THE INVESTIGATION ON THE CHLOROPLAST AND NUCLEAR GENOMES OF TAXA BELONG TO THE SUBGENUS *DRACUNCULUS* (BESS.) RYDB. OF *ARTEMISIA* L. (ASTERACEAE) IN TURKEY

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MSc THESIS

Department of Biology

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SUMMARY

THE INVESTIGATION ON THE CHLOROPLAST AND NUCLEAR GENOMES OF TAXA BELONG TO THE SUBGENUS *DRACUNCULUS* (BESS.) RYDB. OF *ARTEMISIA* L. (ASTERACEAE) IN TURKEY

In this research, 60 individuals of 21 specimens taken from 17 different populations belong to taxa of the subgenus *Dracunculus* in Turkey were examined. Depending on the width of the populations belong to the taxa, between 1 and 4 individuals with the same label information were used for each taxa. For all examined individuals from the same and different populations belong to taxa of the subgenus *Dracunculus,* it has been determined the sequences of regions both *psb*A-*trn*H of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2).

Molecular diversity parameters were obtained from both separate and co-evaluations of sequences of the *psb*A-*trn*H and ITS regions of examined individuals. Molecular diversity parameters obtained from co-evaluations of sequences of the *psb*A-*trn*H and ITS regions of examined individuals were used only in the phylogenetic tree drawing.

In the Maximum Likelihood method, by entering the bootstrap value 100, a single phylogenetic tree for total of 63 individuals, 60 of which were examined, 2 of which were control group and 1 of which was an external group was obtained.

It was found that there were no gene flow and hybridization between the four studied taxa of the subgenus *Dracunculus*, and these four taxa were also completed their speciation.

According to the results of this molecular study, *A. campestris* var. *campestris, A.campestris* var. *marschalliana* and *A.campestris* var. *araratica* was proposed to raise from variety level to species level. Thus, like in the Flora of Turkey, the new systematic positions and combinations of the three varieties of the species *A. campestris* will be independent species *A. campestris*, *A. marschalliana* and *A. araratica*, like the Flora of Turkey.

Keywords: *Artemisia, Dracunculus,* Turkey, *Artemisia scoparia, Artemisia campestris*, *Artemisia marschalliana*, *Artemisia araratica*, *psb*A-*trn*H, ITS, PCR, Phylogenetic tree

ÖZET

ARTEMISIA L. (ASTERACEAE) CİNSİNİN _DRACUNCULUS_ (BESS.) RYDB. ALTCİNSİNE AİT TÜRKİYE'DEKİ TAKSONLARIN KLOROPLAST VE ÇEKİRDEK GENOMLARI ÜZERİNE ARAŞTIRMA

Bu araştırmada, *Dracunculus* altcinsinin Türkiye'deki taksonlarına ait 17 farklı populasyondan alınan 21 örneğin 60 bireyi incelenmiştir. Taksonlara ait populasyonların genişliğine bağlı olarak, her takson için aynı etiket bilgisine sahip 1 ila 4 kişi kullanılmıştır. *Dracunculus* altcinsi taksonlarına ait hem aynı hem de farklı populasyonlardan incelenen tüm bireyler için, kloroplast DNA'sının *psb*A-*trn*H ve nükleer DNA'nın ITS bölgelerinin (ITS1-5.8 geni - ITS2) dizileri belirlenmiştir.

Moleküler çeşitlilik parametreleri, incelenen bireylerin *psb*A-*trn*H ve ITS bölgelerinin sekanslarının hem ayrı hem de birlikte değerlendirilmesinden elde edildi. İncelenen bireylerin *psb*A-*trn*H ve ITS bölgelerinin sekanslarının birlikte değerlendirilmesinden elde edilen moleküler çeşitlilik parametreleri yalnızca filogenetik ağaç çiziminde kullanıldı.

Maximum likelihood yönteminde, bootstrap değeri 100'e girilerek, 60'ı incelenen, 2'si kontrol grubu ve 1'i harici bir grup olmak üzere toplam 63 birey için tek bir filogenetik ağaç elde edildi.

