O. Binzat 254!

Distribution in Turkey: Scattered in Inner & S.W. Anatolia

General distribution: Soviet Armenia. C. Asia.

Phytogeography: Ir.-Tur. Element

Figure 86. General appearences of *V. anatolica*.

3. *V. pannonica* Crantz, Stirp. Austr. ed. 2, fasc. 5:393 (1769).

Annual. Stem ± adpressed-pilose decumbent or climbing, 20-80(-110) cm. Leaflets (4-) 5-9 paired, 6-25(-35) × 2-7(-8) mm, linear or linear-oblanceolate to oblong or obovate, obtuse, truncate or retuse. Stipules 1-4 mm, semi-hastate to ovate or lanceolate; tendrils simple or branched. Peduncle somewhat shorter than calyx, 2-4-flowered. Flowers 15-22 mm, yellowish, whitish brown or purplish. Calyx 8-13 mm, somewhat gibbous, with a rather oblique lip, densely pilose; teeth unequal, the lower c. as long as tube, linearsubulate. Standard subadpressed-pubescent on the outer surface, limb about as long as claw. Legume oblong, 15-30 x 6-10 mm, acute, convex at the lower edge, densely adpressed pilose-villous. Seeds 2-7, hilum 1/6-1/4 of perimeter.

Habitat and phenology: Flowering time is in between May and July. It lives in the altitude between 15 -2000 m. Habitat is disturbed and agricultural lands. ,

Figure 87. General appearences of *V. pannonica*

Type: [Austria], ad aggerem Belveder, *Crantz.*

Distribution in Central Anatolia: **A4** Ankara: Beypazarı Karaşar Ca: 1000m 28.5.1971 Y. Akman! **A5** Yozgat Behramşah kalesi 1104 m. 23.06.2010 O. Binzat 203! **B6** Sivas: Zara-Şerefiye road, 1639 m, 05.06.2010 O. Binzat 141!

Distribution in Turkey: N.W. Turkey, S. W. Anatolia.

General distribution: N.W. Africa, Cyprus, Caucasia, N. & N.W. Iran.

Phytogeography: Unknown or Multiregional

4. ***V. hybrida*** L., Sp. PL 737 (1753).

Synonym: *V. linnaei Rouy*, Fl. Fr. 5:220 (1899). Ic: Reichb., Ic. Fl. Germ. 22: t. 244 (1903); Fiori, Ic. Fl. Ital. f. 2155 (1899).

Annual. Stem adpressed-pilose, 15-80 cm, decumbent, ascending or climbing. Leaflets 5-7paired, 5-20 x 3-8 mm, obovate to oblanceolate, sometimes obtriangular or linear, cuneate at base, truncate to notched, rarely obtuse. Stipules 2-3 mm, semi-hastate, the upper lanceolate. Tendrils simple or branched. Peduncle usually nil. Pedicel shorter than calyx. Flowers solitary, (18-)20-31(-35) mm, sulphur yellow, sometimes purple veined. Calyx 8-10 mm, somewhat gibbous, with an oblique mouth, pilose; teeth shorter than tube, unequal, lanceolatelinear. Standard subadpressed-pubescent on the upper surface, limb broadabout as long as claw. Legume oblong-rhomboid, 20-35 x 6-12 mm, adpressed, pilose. Seeds 2-5. hilum 1/10-1/8 of perimeter.

Habitat and phenology: Flowering time interval is larger than the others. This time interval is from March to August. Altitude changes 2-1500 m. disturbed and undisturbed lands and open woodlands are the living places of this species.

Described from S. France (Hb. Linn. 906/27!).

B3 Eskişehir: Sündiken dağı Sarıçam deresi C:500m. 4.6.1971 T. Ekim! Sündiken dağları 1435 m. 16.6.2010 O. Binzat 154!

Distribution in Turkey: Widespread. but mainly in Outer Anatolia, Turkey-in-Europe and Islands.

General distribution: Medit. area, Romania, Crimea, Syrian Desert, N. Iraq, Iran, Soviet Azerbaijan, Transcaspia.

Phytogeography: Unknown or Multiregional

Figure 88. General appearance of *V. hybrida*

5. *V. sericocarpa* Fenzl, Pug. no. 4 (1842). var. sericocarpa. Ic: Boul., Fl. Lib. Syr. t. 138 (1930).

Annual. Stem adpressed-pilose, 6-80 cm, ascending or climbing. Leaflets 3-8 paired, (3-)5-18(-22) × 1-3 mm, linear to obovate, obtuse or truncate to retuse or praemorse. Stipules c. 3 mm, semi-hastate to lanceolate-subulate. Tendrils mostly branched. Peduncle usually much shorter than calyx (rarely slightly longer). Flowers 18-29 mm, sulphur or cream, generally solitary, rarely twin. Calyx c. 9-13 mm, gibbous, with an oblique mouth, densely adpressed-pilose; teeth unequal, equal to or shorter than tube, linear-subulate. Standard with limb broad, ± retuse, glabrous, longer than claw. Legume 15-30 x 7-10 mm. oblong-rhomboid, slightly turgid, beaked, densely adpressed-sericeo-villous. Seeds 2-4, hilum c. 1/6 of perimeter.

Habitat and phenology: Flowering time is in between March and July. Altitude changes in between 20-2000m. Habitat for this species is disturbed and undisturbed lands, limestone pavement.

Lectotype: [Turkey C5] Tauri Cilicici circa Gulek, 1836, *Kotschy* 151 (W!).

Distribution in Central Anatolia: **A4** Ankara: Hacı kadın valley 980m. 40 00 450K 32 52 46D 4.7.2010 O.Binzat 248! Hacı kadın valley 1.5.1942 H. Bağda! Ayaş, Pınaryaka köyü, 1090 m, 06.07.2010, O. Binzat 253! **B3** Eskişehir: Sündiken Mountain, Mihalıççık around Beşpınar, P. nigra forests Ca:1400m. T. Ekim! **C4** Konya: Ermenek Bozdağ south side of Q. cocifera bushy area Ca:1100m. 28.5.1978 M. Vural! Bucakkışla, Dede dağı rocky dried hillside Ca. 580m. 29.5.1979 M. Vural! Karaman: Karadağ, Radar road, 37 23 510K 33.09.738D 1851m. 22.5.2010 O. Binzat 140!

Distribution in Turkey: N.W., S. & E. (southern) Anatolia, Islands.

General distribution: W. Syria, N. Iraq, Syrian Desert, W. Iran, Cyprus.

Phytogeography: Unknown or Multiregional

Sect. *Peregrinae* Kupicha, Notes R.B.G. Edinburgh., 34:323 (1976)

Description: Annual. Climbing or scrambling; stem slender. Stipules entire or semi hestate; 1-4 x 1-4 mm; edge entire or with 1-2 teeth. Leaf 22-80 mm; apex tendrilous; 4-16 leaflets; leaflet 6-40 x 1-6 mm; symmetric; margins entire. Peduncle absent; with 1 flower. Calyx mouth oblique; lower tooth longer than upper; base gibbous; pedicel 1-3 mm. flowers 9-24 mm; all petals approximately equal length; standard cream, blue or purple; shape platonychioid or stenonychioid; claw bowing present; upper standard surface glabrous. Wing marking absent; wing limb with slight basal folding. Legume 12-40 x 4-15 mm; oblong; round in cross-section; sutures curved; valves pubescent; hairs simple; septa absent; 2-7 seeds per legume. Seeds 3.5-6.5 x 3.5-9.5; round or oblong; laterally flattened or not laterally flattened; hilum less than quarter of seed circumference; lens positioned near hilum; testa surface smooth.

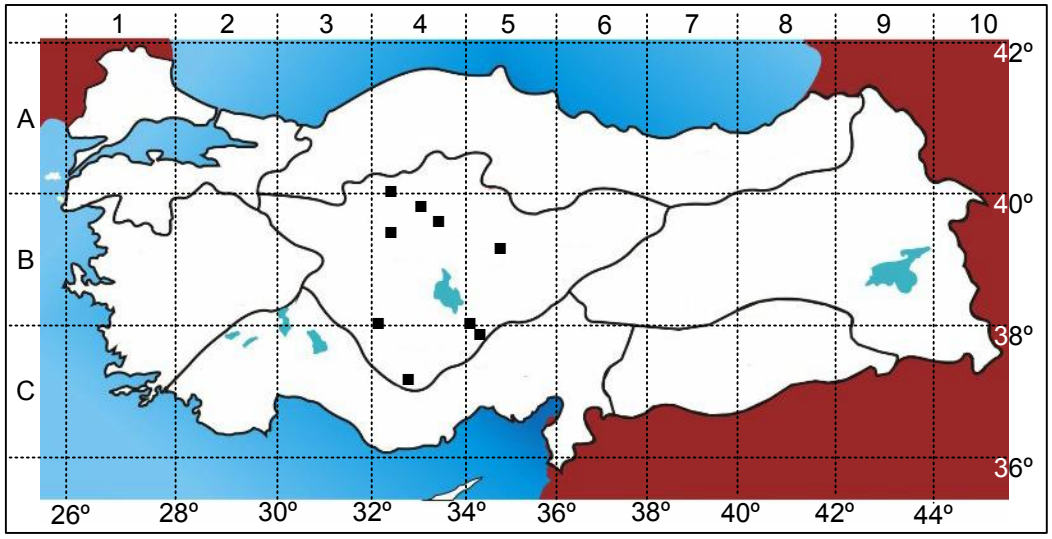

Figure 89. Distribution map of section *Peregrinae* (■) *V. peregrina*

6. *V. peregrina* L., Sp. PL 737 (1753). Ic: Reichb., Ic. Fl. Germ. 22: t. 246 (1903); Fiori, Ic. Fl. Ital. f. 2159 (1899).

Annual. Stem adpressed-puberulent or pubescent, 10-70(-95) cm, procumbent to erect. Leaflets 3-5 paired, 5-35(-40) x 0.5-5(-6) mm, narrowly linear to oblanceolate or narrowly cuneate. tapering at base, retuse to praemorse, sometimes acuminate or obtuse. Stipules 3-4 mm. minute, semi-hastate, the upper lanceolate: tendrils simple or branched. Peduncle nil. Pedicel c. as long as calyx. Flowers l(-2), violet, 12-20 mm. Calyx 6-9 mm, somewhat gibbous, with an oblique lip; teeth almost as long as tube, unequal, lanceolate-acuminate. Standard with limb c. 2 × claw. Legume narrowly oblong, (15-)20-40 x(4-)6-ll(-12) mm, shortly beaked, adpressed puberulent or sometimes glabrous. Seeds 3-7, hilum very short.

Habitat and Phenology: Flowering time is in between February- July. Habitats for this species are dry agricultural and disturbed lands. Altitude changes in 10-1450 m.

Described from France (Hb. Linn 906/28!).

Distribution in Central Anatolia: **A4** Ankara: Çubuk valley, *Kotte* 245! **B4** Ankara: 35 km from Sereflikoçhisar to Aksaray, 930 m, *Hub.-Mor.* 16192. METU on the road near the Mine Engineering Department 1022m. 18.06.2009 O. Binzat 31! Beypazarı Karasar yolu1174m. 40.28.355K 31.92.701D 06.07.2010 O. Binzat 252! Ayaş, Pınaryaka village, 40.51.399K 32.30.121D 1093 m, 06.07.2010, O. Binzat 255! Kırşehir: Akçakent road Çiçekdağı 1185 m. 39.34.506K 34.19.542D 26.6.2010 O. Binzat 222! Ankara: 35 km from Sereflikoçhisar to Aksaray,930 m, *Hub.-Mor.* 16192. **B5** Kayseri: Kayseri, *Bal.* 129! **C4** Konya: Konya to Çumra,Kücük Köy, 980 m, *Helbaek* 2590! Balkı – Beyşehir road 38.05.094K 31.49.547D 1197m. 17.06.2010 O. Binzat 157! Sivas: Hafik, 1579 m, 22.06.2010, O. Binzat 201! **C5** Niğde: Niğde in Ortakayaardi valley, 1200 m, *D.* 19066!