Dracunculus altcinsinin incelenen dört taksonu arasında gen akışı ve melezlenme olmadığı ve bu dört taksonun da türleşmelerini tamamladığı tespit edildi.

Bu moleküler çalışmanın sonuçlarına göre, *A. campestris* var. *campestris, A.campestris* var. *marschalliana* ve *A.campestris* var. *araratica* varyete seviyesinden tür seviyesine yükseltilmesi önerisi yapıldı. Böylece, *A. campestris* türünün üç varyetesinin yeni sistematik konumları ve kombinasyonları, Türkiye Florası'ndaki gibi *A. campestris, A. marschalliana* ve *A. araratica* şeklinde olacaktır.

Anahtar Kelimeler: *Artemisia, Dracunculus,* Türkiye, *Artemisia scoparia, Artemisia campestris, Artemisia marschalliana, Artemisia araratica, psb*A-*trn*H, ITS, PCR, Filogenetik ağaç

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ABBREVIATIONS

BUFH : Herbarium of Bitlis Eren University

CBOL : The Consortium for the Barcode of Life

FUH : Herbarium of the Faculty of Science of Fırat University

ITS : Internal transcribed spacer regions of nuclear ribosomal gene

IR (IRA and IRB) : Two copies sequences of inverted repeat regions of the chloroplast DNA

LSC : A large single copy region of the chloroplast DNA

NCBI : National Center for Biotechnology Information

psb**A-t*****rn*****H :** Single copy sequences of intergenic region of the chloroplast DNA

rDNA : DNA segments of the ribosomal RNA gene

rRNA : Ribosomal RNA

Sect. : Section

sp. : Species

SSC : A small single-copy region of the chloroplast DNA

var. : Variety

Ap. : Appendix

1. INTRODUCTION

Artemisia L. is one of the larger genera in the family Asteraceae and the largest genus in the tribe Anthemideae, comprises from 200 to more than 500 taxa at the specific or subspecific level (Bremer and Humphries, 1993; Ling, 1991a, b; Ling, 1995a, b; Mabberley, 1990; McArthur, 1979; Torrell *et al.*,1999).

Traditionally, the subgeneric classification of the genus *Artemisia* L. follows a system established by Besser (1829) wherein he separated four sections based on various combinations of disc and ray flower occurrences and fertility. These sections are *Abrotanum* (Duhamel du Monceau) Besser, *Absinthium* (Miller) Candolle, *Dracunculus* Besser and *Seriphidium* Besser.

Besser's four sections have been modified by subsequent workers. Rydberg (1916) created subordinate sections including new section *Tridentatae* for the North American members of the section *Seriphidium* and elevated these sections to subgenera.

Current consensus is to recognize three subgenera : *Artemisia* Lessing [included the subgenara *Abrotanum* Besser and *Absinthium* (Miller) Lessing], *Dracunculus* (Besser) Rydb., and *Seriphidium* (Besser) Rouy. However, McArthur *et al.* (1981), based on karyotypic, chemotaxonomic, and distributional criteria, elevated the section *Tridentatae* Rydb. to subgeneric status as *Tridentatae* (Rydb.) McArthur inclusive of 11 species. Several authors, e.g., Barker and McKell (1983, 1986), Shultz (1983, 1986) and Wilt *et al.* (1992), have accepted this proposal (McArthur and Sanderson, 1999).

Nowadays, the most commonly accepted subdivisions of the genus *Artemisia* are separated into 4 subgenera as *Artemisia* Lessing, *Dracunculus* (Besser) Rydberg, *Seriphidium* Besser ex Lessing and *Tridentatae* (Rydberg) McArthur (McArthur *et al.*, 1981; Civelek *et al.*, 2010; Kursat, 2010; Kursat *et al*., 2015).

Recently, a new subgenus so - called *Pacifica* Hobbs & Baldwin has been described, which is fifth subgenus of the genus *Artemisia* (Hobbs and Baldwin, 2013). The subgenus *Pacifica* includes the Hawaiian endemics of the genus *Artemisia* and their Asian congener *A. chinensis* L., formerly segregated as an independent monotypic genus (*Crossostephium chinense* (L.) Makino). Like the subgenus *Tridentatae*, the subgenus *Pacifica* has not taxa in Turkey.

Notwithstanding, a major in-depth reclassification (combining molecular and traditional data of the genus) has not yet been proposed. Four subgenera *Artemisia* Lessing [included traditional two subgenara *Abrotanum* Besser and *Absinthium* (Miller) Lessing], *Dracunculus* (Besser) Rydberg, *Seriphidium* Besser ex Lessing and *Tridentatae* (Rydberg) McArthur are still widely used in their traditional systematic circumscription (Pellicer *et al.*, 2014).

The first detailed phylogenetic interpretation of the sections or subgenera established *Artemisia (= Abrotanum + Absinthium)* as the more primitive, while *Dracunculus*, *Seriphidium* and *Tridentatae* were considered to be more advanced (Hall and Clements, 1923).

The genus *Artemisia* L. contains all life forms except trees: Annual, biennial and perennial herbs, suffruticoses (subshrubs), fruticose (shrubs), some large in stature.

There are 22 species without any infraspecific taxa that belong to the genus *Artemisia* in the 5th volume of the Flora of Turkey (Cullen, 1975; Davis, 1975; Davis *et al.*, 1988). Later, the species *Artemisia verlotiorum* Lamotte was added to the 10th volume of the Flora of Turkey as a new record for Turkey, so species numbers of the genus *Artemisia* in Turkey became 23 in total (Davis *et al.*, 1988).

The genus *Artemisia* in the Flora of Turkey are not divided to sections or subgenera. At the same time, none of these species has infraspecific taxa. Total of 23 species belong to the genus *Artemisia* in the Flora of Turkey are *A. vulgaris* L., *A. verloitorum* Lamotte, *A. abrotanum* L., *A. austriaca* Jacq., *A. incana* (L.) Druce, *A. armeniaca* Lam., *A. chamaemelifolia* Vill., *A. annua* L., *A. tournefortiana* Reich., *A. alba* Turra, *A. absinthium* L., *A. arborescent* L., *A. splendens* Willd., *A. caucasica* Willd., *A. haussknechtii* Boiss., *A. araratica* Krasch., *A. campestris* L., *A. marschalliana* Sprengel, *A. araratica* Krasch., *A. scoparia* Waldst. & Kit.**,** *A. santonicum* L., *A. taurica* Willd., *A. spicigera* K. Koch, *A. herba-alba* Asso (Cullen, 1975; Davis, 1975; Davis *et al.*, 1988).

Civelek *et al*. (2010) have carried out a revisionary study of the genus *Artemisia* in Turkey. According to results of this revisionary study, there are 3 subgenera, 22 species and 26 taxa which also include 8 infraspecific taxa belong to the genus *Artemisia* in Turkey (Civelek *et al.*, 2010; Kursat, 2010; Kursat *et al.*, 2011a and b, 2014, 2015, 2018).

The taxa of genus *Artemisia* were divided into subgenera during revisionary study. Subgenera *Artemisia, Dracunculus* and *Seriphidium* have taxa in Turkey, but the subgenus *Tridentatae* which is endemic to North America has not taxa in Turkey (Civelek *et al.*, 2010; Kursat, 2010; Guner *et al.*, 2012).

Taxa belong to the genus *Artemisia* show some ontogenic (developmental) variations in terms of flower colors and indumentum (hair cover of surfaces). Flower colors and indumentum of the plants change, when passing from pre-flowering stage to flowering stage or from flowering stage to fruiting stage (especially their hairs are usually shed when passing from flowering stage to fruiting stage). Therefore, different specimens with different developmental stages must be collected from the same population of the same taxon for correct identification in systematic studies (Civelek *et al.,* 2010; Kursat, 2010; Kursat *et al.,* 2015).