Distribution in Turkey: Widespread except in N. & N.E. Anatolia.

World distribution: Mediterranean, Crimea, S.W. & C. Asia.

Phytogeography: Unknown or Multiregional

Figure 90. General appearance of *V. peregrina*

Sect. *Wiggersia* (Alef.) Maxted, Kew Bull. 47(1): 129-130 (1991c).

Description: Annual, scrambling. Stem slender. Stipules entire or semi hastate; 2-6.5 x 1-4 mm; edge entire or with 1-2 teeth. Leaf 3-48 mm; apex tendrilous; 2-12 leaflets per leaf; leaflet 2-23 x 1-9 mm; symmetric; margins entire. Peduncle 1-2 mm; with 1 flower. Calyx mouth straight; teeth subequal; base not gibbous. Pedicel 1-2 mm. Flowers 5-15mm; all petals approximately equal length. Standard cream, blue or purple; shape stenonychioid; claw bowing absent; upper standard surface glabrous. Wing marking absent; wing limb without basal folding. Legume 13-35 x 3-5 mm; linear; round in cross section or laterally flattened; sutures parallel or curved; valve glabrous or pubescent;

hairs simple; septa absent; 4-8-(12) seeds per legume. Seeds 1.5-3.5 x 1-3 mm; round; not laterally flattened; hilum less than quarter of seed circumference; lens positioned near hilum; testa surface rough.

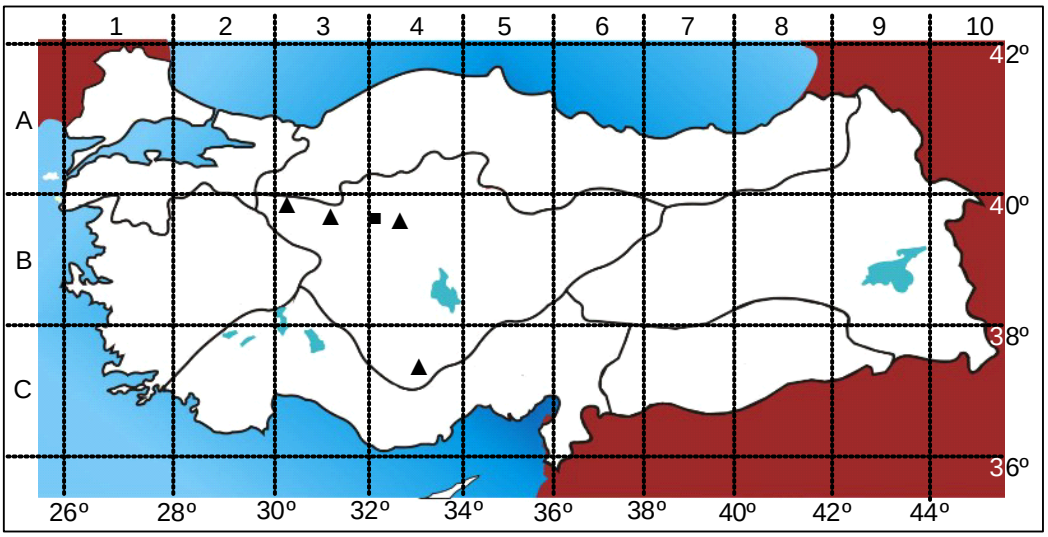

Figure 91. Distribution map of section *Wiggersia* (■) *V. cuspidata*, (▲) *V. lathyroides*

7. *V. cuspidata* Boiss., Diagn. ser. 1(2): 104 (1843).

Annual. Stem finely pubescent, 8-50 cm, decumbent or ascending. Leaves lower leaves with 1-3-pairs of leaflets, the upper with 4-5 pairs; leaflets variable in length, up to 17(-23) x l-6 mm, obovate cuneate to linear-lanceolate, retuse to acute, awned. Stipules up to 5 mm, semi ovate the uppers semi-sagittate. Tendrils mostly simple. Flowers solitary, 10-14 mm, nearly sessile, usually purple, sometimes bluish or whitish. Calyx 5-7 mm, with a rather straight mouth, adpressed-pilose; teeth almost as long as tube, almost equal, lanceolate. Legume generally linear, 22-27 x 3-4 mm, attenuate into a long, nearly straight subuncinate beak, glabrous. Seeds 5-8, 2.5-3.5 mm, ruminatereticulate, hilum minute.

Habitat and Phenology: Flowering time is in between April – June. Habitats of this species are disturbed and undisturbed lands and open woodlands. Altitude that this plants grow is changing between 120-1550 m.

Syntypes: [Turkey] In pinetis montium Lydiae et Cariae; [Bl Izmir] montes circa Smyrnam (Izmir); [B2 Izmir] Tmolus; [C1 Aydin] Mesogis supra Tralles; [C2 Denizli] Cadmus (Baba Da.), *Aucher* 981; v 1842, *Boissier* (G!).

Distribution in Central Anatolia: **A4** Ankara Nera Ayaşbeli Uzteks factory 1141m. 28.6.2009 O. Binzat 57! Ayaşbeli Ca:1300m. inside Q.pb. 5.6.1975 P.H. Davis!

Distribution in Turkey: W. Turkey, Islands; rare in S. & C. Anatolia.

General distribution: Greece (Thrace), Lebanon, Anti-Lebanon, Palestine, N.W. Iran.

Phytogeography: E. Medit element.

8. *V. lathyroides* L., Sp. PL 736 (1753). Ic: Reichb., Ic. Fl. Germ. 22: t. 242 (1903).

Annual. Stem slender, more or less pubescent, 5 – 40 cm, decumbent to ascending. Leaflets 2 – 4 paired, (2-)4-15(-20) x 1-5 mm, the lower obovate oblong, truncate or retuse, the upper oblong to linear-lanceolate, truncate to retuse, sometimes acute, mucronulate. Stipules subentire, semi-sagittate. Tendrils generally short and simple. Flowers mostly solitary, 6-9 mm, subsessile or short-pedicelled, violet, rarely bluish or white. Calyx 3-5 mm, almost regular, pilose; teeth about as long as tube, subequal, lanceolate-subulate. Legumes linear, 15-30 x 2-4 mm, contracted into a short recurved beak, glabrous**.** Seeds 5-8, 1.5-2 mm, tuberculate, hilum minute.

Habitat and Phenology: Flowering time is in between March - August. Habitats for this species are lawn and grazed pasture weeds, open woodlands and disturbed lands.

Described from England and Germany (Hb. Linn. 906/22!).

Distribution in Central Anatolia: **A3** Ankara Beypazarı Karasar yolu 40.28.355K 31.92.701D 1174m. 06.07.2010 O. Binzat 251! Beypazarı step 23.7.1972 Y. Akman! **B3** Eskişehir: Sündiken Mountain at the base of Quercus forests Ca:1400 m. 22.6.1974 T.Ekim! **B4** Ankara Hacı kadın valley 980m. 40 00 450K 32 52 46D 4.7.2010 O.Binzat 245! **C4** Konya Ermenek Kazancı town rocky places around Çökek region 1000m. 11.4.1984 H.Sümbül 2821!

Distribution in Turkey: Mainly N.W., W. & S.W. Turkey; rare in E. Anatolia.

General distribution: Most of Europe, N. W. Africa, Cyprus, Syrian Desert (Dj. Druze); N. Iraq?

Phytogeography: Unknown or Multiregional

Sect. *Vicia* L., Sp. Pl. 736 (1753). Fl. Eur., 2:134; Fl. Iran., 41; Fl. Iraq, 3; 528; Fl. Pal., 2:202; Fl. Tur., 3;303; Fl. USSR., 13: 453.

Description: Annual or perennial; climbing; stem slender. Stipules entire or semi-hastate or semi sagittate; 2.5-12 x 1-11mm; edge entire or width 1-8 teeth. Leaf 12-84 mm; apex tendrilous; 4-18 leaflets per leaf; leaflets 7-38 x 1-15 mm; symmetric; margins entire, serrate or incised. Peduncle 1-13 mm; with 1-4 flowers. Calyx mouth straight; teeth subequal; base not gibbous; pedicel 1-4 mm. flowers 10-33 mm; all petals approximately equal length; standard cream, yellow blue or purple; shapestenonychioid; claw bowing absent; upper standard surface glabrous. Wing marking absent; wing limb with slight or strong basal folding. Legume 6-70 x 4-12 mm; linear or rectangular; round in cross

section or laterally flattened; sutures straight; valves glabrous or pubescent; hairs simple; septa absent or present; 1-14 seeds per legume. Seeds 2-7 x 2-7 mm; round; laterally flattened or not laterally flattened; hilum less than quarter of seed circumference or over half of seed circumference; lens positioned near hilum; testa surface smooth.

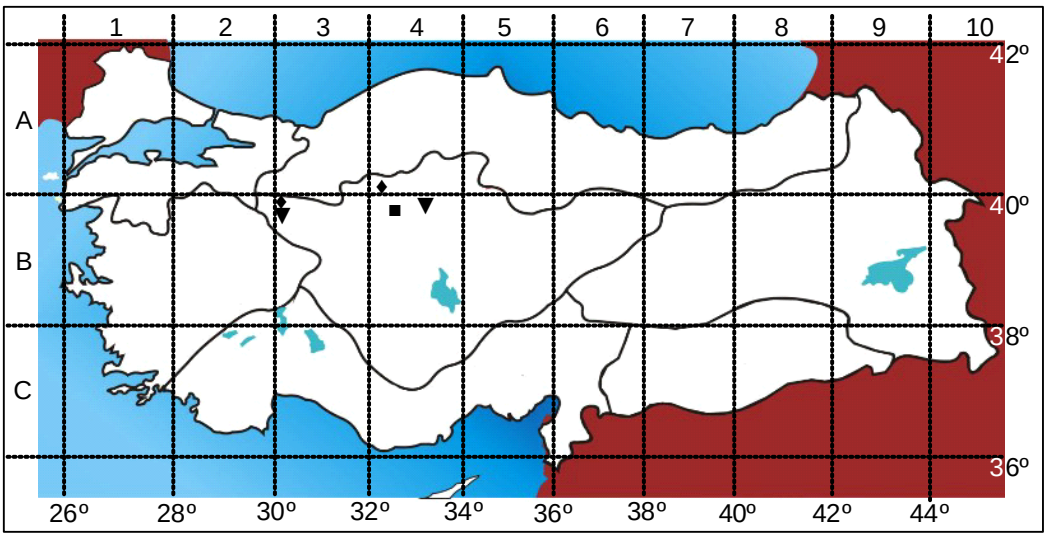

Figure 92. Distribution map of section *Vicia* (■) *V. sativa* L. subsp. *sativa* (▼) *V.sativa* L. subsp. *nigra* var. *segetalis* (●) *V. sativa* L. subsp. *angustifolia* (♦) *V. grandiflora* var. *grandiflora*

9. *V. sativa* L., Sp. PL 736 (1753). Zhukovsky, La Turquie Agricole, 382-402 (1933); Mettin & Hanelt in Kulturpfl. 12:163-225 (1964); Yamamoto in Mem. Fac. Agric. Kagawa Univ. 21:1-104 (1966).

Annual. Stem pubescent to subglabrous 20-90 cm, decumbent to erect or climbing. Leaflets 4-8 paired, usually 10-40x2-15 mm, linear or lanceolate to oblong or obovate, rarely deeply toothed. Stipules semi-hastate, dentate, rarely entire. Tendrils branched. Flowers l-2, axillary, (10-)14-27(-30) mm, pale pink to purplish violet, rarely white, short-pedicelled. Calyx 7-20 mm, campanulate-tubular, nearly regular, pubescent; teeth (3-)5-l 1(-14) mm, subequal, linear-subulate or lanceolate. Legume (25-)35-65(-70) x 5-

9(-12) mm, linear, somewhat beaked, usually ± pubescent; sometimes also with subterranean, 1-2-seeded fruits. Seeds (of aerial legumes) usually 6-12, smooth, 2-7diam., hilum short.