During revisionary study of the genus *Artemisia* in Turkey, the species *Artemisia bashkalensis* Kursat & Civelek was identified as a new species globally (Kursat *et al.,* 2015). *Artemisia fragrans* Willd., *Artemisia sieberi* Besser subsp. *sieberi* and *Artemisia santonicum* L. subsp. *patens* (Neilr.) K. Persson were identified as new records for Turkey (Civelek *et al.,* 2010; Guner *et al.,* 2012; Kursat 2010; Kursat *et al.,* 2011a, 2011b and 2014). It was observed that all specimens identified as the species *Artemisia herba-alba* Asso in the Turkish herbaria are actually the taxon *A. sieberi* subsp. *sieberi,* and the species *Artemisia herba-alba* certainly are not distributed in Turkey (Civelek *et al.,* 2010; Kursat, 2010; The plant list, 2019). In addition, the species *Artemisia alba* Turra is only known from the East Aegean Islands which are outside of Turkey's borders (Cullen, 1975; Davis, 1975). For these reasons, the species *A. alba* and *A. herba-alba* have been removed from the Turkey's species list (Civelek *et al.,* 2010; Guner *et al.,* 2012; Kursat, 2010; Kursat *et al.,* 2011a).

Their distributions in Turkey and morphological features in mind, the closely related independent species *A. campestris* L., *A. marschalliana* Sprengel and *A. araratica* Krasch. in Flora of Turkey were reduced to variety levels and these were linked to the species *A. campestris* in the revisionary study of the genus *Artemisia* in Turkey (Civelek *et al.,* 2010; Kursat, 2010).

Recently, a new variety from Eastern Anatolia of Turkey was identified as *Artemisia taurica* Willd. var. *vanensis* Kursat & Civelek (Kursat *et al.,* 2018). The species *A. caucasica* Willd. in the 5th volume of Flora of Turkey was made synonym to the species *A. alpina* Pall. ex Willd. (Cullen, 1975; Davis, 1975; The plant list, 2019).

The taxa of the genus *Artemisia* L. in Turkey which are defined until now are given below (Civelek *et al.,* 2010 and 2018; Kursat, 2010; Kursat *et al.,* 2011a, 2011b, 2014, 2015 and 2018) :

Genus: *Artemisia* L.

I. Subgenus *Artemisia* Less.

1. *A. vulgaris* L.
2. *A. verloitorum* Lamotte
3. *A. abrotanum* L.
4. *A. austriaca* Jacq.
5. *A. incana* (L.) Druce
6. *A. armeniaca* Lam.
7. *A. chamaemelifolia* Vill.
8. *A. annua* L.
9. *A. tournefortiana* Reichb.
10. *A. absinthium* L.
11. *A. arborescens* L.
12. *A. splendens* Willd.
13. *A. alpina* Pall. ex Willd.
14. *A. haussknechtii* Boiss.

II. Subgenus *Dracunculus* (Bess.) Rydb.

1. *A. campestris* L. var. *campestris*
2. *A. campestris* L. var. *marschalliana* (Spreng.) Poljak.
3. *A. campestris* L. var. *araratica* (Novopokr.) Poljak.
4. *A. scoparia* Waldst. & Kit.

III. Subgenus *Seriphidium* (Bess.) Rouy.

1. *A. santonicum* L. subsp. *santonicum*
2. *A. santonicum* L. subsp. *patens* (Neilr.) K. Persson
3. *A. bashkalensis* Kursat & Civelek
4. *A. taurica* Willd. var. *taurica*
5. *A. taurica* Willd. var. *vanensis* Kursat & Civelek
6. *A. spicigera* K. Koch
7. *A. fragrans* Willd.
8. *A. sieberi* Bess. subsp. *sieberi*

1.1. General information about the genus *Artemisia* L. and the subgenus *Dracunculus* (Bess.) Rydberg in Turkey

1.1.1. Description of the genus *Artemisia* L. (Figures 1.1, 1.2, 1.7)

***Artemisia* L.** (Linnaeus, 1753 and 1754; Davis, 1975; Schinskin and Bobrov, 1995; Civelek *et al.,* 2010; Kursat, 2010)

General English names of the genus *Artemisia* L. are known as "sage wort", "sagebrush", "wormwood", "mug wort", "Felon-herb", "sailor's-tobacco", "armoise", "tarragon" and "herbe Saint-Jean" [Greek *Artemis,* goddess of the hunt and namesake of *Artemisia*, Queen of Anatolia. "*Artemisia*" was the wife of King Mausolus]

General Turkish names of the genus *Artemisia* L. are known as "yavşan otu", "pelin otu" and "tarhun".

Annual, biennial and perennial herbs, suffrutescent, suffruticoses (subshrubs), fruticose (shrubs), usually strongly and pleasantly aromatic or rarely not. Stems $1–10^{+}$, 3 – 350 cm erect, ascending, sometimes procumbent, usually branched, glabrous or hairy of basifixed and medifixed (Figure 1.1) or viscid hairs or punctate-glandulose (glands-dotted or sessile glands). Leaves basal or basal and cauline, alternate, petiolate or sessile, usually pinnately and/or palmately lobed, sometimes apically ± 3-lobed or -toothed, or entire, faces glabrous or hairy. Synflorescence racemose, sometimes spicate, usually grouped into panicles; capitula (flower heads) usually many, often secund (arranged on one side), usually small, pedunculate to sessile, nodding (pendulose) or erect, homogamous (with all florets hermaphrodite and fertile) or heterogamous with peripheral female florets and central disc florets, both fertile or only peripheral female florets fertile but central disc florets sterile (with abortive ovaries/with rudimentary pistils, functionally staminate), discoid (with only disk florets i. e. tubular, actinomorphic and hermaphrodite (never pistillate)), sometimes disciform (with peripheral pistillate florets and central disk florets, superficially similar to discoid) (Figures 1.2 and 1.7), geiconogamous (fertilization between different flowers on the same plant) or autogamous (self-fertilized). Involucres campanulate, globose, ovoid, ellipsoid or turbinate, 1.5 – 8 (-10) mm diam. Phyllaries (involucral bracts) persistent, 2–20 (+) in 2 – 6 (-7) irregular series, distinct (usually green to whitish green, rarely stramineous i. e. straw colored), ovate to lanceolate, unequal (outer bracts gradually reducing and considerably shorter than inner bracts) or almost equal, margins and apices (usually green or white, rarely purplish, dark brown or black) ± scarious (abaxial faces glabrous or hairy). Receptacle usually convex, conical, hemispherical or less almost flat, epaleate (lacking paleae) or paleate (bearing paleae, only in *A. palmeri* A. Gray), glabrous or somewhat hairy. Peripheral pistillate florets in disciform heads usually 3-10 or more in 1 – 2 series, their corollas very narrow, sometimes almost filiform tubular, 2-, 3- toothed, almost colorless or corolla tubular, 2-, 3-, 4-toothed, colored (corollas of 1–3 pistillate florets in heads of *A. bigelovii* A. Gray sometimes ± 2-lobed, weakly raylike). Disc florets in discoid and disciform heads 2–20 (–30+), hermaphrodite (bisexual) and fertile or hermaphrodite with abortive ovaries, functionally staminate and sterile, their corollas (glabrous or ± hirtellous) yellow of various shades or reddish - violet, tubes ± cylindric, throats sub globose or funnelform, lobes 5, ± deltate. Anthers linear, with 2 obtuse basal appendages and with lanceolate or oblong – lanceolate, acute, less often sub-obtuse an apical appendage; pollen grains globose, smooth or almost smooth surface, always nonspinulose. Style ca. as long as or longer than corolla or sometimes shorter than corolla; style (stigma) bifid (divergent), lobes of stigma in peripheral pistillate florets usually narrow – linear, apically more or less narrowed, acute or obtuse, lacking hairs or cilia; style in hermaphrodite (bisexual) central florets linear, apically truncate, barbate form uprights hairs; style of hermaphrodite florets with rudimentary pistils (functionally staminate florets) apically not bifid, infundibuliform, with erect ciliate hairs or short connate lobes. Cypselae (achenes) small, homogeneous, obovate or oblong - ovate, almost terete or flattened, faces finely striate or sulcate, glabrous or hairy (not villous), often gland-dotted (pericarps sometimes with myxogenic cells, without resin sacs; embryo sac development monosporic), brownish, apically more or less roundish, papus absent, corona absent or minute (slightly raised upper edge as if rudiment corona, annulus or scarious corolliform ring).