1.a. Legumes ± torulose, 45-70 *x* 6-10 mm **subsp. *sativa***

1.b. Legumes not torulose, generally smaller, less than 6.5 mm broad **subsp. *nigra***

subsp. *sativa*. Syn: *V. sativa* L. subsp. *obovata* (Ser.) Gaudin, Fl. Helv. 4:510 (1829); *V. torulosa* Jord. in Bor., Fl. Centr. Fr. ed. 3, 2:173 (1857). Ic: Reichb., Ic. Fl. Germ. 22: t. 248 (1903).

Habitat and phenology: *V. sativa* subsp. *sativa*, Flowering time interval changes in between January and December. Agricultural and disturbed lands, margins of woodlands are the places where this subsp. can be found. Elevations changes in the range 10-2100 m. This subsp. is grown, both as a fodder and forage plant in Europe, North Africa and West Asia.

Described from Europe (Hb. Cliff.! Hb. Linn. 906/20!).

Distribution in Central Anatolia: **B3** Eskişehir Sündiken Mountain Gökçekaya Alapınar base 18.5.1971 T.Ekim! **B5** Sivas: Hafik, 1346 m, 22.06.2010 O. Binzat 204!

Phytogeography: Unknown or Multiregional

subsp. *nigra* (L.) Ehrh. in Hannover. Mag. 1780 (15): 229 (1780).
var. *nigra*. Syn: *V. sativa* L. var. *angustifolia* L., Fl. Suec. ed. 2, 2:255 (1755) in obs.; *V. sativa* L. var. *nigra* L., Sp. P1. ed. 2, 1037 (1763); *V. sativa* L. subsp. *angustifolia* (L.) Aschers. & Graebn., Syn. Mitteleur. Fl. 6(2):971 (1909). Ic: Reichb., Ic. Fl. Germ. 22: t. 250 (1903); Guinea (op. cit.) 26, t. (1953).

Habitat and phenology: *V. sativa* subsp. *nigra* (L.) Flowering time for this subspecies is in between February and November. Common pan-temperate and semi-tropical weeds, agricultural and disturbed lands, margins of the woodlands are the places on where the plant grows. This subsp. is most widespread form of sativa subspecies.

Described from Europe.

Distribution in Central Anatolia: **B4** Ankara: Polatlı roadsides humid places Ca: 900m. 8.6.1984 Y.Akman! **B5** Yozgat: Akdağmadeni Ortaköy-Göl deresi, Kayabaşı region Kayalık Ca :1550m. 7.7.1979 T.Ekim! **C4** Konya: Konya to Çumra, *Helbaek* 2602!

Phytogeography: Unknown or Multiregional

Habitat and Phenology: Flowering time is in between February to November. Habitats of this species are common pan temperate and semi tropical weeds, agricultural and disturbed lands and margins of woodlands. Altitude, at which the plant grows, changes in between 1-2900 m.

Figure 93. General appearance of *V. sativa*

10. *V. grandiflora* Scop., Fl. Carn. ed. 2, 2:65 (1772).

Annual, Stem ± pubescent or subglabrous, l8-90 cm. usually climbing. Leaflets 3-7 paired, (3-)5-30 × (l.5-)3-15(-20) mm, obovate to oblong or even linear, entire or margins rarely toothed, acutish to retuse. Stipules 3-5 mm, ovate to semi-hastate, tapering, the lower irregularly dentate; tendrils branched. Peduncle very short, pedicel much shorter than calyx. Flowers generally solitary (-3), pale yellow to buff, (16-)22-32 mm. Calyx 10-15 mm, nearly regular but rather gibbous, pubescent; teeth about as long as to much shorter than tube, subequal, lanceolate-subulate. Standard broad, limb c. 3/2 x as long as claw, glabrous. Legume broadly linear, 20-45(-50) x (4-)5-7(-9) mm, long-beaked, ± puberulent, glabrescent towards maturity. Seeds (6-)8-12, hilum c. (1/2-)2/3-3/4 of perimeter.

Habitat and Phenology: *V. grandiflora* var. *grandiflora*. Flowering time is in between March and July. Habitats for this plant are woodlands, woodland margins and disturbed lands. Elevation changes in the range of 200-1200 m.

Type: [Yugoslavia] Carniolia, Tergestus, *D. D. Krapf.*

Distribution in Central Anatolia: **A4** Ankara: İnözü, 774 m, 07.07.2010 O. Binzat 263! **B3** Eskişehir Türkmen Mountain T.Ekim!

Distribution in Turkey: Mainly Outer Anatolia, Turkey-in-Europe, Islands.

General distribution: C. Europe, N. Balkans, S. Russia, Crimea, N. & N.W. Iran, Afghanistan.

Phytogeography: E. Medit.-Euro-Sib. element with Ir.-Tur. expansions.

Figure 94. General appearance of *V. grandiflora*

Sect. *Attosa* (Alef.) Asch. & Graebner,

Synonym: Mittelleur. Fl., &,2:949 (1909). Kupicha, Notes Roy. Bot. Gard. Edinburgh, 34:320 (1976).

Description: Perennial; erect or climbing; stem slender or stout. Stipules entire or semi hastate; 2.5-9 x 1-5 mm; edge entire or with 1-6 teeth. Leaf 25-254 mm; apex tendrilous or mucronate; 2-28 leaflets per leaf, leaflet 10-85 x 3-38 mm; symmetric; margins entire. Peduncle 7-32; with 1 to 8 flowers. Calyx mouth oblique;lower tooth longer than upper; base gibbous; pedicel 1-3mm. Flowers 12-22 mm; all petals approximately equal length; standard yellow blue or purple; shape platonychioid (limb and claw same width); claw bowing absent; upper standard surface glabrous. Wing marking absent; wing limb with slight basal folding. Legume16-43 x 3-5 mm; round or oblong; not laterally flattened; hilum over half seed circumference; lens positioned near hilum; testa surface smooth.

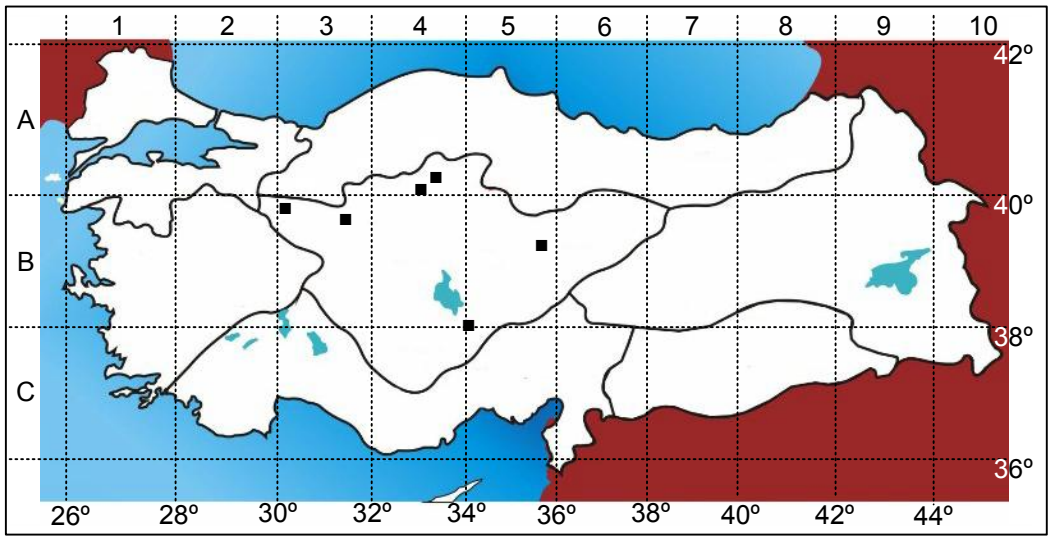

Figure 95. Distribution map of section *Attosa* (■) *V. truncatula*

11. *V. truncatula* Fischer ex Bieb., Fl. Taur.-Cauc. 3:473 (1819). Ic: Jáv. &Csap., Ic. Fl. Hung. 296 (1932); Fl. Azerb. 5: t. 44 f. 2 (1954). Map 61, p. 297.

Perennial. Stem rather slender, subglabrous erect, 15-35 cm. Leaves all ending in a mucro; leaflets 10-16-paired, linear-oblong, (5-)10-30 x2.5 mm, obtuse, mucronate. Stipules minute, semi-hastate, usually entire. Peduncle shorter than the flowers; raceme 3-7 flowered, dense. Calyx 6-8 mm, subglabrous or pubescent, mouth oblique; lowest tooth usually much shorter than tube. Corolla yellow, 14-16 mm. Legume narrowly oblong, 30-33 x 5-6 mm, attenuate towards base and apex, glabrous, several-seeded.

Habitat and phenology: Flowering time is in between June and July. Decidious woodlands, Abies and Pinus sylvestris forests are the habitats of this plant. Suitable altitude ranges is in between 600 -2150m.

Type: [Crimea] in Tauria maxime meridionale, circa Nikitam. (In error for the Caucasus ?).

Distribution in Central Anatolia: **A3** Ankara Beypazarı Sorkum-Kayalıklı road ayrımı 3.7.1971 Det.P. H. Davis! **A4** Gerede-Aktaş forest Künef village, meşe içi Ca:1250m 8.7.1976 O. Ketonoğlu 524! Ankara: Karagöl, 1600 m, *Coode & Jones* 2157! Kızılcahamam Pinus nigra forest 1240 m. 23.6.2009 O. Binzat 40! **B3** Eskişehir: Sündiken Mountain Karaçukur meşelerin altı Ca:1000-1300m. 22.7.1976 T.Ekim! Türkmen Mountain Çavuş valley under Fagus 7.6.1976 T.Ekim! **B5** Yozgat: Akdağmadeni Kadınpınarı, Ormanaltı Ca: 1500-1700m. 3.6.1980 T.Ekim 5046!

Distribution in Turkey: N. and rarely in S.W. Anatolia.

General distribution: Bulgaria, Yugoslavia. Romania, Caucasia, N. Iran.

Phytogeography: Euro-Siberian element.

Sect. ***Narbonensis*** Section *Narbonensis* (Radzhi) Maxted, Kew Bull. 47(1); 129-130 (1991c). Fl. USSR., 13: 473.

Description: Annual. Erect; stem stout. Stipules semi sagittate; 7-28 x 4,5-25 mm; edge with 1-12 teeth. Leaf 7-126mm; apex tendrilous; 2-12 leaflets per leaf; leaflets (8-)19-70x7-45 mm; asymmetric; margins entire, serrate or incised. Peduncle 1-29; with 1-6 flowers. Calyx mouth oblique; lower tooth longer than upper; base not gibbous; pedicel 1-4. Flowers 14-36 mm; all petals approximately equal length; standard cream, blue or purple; shape platonychioid; claw bowing absent; upper standard surface glabrous. Wing marking absent or present; wing limb with slight basal folding. Legume 27-75 x 7-20 mm; rectangular or rhomboid; round in cross-section or laterally flattened; sutures straight; valves pubescent; hairs tuberculate; septa absent or present; 2-9 seeds per legume. Seeds 4-8 x 4-8 mm; round; not laterally flattened; hilum less than quarter of seed circumference; lens positioned near hilum; testa surface smooth.

The species are most commonly associated with dry land open disturbed habitats. They are most commonly found growing as weeds in cereals and vineyards, or among rocks the species are commonly large in size and they are able to stand some shading and competition. They do not show any preference for any altitude.