The genus *Artemisia* has two basic chromosome numbers (x=9 and x=8). The taxa of the genus *Artemisia* show dysploidy (Figures 1.3 and 1.4 ; Tables 1.3 and 4.1))

Type of genus: *Artemisia vulgaris* L.

Species ca. 350–500, mostly Northern Hemisphere (North America, Eurasia), some in South America and Africa

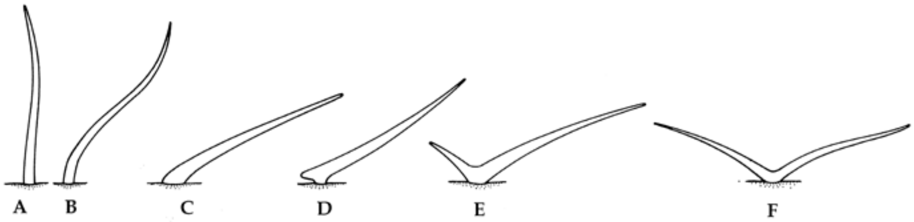

Figure 1.1. The general types of basifixed and medifixed hair in plants. A- hair basifixed and erect, B- hair basifixed and spreading, C- hair basifixed and ± spreading, D- hair laterally attached at base, E- hair asymmetrically medifixed, F- hair symmetrically medifixed (Civelek *et al.*, 2018).

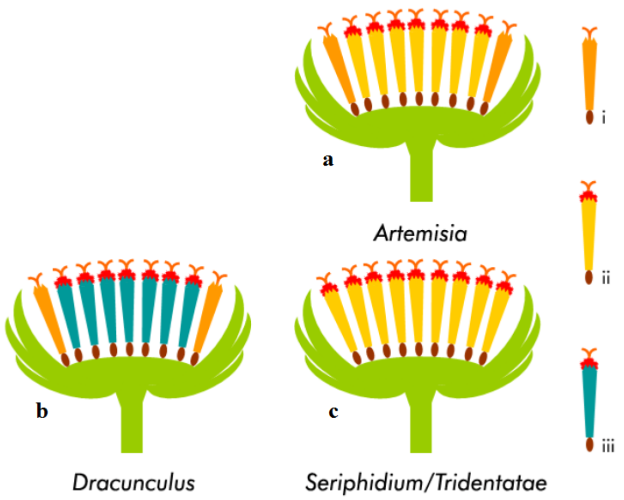

Figure 1.2. Diagrams of the flower head structure of subgenara in the genus *Artemisia* L. i- female fertile florets, ii- perfect hermaphrodite (bisexual) fertile disc florets, iii- reduced hermaphrodite sterile disc florets (with abortive ovaries and functionally staminate); a and b- disciform capitula, c- discoid capitula (modified from Pellicer *et al.*, 2011).

1.1.2. Karyology (polyploidy and dysploidy) of the genus *Artemisia* L.

Dysploidy is the situation where species in a genus or subgenus have different basic chromosome numbers. Dysploidy is something different from aneuploidy (Figure 1.3). In aneuploidy, the chromosome change resulted from a missing or adding of a resemble (homologous) chromosome to the existing chromosome. In this case, genetic information on the given chromosome may be lost or double. While in dysploidy, the chromosome change resulted from structural change of the old chromosome; such as centric fusion, centric fission and dissociation process. The whole genetic information will still be the same (Figure 1.3). The dysploidy is then more stable within a species (Kaymak, 2007; Moore, 1976).