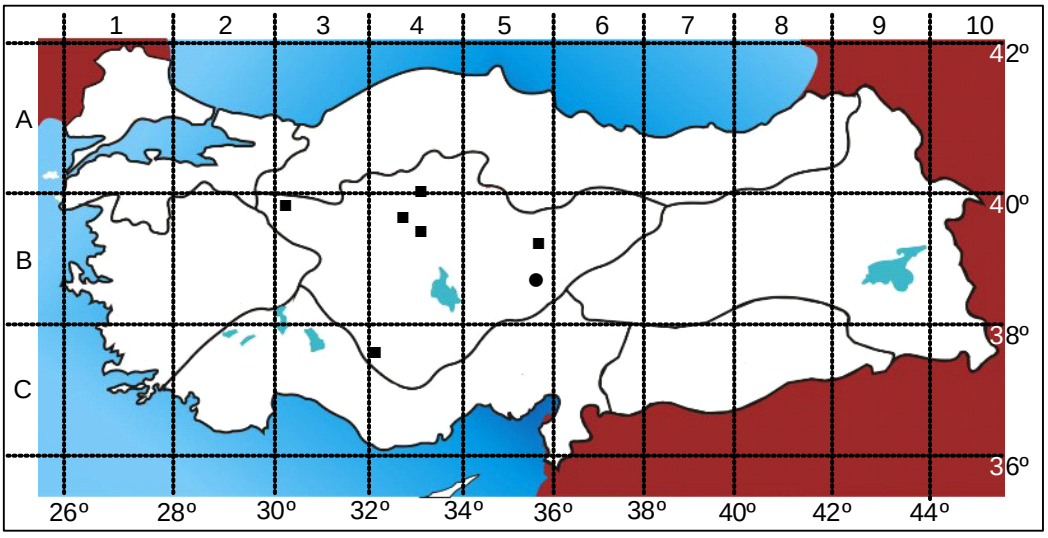

Figure 96. Distribution map of section *Narbonensis* (■) *V. narbonensis* var. *narbonensis* (●) *V. galilea*

12. *V.narbonensis* L.,Sp. P1.737 (1753).

Synonym: *Faba narbonensis (L.)Schm* in Verh. Nat. Ver. Brunn 15:192(1877). Ic: Bot. Mag. 118: t. 7220(1892); Coste, Fl. Fr.1:385, t. (1901).

Stem thick, subglabrous to pilose-hirsute 15-70 cm. Leaves, the upper leaves with 2-3 pairs of leaflets, the lower leaves with one pair of large; leaflets large, (7-)10-40(-50) x (5-)9-20(-30) mm, elliptic or oblong-lanceolate to ovate-orbicular or obovate; stipules large, semi-orbicular, entire to dentate; tendrils simple or branched. Peduncle, shorter than flowers, 1-2 flowered. Flower, 16-30 mm. ± concolorous. usually dark violet, infrequently lilac or tinged with cream. Calyx, 8-10 mm, mouth slightly oblique: teeth somewhat unequal, ± lanceolate, 1/2 as long to as long as tube. Standard 2-5/2 x as long as calyx, with the limb as long as the claw and manifestly longer than the wings. Legume, 35-50(-70) x 8-ll(-15) mm, linear-oblong, with a recurved beak, ± tubercledhairy, becoming glabrescent at maturity except for the tubercled-ciliate margins. Seed, (3-)4-6, subgiobose, 4-6 mm, hilum short.

Habitat and phenology: Flowering time is in between March and July. Disturbed and agricultural lands, and more rarely open woodlands are the habitats of this species. Altitude ranges vary in 14- 2100 m

Described from France (Hb. Cliff.! Hb. Linn. 906/33!).

Distribution in Central Anatolia: **A4** Ankara: Ayaşbeli, above the Pınaryaka village Quercus pubescens base Ca:1300m. 7.6.1975 Y. Akman 6671! Ayaş, Pınaryaka village, 1093 m, 06.07.2010, O. Binzat 250! Hacıkadın valley 20.5.1945 B. Kasaplıgil! Kızılcahamam –Kargasekmez Ca:1100m. 9.6.1974 O. Ketenoğlu 158! **B3** Türkmen Mountain E. Nadas 19.6.1976 T.Ekim 2459! **B4** Ankara: Beynam forest near water Ca 1300m. 18.6.1970 Y. Akman 8383! **B5** Yozgat: Akdağmadeni Akdağ- Ankara 5 km. end of the road Ca:1450m. 5.6.1980 T. Ekim 5311! Kayseri: Melikgazi hill 1600m. 19.06.2010 O. Binzat 177! **B6** Sivas: Hafik – Bayat road, 39.46.836K 36.39.806D, 1397m. 22.06.2010 O.Binzat190!

Distribution in Turkey: Widespread except in N.E. and much of adjacent E. Anatolia.

General distribution: S. Europe, Romania, Hungary, Crimea, S.W. Asia, N. Africa.

Phytogeography: Unknown or Multiregional

13. *V. galilaea* Plitm. & Zoh. in Israel J. Bot. 14:91 f. 2 (1965).

Differs from *V. narbonensis* by its fewer leaflets l-2paired that are ovate to orbicular, often larger and usually entire, and by its fewer (1-3) paler, bicoloured flowers, the corolla being 5/2-3 x as long as the calyx, the limb of the standard usually lilac and as long as or shorter than the claw, rather reflexed and only slightly longer than the whitish, dark-tipped wings. Legume generally wider 10-14 mm. and densely pilose.

Type: Palestine, Upper Galilee, Mt. Admon, *Plitmann & M. Zohary* 1802 (HUJ!). S.W. & S. Anatolia.

Distribution in Central Anatolia: **B5** Yozgat**:** Sorgun-Alaca road 1322m. 39.54.247K 34.56.220D 24.06.2010 O. Binzat 212! 5 km N of Boğazliyan, 1200 m, *Coode & Jones* 1489! **C5** Konya: Küçük Köy, *Helbaek* 2438!

Distribution in Turkey: S.W. & S. Anatolia.

Phytogeography: Unknown or Multiregional

Sect. *Ervillia*

Description: Plants annual. Leaves epi-amphistomatic, multijugate, mucronate; leaflets linear. Inflorescence with one to several small pale-lilac flowers. Calyx subregular with equal teeth; vexillum ovate; style dorsally compressed, varying form pubescent all round to only on adaxial face. Fruits subtorulose. Seeds with short hilum. – Monotypic

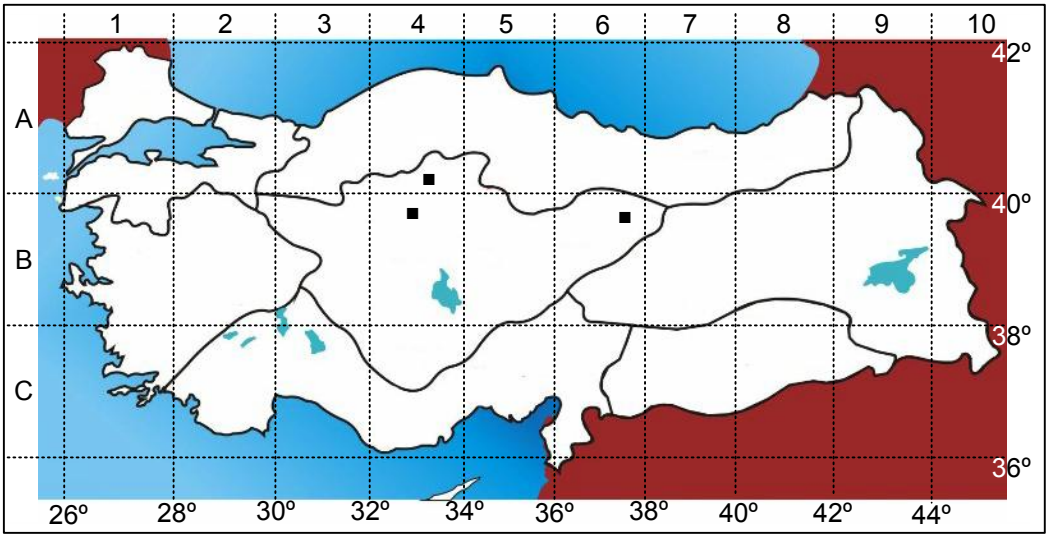

Figure 97. Distribution map of Section *Ervillia* (■) *V. ervilia*

14. *V. ervilia* (L.) Willd., Sp. PL 3:1103 (1802).

Synoym: *Ervum ervilia* L., Sp. P1. 738 (1753). Ic: Reichb., Ic. Fl. Germ. 22: t. 216 (1903): Guinea (op. cit.) 173, t. (.1953).

Annual. Stem glabrous to sparingly adpressed-pubescent, 8-70 cm, erect. Leaves ending in a mucro: leaflets 8-15 paired, (3-)5-15(-17) x l-3(-4) mm, narrowly linear to oblong-lanceolate; stipules semi-hastate, long-dentate. Peduncle l-4 flowered. as long as or longer than the flowers, much shorter than the leaves. Flowers 7-12 mm, lilac, pink, pale yellow or white. Calyx 5-7 mm, ± adpressed-pubescent. mouth suboblique; teeth somewhat longer than tube, equal, subulate. Standard not reflexed; keel navicular. Legume oblong-linear, 12-25 x 3-5 mm. torulose to submoniliform, minutely puberulent. Seeds 2-4, hilum very short.

Described from France and Italy (Hb. Linn. 907/8!).

Habitat and phenology: Flowering time is in between March and June. Habitats for this plant are Quercus scrubs, stony slopes, screes, fields, vineyards, roadsides. Altitude is in the range of 1-1700 m.

Distribution in Central Anatolia: **A4** Çankırı: Deyrez Chai, 1170 m, *Czecz.* 574. Ankara: Hacı kadın valley 40 00 450K 32 52 46D 980m. 4.7.2010 O.Binzat 246! **B4** Ankara: Galatia, Kavaklıdere, *Bornm.* 1929:14047! **B5** Sivas : Hafik road, 1346 m. 22.06.2010, O. Binzat 193!

Distribution in Turkey: Widespread, except in the N.E.

General distribution: Medit. area, S.W. Asia. Wild

Phytogeography: Unknown or Multiregional

Sect. *Lentopsis*

Description: Plants annual. Leaves amphistomatic, tendrillous, with few to several pairs of small elliptic leaflets. Inflorescence few flowered, flowers bicolored lavender blue and white. Calyx subregular, with upper teeth longer the lowest one; vexillum ovate, with two small pouches; style dorsally compressed, pubescent all round. Legume subtorulose. Seeds lenticular, with short hilum. –Monotypic.

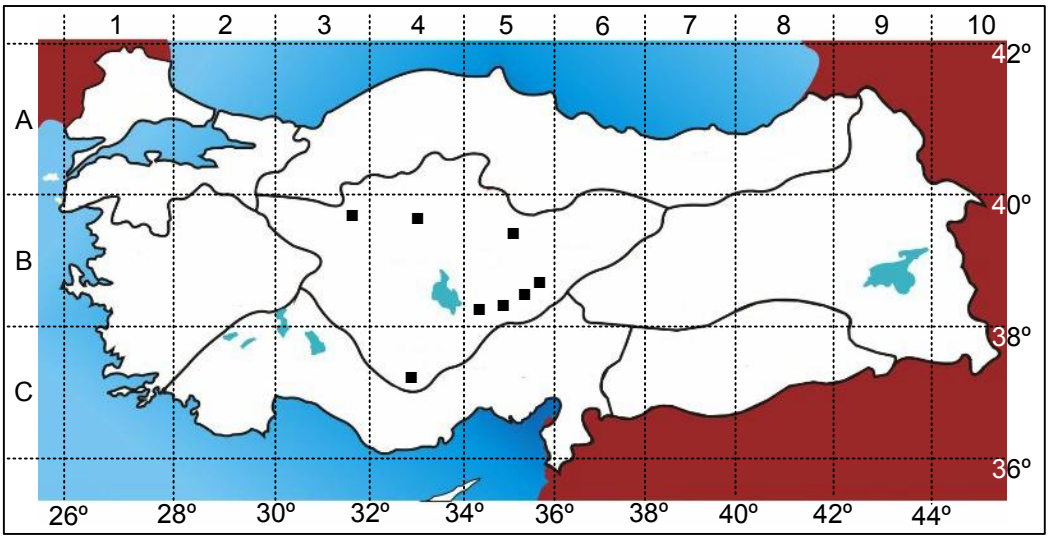

Figure 98. Distribution map of section *Lentopsis* (■) *V. caesarea*

15. *V. caesarea* Boiss. & Bal. in Boiss., Diagn. ser. 2(6): 69 (1859).

Synoym: *V. Vulcanica* Hand.-Mazz. in Ann. Nat. Hofmus. Wien 28:164, t. 13 f. 2 (1914). Map 62, p. 297.

Densely villous, ascending annual (sometimes indurated at base), 10-50 cm. Leaflets (2-)3-6-paired, 4-15 x 1-4 mm, oblong-linear to elliptic-lanceolate, acutish; stipules lanceolate-ovate; tendrils simple. Peduncle somewhat shorter or longer than leaf, 2-5 flowered. Pedicels recurved. Flowers 9-12(-14) mm, bicoloured. Calyx c. 6 mm, scarcely gibbous, villous, with an obscurely oblique mouth; teeth at least as long as tube, filiform-subulate, the upper slightly longer than the lower. Limb of standard lavender-

blue, longer than the claw, wings and keel whitish. Legume 15-23x4-5 mm, oblong-linear, strongly torulose, glabrous. Seeds (l-)2-4, hilum very short.

Type: *V. Caesarea* Boiss. & Bal. In Boiss., Diagn. Ser. 2, 6;69(1859)

Habitat and Phenology: Flowering time is in between May and June. Eroded slopes, screes and fields are the habitats of this plant. Altitude where the plant grows change in the range of 800 – 1600 m.

Distribution in Central Anatolia: **B4** Ankara: Ankara, Kezlar Pounar, *Frères E.C.*! Beynam, 23 v 1963, *anon.!* Konya: Serai Koy nr. Konya, *Andrasovszky* 471. **B5** Kayseri: Kayseri to Ova, *Bağda* 1944:181! Develi kızık road sides 1400 m. 19.6.2010 O. Binzat175! Aksaray: Ihlara, helvadere village 1394 m. 23.5.2010, O. Binzat 101! Yozgat: 20 km from Yozgat to Yerköy, 1100 m, *Coode & Jones* 1536! Nevşehir: Göreme. 1130 m, *D.* 42201! Sarıkız high plateau 1802 m. 18.6.2010 O. Binzat 170! Niğde: Hasan Da. above Taşpinar, 1500 m, *D.* 19020! **B6** Sivas, Pınarbaşı şarkışla entrance 1313 m. 20.6.2010, O. Binzat 180! **C4** Konya: 53 km from Ermenek to Karaman, 1480-1580 m. *Hub.-Mor.* 8506. **C5** Niğde: Ulukişla, *Reese.*

Distribution in Turkey: C. and adjacent S. Anatolia.

Endemic

Phytogeography: Ir.-Tur. Element

Figure 99. General appearance of *V. caesarea*

Sect. *Cracca* S. F. Gray.

Description: Annual to perennial, often climbing. Stipules without a dark nectariferous spot. Leaflets few many paired small to large. Peduncle usually much longer than the 1-many flowers. Flowers usually blue-lilac to purplish red, rarely yellow. Calyx usually irregular and ± gibbous. Style ± compressed, ± equally pubescent all round near the apex. Legumes wit coriaceous, glabrous or hairy valves, not torulose; seeds few to many.

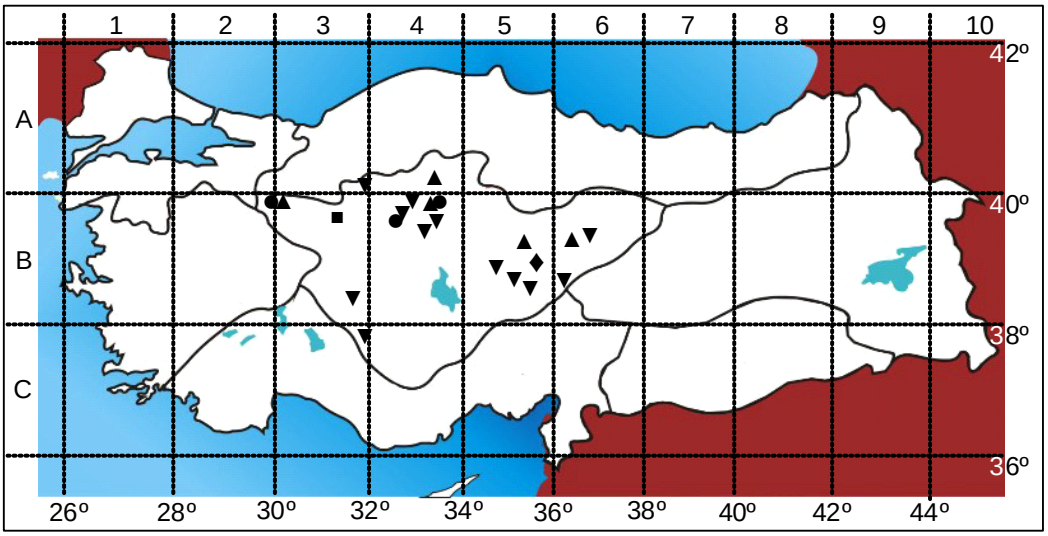

Figure 100. Distribution map of section *Cracca* (▼) *V. tenuifolia* subsp. *dalmatica*, (▲) *V. tenuifolia* subsp. *tenuifolia*, (■) *V. villosa* subsp. *varia* (▼) *V. villosa* subsp. *villosa*

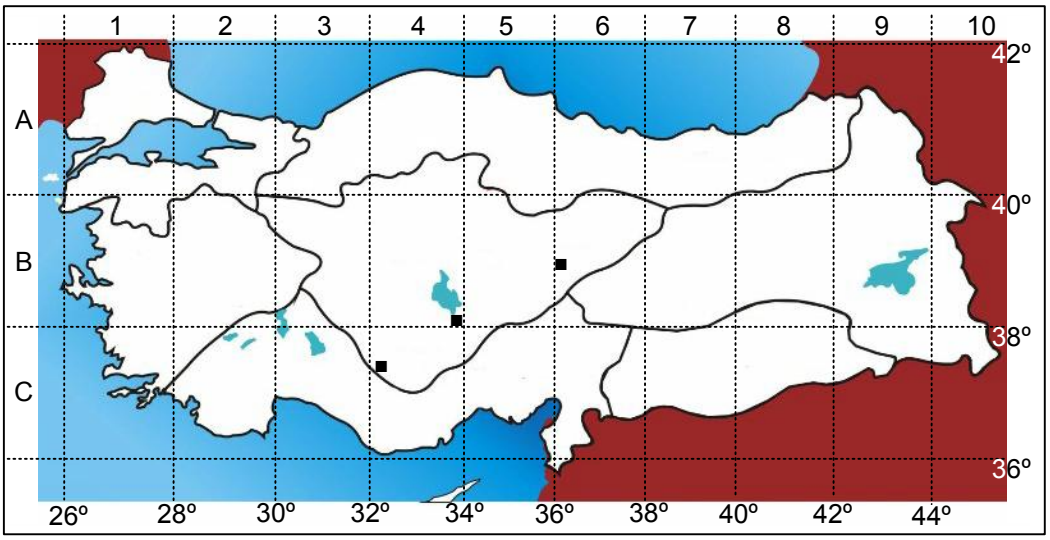

Figure 101. Distribution map of section *Cracca* (■) *V. monantha*

16. *V. tenuifolia* L., Sp. PL 735 (1753). Davis in Notes R.B.G. Edinb. 29: 314 (1969). Maps 57, 58. p. 285.

Slender perennial. Stem erect or climbing, glabrescent or adpressed-hairy. Leaflets 9-16 paired, 0.8-4 cm, ovate-oblong to linear. Stipules, semihastate. Tendrils branched. Peduncle shorter or longer than leaf; raceme 10-40-flowered, dense or lax. Flowers 13-18 mm., violet or lilac (rarely white). Calyx 3-6 mm, scarcely gibbous, often purplish, the lowest tooth shorter to slightly longer than tube. Limb of standard subequal to nearly twice as long as claw. Style laterally compressed. Legume 20-30 mm, always glabrous. Seeds several.

Figure 102. General appearance of *V. tenuifolia*

1.a. Leaflets narrowly linear, 10-30 x0.5-2(-3) mm, acute; inflorescence usually lax, flowers often more spreading; legume obliquely oblanceolate **subsp. *dalmatica***

1.b. Leaflets oblong-linear, 15-40x2-5 mm, usually obtuse; inflorescence rather dense, flowers nodding; legume obliquely oblong. **subsp. *tenuifolia***

subsp. *dalmatica* (A. Kern.) Greuter Willdenowia 16: 114. (1986)
Synonym: *V. Elegans* Guss., Fl. Sic. Prodr. 2:438 (1828); *V. tenuifolia* var. *laxiflora* Gris., Spic. 1:82 (1843)! *V. tenuifolia* Roth var. *Stenophylla* Boiss., Fl. Or. 2:586 (1872)! Nomen illegit.; *V. dalmatica* Kerner, Sched. Fl. Austro-Hung. 4:1029 (1886); *V. variabilis* Freyn in Öst. Bot. Zeitschr. 42:82 (1892) pro parte; *V. elegans* var. *Asiatica* Freyn in Bull. Herb. Boiss. 3:192 (1895)! *V. asiatica* (Freyn) Grossh., Fl. Kavk. 5:395 (1952)! Ic: Reichb., Ic. Fl. Germ. 22: t. 232 (1903)

Habitat and Phenology: *V. tenuifolia* L. subsp. *dalmatica*, Flowering time is in between May and July. Habitats for this plant are corn and follow fields, less commonly in scrub, on rocky slopes and on banks. Altitude changes in the ranges of 1 – 2200 m.

Described from N. Greece (syntypes of *V. tenuifolia* var. *laxiflora* Gris. (K!)).

Distribution in Central Anatolia: **A4** Ankara: Hacikadin valley, 800 m, *D.* 18839! Kızılcahamam-Çerkeş, on the roadsides after passing Güven town. 40 27 068K 32 37 134D 23.6.2009 1165 m. O. Binzat43! Ayaşbeli, 45 km from Ankara to Ayaş, 1113 m, 28.06.2009, O. Binzat 51! Çubuk Dam Mountain steppe Ca: 1200m. 10.6.1955 K.H. Hasenbalg! **A5** Yozgat: 10 miles from Çekerek to Alaca, 800 m, *Coode & Jones* 1642! **B3** Konya: Sultan Da. Above Akşehir, 1100-1400 m, *Bornm.* 1899:4356! **B4** Ankara: Elma Da., 1200 m, *Markgraf* 1O534*!* **B5** Kirşehir: Mucur to Sife G., *D.* 21800! **B6** Sivas: Sivas to Zara, 1200 m, *Balls* 1391a. **C3** Konya: 13 miles from Beyşehir to Konya, 1100 m, *D.* 35849! **C4** Konya Ermenek 3km. apart from Eastern part of Ermenek Ca:1200m. 27.8.1978 M. Vural 661!

Distribution in Turkey: Widespread; particularly abundant in Inner Anatolia.

General distribution: Italy, Balkans, Hungary, Romania. Crimea, Cyprus, Transcaucasia, W. Syria, Iran; N. Iraq ?

Phytogeography: Euro-Sib. element

subsp. *tenuifolia* (Roth) Gaudin, Fl. Helv. 4:507 (1829). Figure 3, p. 323. Syn: *V. tenuifolia* Roth, Tent. Fl. Germ. 1:309 (1788); *V. boissieri* Freyn in Bull. Herb. 3oiss. 3:191 (1895) pro parte! ?*V. antiqua* Grossh., Fl. Kavk. ed. 1, 2:367 (1930): *V. variabilis* sensu Grossh., Fl. Kavk. 5:394 (1952) non Freyn (1892)! Ic: Hegi. I11. Fl. Mittel-Eur. 4(3): 1532 f. 1545 (1924); Guinea, op. cit. 113, t. (1953).

Described from Germany.

Distribution in Central Anatolia: **A4** Ankara: Kalecik 3.7.1960 K. Karamanoğlu! Aydas high plateau 10.7.1948 H. Bağda! Kızılcahamam Soğuksu National Park, 1222 m, 23.06.2009, O. Binzat 43! **B3** Eskişehir: Türkmen Mountain Kaplan De. Kayalık, Ca:1500m 25.7.1976 T. Ekim 2460! Sündiken Mountains Mihalıççık, Namazlar P. nigra forests Ca:1500m. 4.7.1970 T.Ekim 600! Türkmen mountain Orman İşletme Müdürlüğü near stream 1088m. 27.6.2009 O. Binzat 56! Between Mihalıççık and Çalcı village aon the road side 1356 m. 26.6.2009 O. Binzat.49!

Distribution in Turkey: N.E. & E. Anatolia.

General distribution: C. & S. Europe, N. & N.W. Iran, N. Iraq; N.W. Africa?

Phytogeography: Euro-Sib. element

17. *V. villosa* Roth, Tent. Fl. Germ. 2:182 (1795).

Annual or biennial. Stem villous or adpressed-pilose to almost glabrous, 15-90(-120) cm, climbing or procumbent. Leaflets 6-10-paired, 0.3-3.5 cm, oblong-ovate to narrowly linear; stipules semi-hastate or sagittate to lanceolate. Tendrils branched. Peduncle as long as the leaf or shorter, 3-40-flowered. Pedicels l-2 mm. Flowers 12-22 mm, violet-blue or ± blue. Calyx 5-8 mm, strongly gibbous, with an oblique mouth, villous to sparsely pilose-pubescent; teeth shorter to longer than tube, narrowly subulate to lanceolate-triangular, ciliate or glabrescent. Limb of standard to nearly as long as the claw; keel navicular. Style laterally subcompressed. Legumes oblong or oblong-rhomboid. (l.5-)2-3(-3.5) × (0.5-)0.6- 1(1.2) cm, glabrous or pubescent. Seeds (l-)2-8, hilum 1/6-1/12 of perimeter.

1a. Stems ± villous; lower calyx tooth at least as long as tube, limb of standard at least f as long as claw; legume glabrous **subsp. *villosa***

1b. Stems glabrescent or adpressed-pilose; lower calyx tooth generally shorter than tube, usually subglabrous; limb of standard 1/2 as long or nearly as long as claw: legume glabrous or pubescent **subsp. *varia***

subsp. *villosa.* Figure 3, p. 323. Synonym: *V. reuteriana* Boiss. & Buhse, Aufz. 73 (1860). Ic: Reichb., Ic. Fl. Germ. 22: t. 234 (1903); Guinea, op. cit. 119, t. (1953).

Described from Vegesak in Germany.

Habitat and phenology: *V. villosa* subsp. *villosa*, Flowering time is in between March and July. Habitats for this species are rocky places, fields, banks and damp places. Altitude changes in the ranges of 3 – 1700 m.

Distribution in Central Anatolia: **A4:** Ankara between Esenboğa and Kalecik, near Kalecik 980 m. 4.7.2010 O. Binzat 247! **B3** Eskişehir: Türkmen Mountain T.Ekim 2423! Eskişehir Babadağı Seyit gazi road 39 30 681K 30.39.067D 1040m. 16.06.2010 O. Binzat 151! **B4** Kayseri: Erciyes 38.36.907K 35.30.840D 1780m. 19.06.2010 O. Binzat174! **B6** Yozgat: Çayıralan Elçi-Toraman village 2 km. Hamza Sultan hill W. Yamaç Ca:1600-1750m. 17.7.1980 T. Ekim 4778! Pınarbaşı Sivas: şarkışla road 2km. 38.44.699K 36.25.259D 1510 m. 20.06.2010 O.Binzat181!

General distribution: Mainly C. & S. Europe, C. & S. Russia, Crimea, S.W. Asia,

Phytogeography: Unknown or Multiregional

subsp. *varia* (Host) Corb. Nouv. Fl. Normand. 181. (1894). Synonym: *V. dasycarpa* Ten., Rel. Viagg. Abruz. 81 (1829); *V. varia* Host, Fl. Austr. 2:332 (1831); *V. villosa* Roth var. *glabrescens* Koch, Syn. 194 (1837). Ic: Fiori, Ic. Fl. Ital. f. 2176 (1899); Guinea, op. cit. 123, t. (1953).

Habitat and phenology: *V. villosa* subsp. *varia.* Flowering time is in between January and June. Habitats for this plant are quercus woods, edge of fields. Altitude changes in the ranges of 1 – 900 m. sometimes cultivated.

Type: [Yugoslavia] Istria maritima inter segetes, ad sepes.

Distribution in Central Anatolia: **B4** Kayseri: Erciyes, 1780m. 19.06.2010, O. Binzat 174!

Distribution in Turkey: Turkey-in-Europe, N.W. & S.W. Anatolia.

General distribution: S. & C. Europe, N. Africa. Palestine.

Phytogeography: Unknown or Multiregional

Figure 103. General appearance of *V. villosa*

18. *V. monantha* Retz., Obs. Fasc. 3:39 (1783). B. L. Burn & P. Lewis in Kew Bull. 1949:497-515 (1950). Ic: Fiori. Ic. FI. Ital. f. 2177 (1899). subsp. *monantha*. Syn: *V. gracilis* Banks & Sol. in Russel, Aleppo ed. 2, 2:259 (1794)! non Lois. (1807); *V. monantha* subsp. *cinerea* (Bieb.) Maire in Bull. Soc. Hist. Nat. Afr. Nord. 31:17 no. 3141 (1940). Ic: Fl. Azerb. 5: t. 48 (1954).

Sparingly adpressed-pilose annual, 20-55(-75) cm, procumbent to erect. Leaflets 5-8-paired, 5-25(-35) x l-5(-8) mm, narrowly linear to oblanceolate or oblong-elliptic. Stipules semi-hastate-bipartite to sparsely dentate. Tendrils simple or branched. Peduncle shorter than leaf but longer or shorter than the l-3(-5) flowers. Flowers 10-15 mm, violet to blue. Calyx 5-6 mm, somewhat gibbous, with an oblique mouth, pubescent; teeth distinctly shorter than tube, unequal, triangular-lanceolate. Standard

with limb rather shorter than claw. Legume oblong-linear, 20-35 x (5-)6-8.5 mm, slightly torulose, glabrous. Seeds 4-6, hilum 1/6 of perimeter.

Habitat and phenology: *V. monantha*, Flowering time is in between March and April. Habitats for this plant are fallow and cultivated fields, phrygana, Altitude changes in the ranges of 900 – 1300 m.

Described from unlocalised material.

Distribution in Central Anatolia: **B4** Ankara: N. end of Tuz G., 900 m, *D.* 42156! **B6** Sivas: Gemerek, 1300 m, *Stn. & Hend.* 5122! **C4** Konya: Konya to Çumra, Küçük Koy, 980 m, *Helbaek* 2582!

Distribution in Turkey: C. Anatolia, scattered.

General distribution: Mediterranean area, S.W. Asia.

Phytogeography: Unknown or Multiregional

Sect. *Variegatae*

Description: Plants Perennial. Leaves amphistomatic to epistomatic, multijugate, often with dense indumentums. Tendrils often reduced or absent. leaves sometimes imparipinnate. Inforescence many flowered. Flowers white to purplish. Calyx irregular; vexillum platonychioid; style dorsally compressed, densely bearded on the abaxial side. Seeds with hilum of medium length.

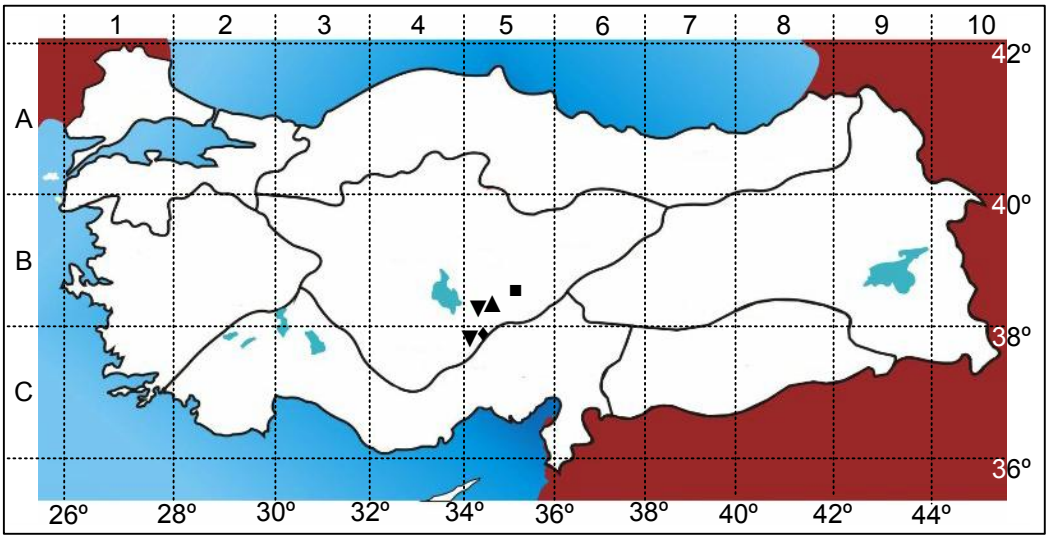

Figure 104. Distribution map of section *Variegatae* (■) *V. canescens* subsp. *canescens* (end.), (▼) *V. canescens* subsp. *argaea*, (▲) *V. canescens* subsp. *leucomalla*, (♦) *V. canescens* subsp. *gregaria*

19. *V. canescens* Lab., Icon. PL Syr. 1:17, t. 7 (1791). Map 59, p. 285.

Sturdy perennial. Stem 12-80 cm, erect or ascending, sparsely to very densely hairy, subcanescent to sericeous. Leaves with or without tendrils; leaflets 5-12-paired, 5-40 mm, elliptic to linear-lanceolate. Stipules large lanceolate-sagittate, entire. Racemes closely 3-18-flowered, long-peduncled. Flowers large, 17-25 mm, lilac, or violetblue. Calyx 6-13 mm, scarcely gibbous, purplish, lowest tooth half as long as the tube to about as long. Style dorsally compressed. Legume oblong, 26-35 x7-ll mm, densely adpressed-villous,-pilose or -pubescent, or glabrous with ciliate sutures. Seed several-seeded.

1a. Upper leaves with or without a short simple tendril, Stipules 1-2 x as wide as the stem **subsp. *argaea***

1b. Upper leaves with a well-developed simple or 2-3-sect tendril. Stipules narrower than the stem or as broad **subsp. *leucomalla***

subsp. *argaea* P. H. Davis, Fl. Turkey 3: 598 (Addenda).
Synonym: *V. argaea Bornm.* in Feddes Rep. 50:141 (1941), nomen!

Habitat and phenology: *V. canescens* subsp. *argaea*, Flowering time is in July. Habitats for this plant are screes. Altitude for this plant is 3000 m. (Endemic; Ir. Tur. element)

Type: [Turkey B5 Kayseri] in glareosis montis Argaei (Erciyas Da.), 3000 m, *Bornmüller.* 1890:2263 (K! W!).

Endemic

Phytogeography: Ir.-Tur. element.

subsp. leucomalla (Bornm.) Davis, comb. et stat. nov. Syn: *V. leucomalla* Bornm.in Feddes Rep. 50:139, t. 338 (1941).

Habitat and phenology: *V. canescens* subsp. *leucomalla*, Flowering time is in between June and July. Habitats for this plant are rocky slopes and screes. Altitude changes in the ranges of 2000 – 2700 m.

Type: [Turkey C5 Niğde] Ala Da., Geröllhänge der alpinen Region, c. 2700 m, *Bornmüller* 1938:817.

Distribution in Central Anatolia: **B5** Niğde: Hasan Mountain nr. Taşpinar Y., 2000 m, *D.* 18987! A Aksaray: Hasan Mountain Volkanik NW hillside above the rye field, alpine steppe Ca:2500m. 27.7.1974 Det. H. Peşmin 1975 A.Düzenli 456! **C5** Niğde: Masmutli Da., 2500 m, *Siehe* 1907:104 (as 'V. *Cappadocica* Siehe')!

Distribution in Turkey: C. & S. Anatolia, local.

Endemic

Phytogeography: Ir.-Tur. element.

Sect. *Panduratae*

Description: Annuals. Leaves epi-amphistomatic, tendrillous; leaflets few- to several-paired, linear. Inflorescence I- few flowered. Flowers reddish-purple to violet. Calyx irregular and gibbous or subregular; standard platonychioid. Style dorsally compressed, pubescent all round but tufted abaxially. Seeds with short hilum.

20. *V. cappadocica* Boiss. & Bal. in Boiss., Diagn. ser. 2(6):68 (1859).

Synonym: *Ervum paucijugum* Trautv. in Acta Horti Petrop. 3:76 (1875); *Lathyrus trijugus* Bornm. in Beih. Bot. Centr. 19(2) 250 (1910); *L. paucijugus* (Trautv.) Schischkin in Ber. Tomsker Staats-Univ. 81:488 (1928); *Vicia paucijuga* (Trautv.) B. Fedtsch. in Sborn. President. Akad. Nauk. Komarov, 745 (1939). Ic: Fl. URSS 13: t. 23 f. 2 (1948); Fl. Armenii 4: t. 72 (1962). Map 61, p. 297.

Annual. Stem subglabrous, ascending, (10-)15-30(-40) cm. Leaflets 2-4(-5)-paired, 10-35x1-4 mm, those of lowest leaves cuneate-obovate, the rest spathulatelinear, obtuse to praemorse, apex denticulate. Stipules 5-8 mm, semi-hastate and incised-dentate at apex; tendrils simple or branched. Peduncle as long or longer than the leaf, l(-2)-flowered. Flowers (10-)12-14(-15) mm, reddish purple (drying violet). Calyx 4.5-6.5 mm. hardly gibbous, mouth scarcely oblique, glabrous; teeth subequal. triangular-lanceolate, slightly shorter than tube. Standard with narrow limb subequal to claw. Style dorsally compressed, pubescent towards tip. Legume linear oblong, 25-35(-40) x 6-8 mm. shortly beaked, glabrous. Seeds (3-)5-7, hilum very short.

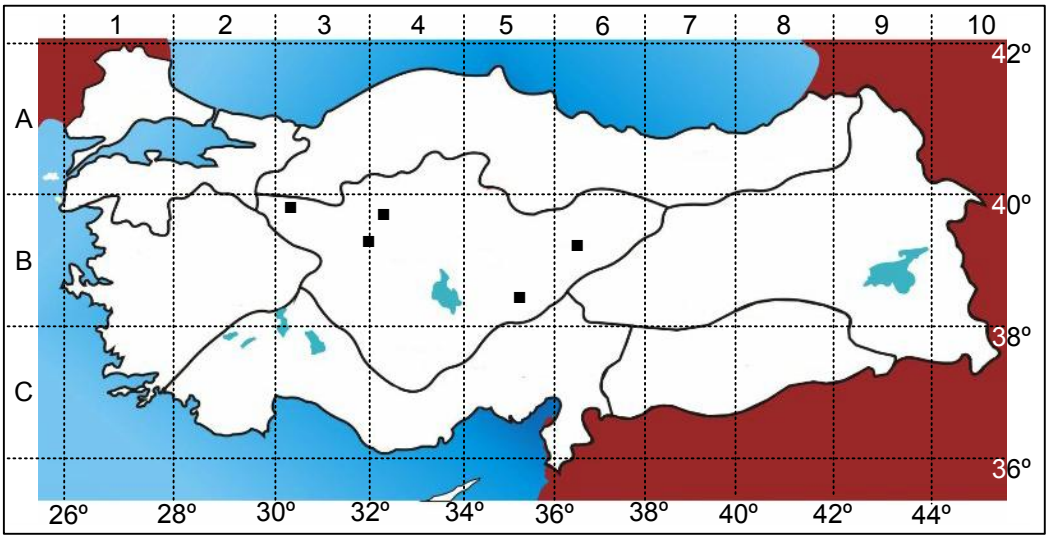

Figure 105. Distribution map of section *Panduratae* (■) *V. cappadocica*

Habitat and phenology: Flowering time is in between April and June. Habitats for this plant are South facing limestone scree, steppe, uncultivated ground, fields. Altitude changes in the ranges of 700 – 1850 m.

Type: [Turkey B5 Kayseri] in planitie Karahisar Cappadociae (Develi), 1200 m, *Balansa* 136 (G!).

Distribution in Central Anatolia: **B3** Eskişehir: nr. Eskişehir, *Turkish Sugar Co.!* Babadağı Seyitgazi yolu 1040 m.16.06.2010 O. Binzat 155! Türkmen tepesi 1203 m. 16.06.2010 O. Binzat 152! **B3/4** Ankara/Eskişehir: Angora (Ankara) to Sivrihisar. *Tufnell* 58! **B4** Ankara: Haymana to Sivrihisar, 4 km E of Saharye river, 720 m, *Hub.-Mor.* 13357. **B5** Kayseri: S of Develi, *Reese.* **B6** Sivas: Gemerek, 1300 m, *Stn. & Hend.* 5122!

Distribution in Turkey: Inner Anatolia, scattered.

General distribution: Transcaucasia, N. & N.W. Iran.

Phytogeography: Unknown or Multiregional

Sect. *Ervoides* (Godron) Kupicha, comb. nov.

Synonym: *Coppoleria* Todaro in Atti Accad. Sci. Litt. Palermo ser. 2, 1:14(1845); *Cracca* Medik. Sect. *Ervoides* Godron in Gren. & Gren. & Godron, Fl. Fr, 1:471 (1848); Paralossa Alef. In Oesterr. Bot. Z. 9:359 (1859); *Vicia* subgen. *Ervoidea* (Godro) Rouy in Rouy & Fouc., Fl. Fr. 5:241 (1899).

Description: Plants annual. Leaves epi-amphistomatic, multijugate, tendrilous, with narrow leaflets; stipules dimorphic: one simple, the other finely laciniate. Inflorescence 1-2 flowered. Flowers lilac. Calyx slightly irregular; vexillum oblong; style dorsally compressed, evenly pubescent all round. Legume subtorulose, Seeds with short hilum. – Monotypic.

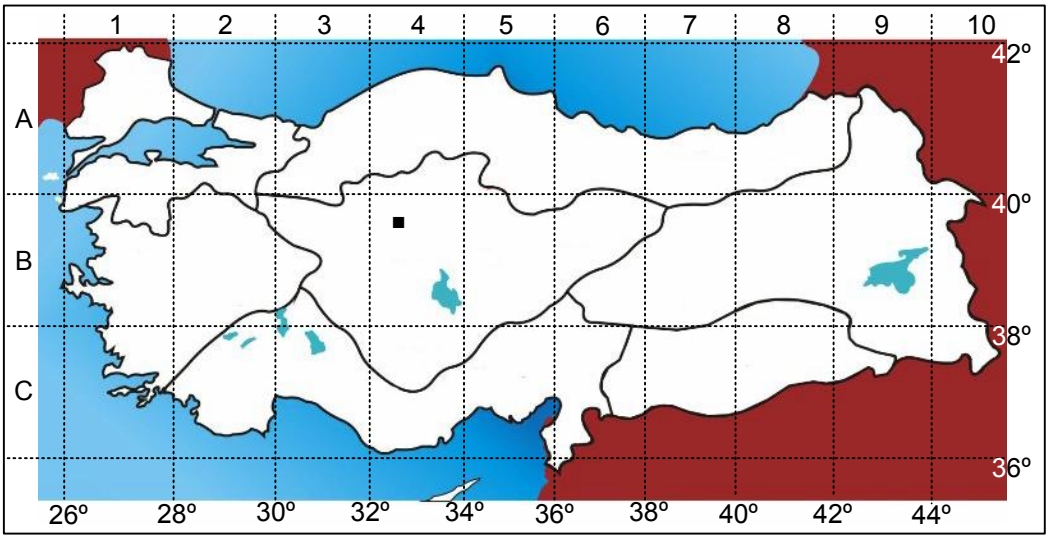

Figure 106. Distribution map of section *Ervoides* (■) *V. articulata*

21. *V. articulata* Hornem., Hort. Hafn. 41 (1807).

Synonym: *Ervum monanthos* L., Sp. P1. 738 (1753) non *Vicia monantha* Retz. (1783); *Lens monantha* (L.) Moench, Meth. 131 (1794); *Lathyrus monanthos* (L.) Willd., Sp. P1. 3:1083 (1802); *Vicia ciliaris* Sibth. & Sm., Prodr. Fl. Graec. 2:71 (1813)! *V. multifida* Wallr., Fl. Hal. Suppl. 3:85 (1815); *V. smyrnaea* Boiss., Diagn. ser. 2(2):38 (1856)! Ic: Sibth. & Sm., Fl. Gr. 7: t. 700 (1830), as *V. ciliaris.*

Annual. Stem, glabrous or subglabrous, 20-75(-90), diffuse or climbing. Leaflets 5-8(-9)-paired, 3-25(-30) x 0.5-4(-5) mm, oblong to narrowly linear. Stipules dimorphic, one minute and linear, the other stipitate and palmately laciniate. Tendrils usually 3 branched. Peduncle longer to shorter than leaf, l(-2)-flowered. Flowers 10-15 mm, lilac. Calyx 4-7(-8) mm, hardly to distinctly gibbous, mouth very slightly oblique, ± pubescent to subglabrous; teeth as long as or longer than tube, subequal, subulate-lanceolate. Limb of standard as long as claw, narrow. Legumes oblong-linear, 20-30(-35) x 5-8(-10) mm, subtorulose, glabrous. Seeds (l-)2-4, hilum short.

Habitat and phenology: *V. articulata*, Flowering time is in between March and June. Habitats for this plant are woods, rocky limestone slopes, macchie meadows. Altitude changes in the ranges of 50 – 800 m. Cultivated in Turkey.

Distribution in Central Anatolia: **B4** Ankara: Ankara. Orman Çiftliği**,** *Üresin* 181 (untypical; cultivated?)!

Distribution in Turkey: Mainly W. Anatolia.

General distribution: Medit. area: probably introduced in C. Europe.

Phytogeography: Unknown or Multiregional

Sect. *Cassubicae* Radzhi in Novit. Syst. Pl. Vasc. (Leningrad) 7:230 (1971).
Synonym: *Vicilla* Schur, Ernum. Pl. Transs. 170 (1866), pro parte excl. typ.

Description: Plants perennial. Leaves epistomatic, tendrillous or mucronate or sometimes imparipinnate; leaflets numerous, ovate. Inflorescence many- flowered, racemose, ebracteolate. Flowers yellow, whitish, pink or purple. Calyx irregular: vexillum oblong; style dorsally compressed, evenly pubescent all round. Seeds with hilum of long to medium length.

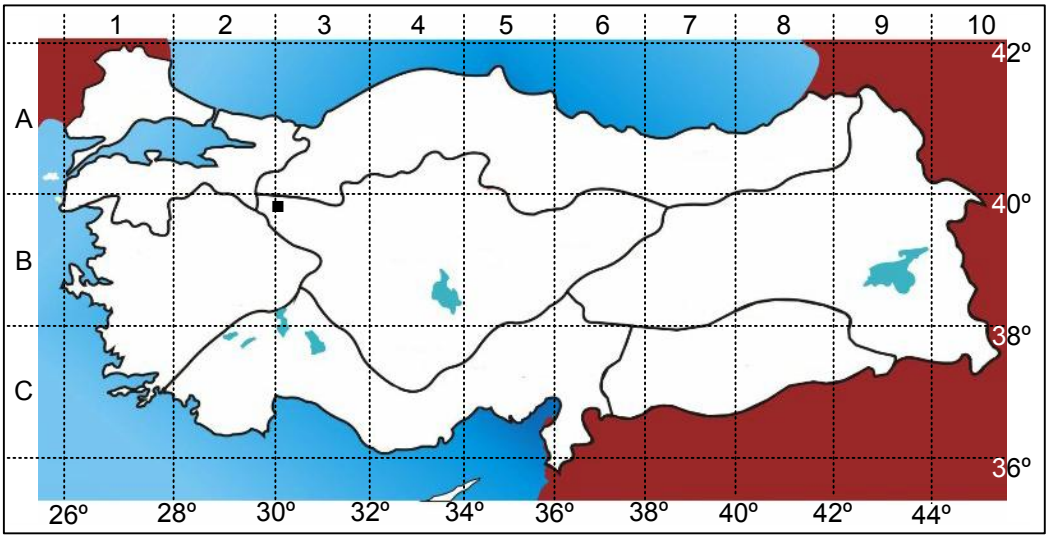

Figure 107. Distribution map of section *Cassubicae* (■) *V. cassubica*

22. *V. cassubica* L., Sp. PL 735 (1753). Ic: Reichb., Ic. Fl. Germ. 22: t. 251 (1903); Fiori, Ic. Fl. Ital. 2: f. 2172 (1899). Map 60, p. 297.

Perennial, with a creeping rootstock. Stems erect, flexuous, 30-60 cm, adpressed-pubescent or shortly villous (var. *villosa* Azn.). Leaves paripinnate, ending in a branched tendril. Leaflets oblong, obtuse, (4-) ll-17-paired. Stipules semisagittate, entire. Peduncle up to 1/2 as long as leaf. Raceme 3-18-flowered, 1-2 x as long as broad. Calyx 5-6 mm, with an oblique mouth, teeth unequal, the lowest tooth slightly shorter to slightly longer

than the tube. Corolla purple or pink, 10-12 mm. Legume broadly rhombic-elliptic, 15-18 x 5-7.5 mm, glabrous. Seed 1-2.

Habitat and phenology: *V. cassubica,* Flowering time is in between April and July. Habitats for this plant are Forests, banks, fields. Altitude changes in the ranges of 1 – 2150 m.

Type: *V. cassubica* L., Sp. Pl. 735(1753).

Described from Germany (Hb. Cliff.! Hb. Linn. 906/6, 7 & 10!).

Distribution in Central Anatolia: **A4** Ankara/Kastamonu: Ilgaz Mountain pass, 1600 m, *Markgraf* 10652! **B3** Eskişehir Türkmen Mountain Orman işletme müdürlüğü dereon the valley sides 1088ö. 27.6.2009 O.Binzat 55! Türkmen hill 1203m. 16.6.2010 O. Binzat 153!

Distribution in Turkey: N. Turkey (local), Amanus.

General distribution: Europe (except the extreme N. & S.), Caucasus, Georgia, Lebanon, N. Iran (Talysch).

Phytogeograpy: Euro-Sib. element.

CHAPTER 4

CONCLUSION

A taxonomic revision of the genus *Vicia* found in Central Anatolia has been performed using fresh specimens collected between 2009 and 2011 along with the herbarium specimens kept in many herbaria. Morphological, anatomical, palynological, petal, sepal and leaf micromorphological investigations, as well as, numerical analysis of *Vicia* taxa collected have been carried out in the revision. The results showed that the study area has 26 taxa, 3 of which are endemic and the remaining is non-endemic. Endemic species are *V. caesarea*, *V. canescens* subsp. *leucomella* and *V. canescens* subsp. *argaea.* Endemism rate is calculated as %12. Endemic species of the genus *Vicia* is distributed on B4, B5, B6, C4 and C5 grid squares. However, B5 and C5 grid squares are rich in amount with respect to these species. According to the Flora of Turkey (Davis 1985) the number of species was 16 in Central Anatolia. But it was observed that the number of species are greater than 16. In the study area 22 species and 4 subspecies have been found.

The threat categories of the taxa were re-evaluated at regional level using IUCN Red List categories and criteria. At the regional level, the threat categories of the taxa are as follows: 2 taxa DD, 1 taxon CR, 7 taxa EN, 1 taxon VU, 1 taxon NT and 14 taxa LC. According to the Turkish Red Data Book (Ekim et al., 2000) *V. canescens* subsp. *argaea* is the one of the endangered species of genus *Vicia* in Turkey. In addition to this, *V. anatolica, V. hybrida, V. cuspidata, V. galilaea*, *V. villosa* subsp. *eriocarpa* has been determined as endangered species because they were represented in small populations in the area. Again in the Turkish Red Data Book, *V. caesarea* was grouped under the LR threat category. But we observed that this species is widely distributed in the Central Anatolia. It spread to B4, B5, B6, C4, C5 grid squares. So the new status for this species was determined as LC. The principle threats for the taxa are urbanization, overgrazing,

constructions and land clearing. Bu the construction is the most harmful threat for the species. In order to preserve the species in danger, we recommended some protection ways 1. The richest regions of endemic species should be protected via in-situ conservation. 2. The areas are to be modeled and managed via using Geographic Information System (GIS) images. 3. Damaged habitats must be restored or rehabilated. 4. People awareness for protection of endemic species has to be increased. 5. Some samples of endemic species can also be transferred to protected areas (national parks and botanical gardens) for conserving.

Members of the genus *Vicia* were found in a very wide variety of habitats, such as corn and fallow, fields, forests, meadows, scrubs, hedge, steppe, screes, rocky and stony slopes, macchie, pastures, damp places, limestone slopes and roadsides. The flowering time of the taxa is 4 to 8 months of year.

Distribution of the taxa according to phytogeographical regions was also accessed as follows; 5 taxa Irano-Turanian element, 4 taxa Mediterranean element, 3 taxa Euro-Siberian element and 14 taxa unknown or multiregional.

Some of the genus *Vicia* species (e.g., *V. peregrina, V. truncatula, V. caesarea, V. monantha, V. canescens* subsp. *argaea, V. canescens* subsp. *leucomella)* can resist drought. They live in the arid climate regions of Central Anatolia This region is in between the triangle of Konya, Karaman Ulukışla. The rest of the species live in the semi arid climate of the Central Anatolia.

Morphological characteristics are investigated and their possible taxonomic values are assessed. Life form, habit, stem, leaf, calyx, and corolla properties of the genus are of taxonomically diagnostic value. The systematic significance of anatomy, palynology, petal, sepal and leaf micromorphology and numerical taxonomy of *Vicia* are investigated comprehensively for the first time. The anatomical properties of roots, stems, and leaves of the genus are assessed at species and sectional level identification. Some anatomical

features, such as, number of cell layers of rays and cortex in the root, shape of the stem, number of cell layers of collenchymas, type of the leaf, number of layers of palisade and spongy parenchyma are found to have taxonomic value in separating the taxa.

It is noted that, most of the species of the genus Vicia are annual. 4 of them are perennial (*V. cassubica, V. cracca, V. canescens* and *V. truncatula*). There are three types of stem in this genus. These are erect, ascending and climbing stems. Majority of the species have the erect stem type. Glabrosity of the stem is also changing between the members of the genus *Vicia*.

Inflorescence of the plants of this genus is significant. This trait divides the genus *Vicia* into two subgenus called as *Vicia* and *Vicilla* (Kupicha 1976). Calyx shape was important character when we grouped the species. There are two types of Calyces. These are oblique calyx shape and straight calyx shape. Straight mouth of calyx shape was seen in some of the members of the subgenus *Vicia* (Table 7). Vexillium types of the genus *Vicia* is another significant character. This character is important in sectional level. Vexillium types are oblong, platonychioid and stenonychioid (Table 8). Sect. *Cracca*, sect. *Variegatae* and sect. *Pandurate* have the platonychioid vexillium. Sect. *Ervilia*, sect. *Lentopsis*, sect. *Vicia* and sect. *Narbonensis* have the stenonychioid vexillium. Finally, section *Cassubicae*, section *Ervoides*, section *Attosa* and some members of section *Hypechusa* have oblong vexillium. Stylar feature was used as another morphologic trait. It was seen that only the sect. *Cracca* is different with respect to this trait. The members of this taxa have laterally compressed style. Glabrosity of the legume was also examined. It was seen that most of the members of the sect. *Hypechusa* have pubescent legumes.

The genus *Vicia* members have compound leaves. Most of them have a leaf ending with tendril. Only two of them have no tendrils. Instead of having tendrils, they have a mucro at the leaves rachis ending (*V. truncatula* and *V. ervilia*). This property of leaves can be useful in infrageneric grouping. Leaf pairs are greater in amount in some species as *V.*

cracca, *V. cassubica*, *V. ervilia* and *V. truncatula*. Not only the number of pairs, but also the shapes of leaflets are also beneficial in classification. Especially, in section *Narbonensis*, the plants have many to and 1-2-(3) paired leaflets. Leaf anatomical studies can also give some clue about the infrageneric grouping. According to Table 4, differences in the cell size of *V. narbonensis* and *V. galilaea* are obvious. These species have thick mesophyll, huge tracheal cells and epidermis cells than the others. Apart from the members of sect. *Narbonensis*, *V. truncatula* posses great sizes of cells. However, the other species have similar cell size. Stem and root anatomical measurements are also supporting these results.

The variation in palynological properties is discussed on the basis of their potential systematic value. The major pollen characters, such as size and shape, type of sculpturing at the mesocolpium (finely reticulate-perforate, obscurely reticulate-perforate and psilate-perforate) and type of sculpturing at the apocolpium (finely reticulate-perforate, obscurely reticulate-perforate, perforate and psilate), are found to be helpful in the delimitation of the taxa.

Based on the cell-shape traits and the fine relief of the cell wall, the epidermal cells of standard and wing petals are identified in four types: tabular rugose cells with longitudinal striations, tabular flat cells with longitudinal striations, papillose conical cells with striations and reticulate. Tabular rugose striate cells are further subdivided into three subtypes because of variation in cell shape, size and density of striations on the surface: Elongated cells with dense striations, elongated cells with less striation and more or less isodiametric cells with dense striations.

On the leaves and calyces of *Vicia*, three different trichome types are identified: peltate, capitate glandular and non-glandular trichomes. The presence of the trichome types, their distribution and density on the leaves and calyces have diagnostic value in distinguishing of the taxa.

Results of the numerical analyses done by the use of MVSP showed that there are two groups and under these there 13 clusters and these were accepted as the sections. Kupicha (1976) grouped the sections under two different subgenera (Table 18). One of them is the subgenus *Vicia* which consists of 6 sections. They are sect. *Hypechusa*, sect. *Peregrina*, sect. *Wiggersia*, sect. *Vicia*, sect. *Narbonensis*, sect. Attosa. The other subgenus is *Vicilla* which has 7 sections. They are sect. *Cracca*, sect. *Cassubicae*, sect. *Variegatae*, sect. *Panduratae*, sect. *Ervilia*, sect. *Lentopsis*, sect. *Ervoides*. Our phenogram obtained at the end of the numerical analyses supported the Kupicha's study (Figure 85).

The infrageneric delimitation of the genus *Vicia* is performed using multivariate analysis. Keys to sections and species are also provided. Expanded descriptions, phenology, distribution and habitats, phytogeography, specimens examined, photographs showing general appearance of the taxa are given.

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