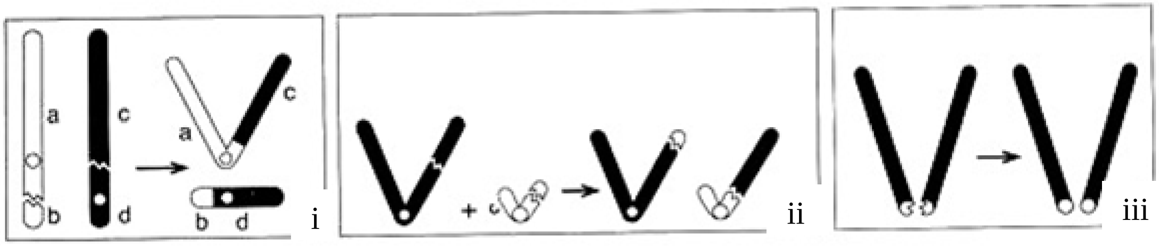

Figure 1.3. Dysploidy formation by centric fusion, dissociation and centric fission mechanisms (Anonymous, 1). 1- Centric fusion (Robertsonian translocation) : The origin of a new V – sahaped (metacentric) chromosome by centric fusion of two nonhomologous acrocentric chromosomes. Segment b-d is lost. 2- Dissociation : A metacentric and a small supernomerary chromosomal fragment undergo a translocation, which results in two chromosomes (acrosentric and metacentric). 3- Centric fission : Direct division of centromer of a metasentric chromosome to two telocentric chromosomes.

The genus *Artemisia* has two basic chromosome numbers, X=9 and X=8. In four subgenera of *Artemisia*, two subgenera (*Seriphidium* and *Tridentatae*) are characterized by X=9 and the other two subgenera (*Artemisia* and *Dracunculus*) have both X=8 and X=9 representatives. In other words, while dysploidy is only present in two of the subgenera in two genera *Artemisia* and *Dracunculus*, dysploidy is absent in two subgenera *Seriphidium* and *Tridentatae* (Oliva and Vallès, 1994; Valles and McArthur, 2001).

A high percentage of *Artemisia* species are polyploid. This phenomenon is present in all the subgenera of the genus. Both basic chromosome numbers show polyploidy, with levels up to 12x for x = 9 and 6x for x = 8 (Tables 1.3 and 4.1). Figure 1.4 presents a scheme of the putative chromosome number evolution in the genus *Artemisia* and illustrate almost all changes in chromosome number and ploidy level of the genus. Polyploidy and dysploidy have played a major role in the chromosomal evolution of the genus *Artemisia* (Torrell *et al*., 1999).

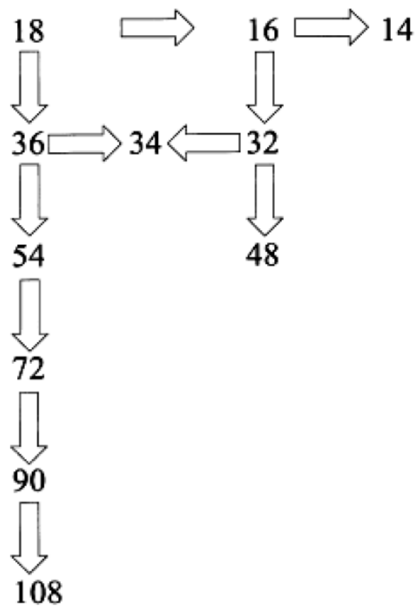

Figure 1.4. Chromosome number evolution in the genus *Artemisia* (Oliva and Vallès, 1994; Valles and McArthur, 2001)

1.1.3. Apomictic (asexual) seed formation in the genus *Artemisia* L.

Apomixis (asexual seed formation) is the result of a plant gaining the ability to bypass the most fundamental aspects of sexual reproduction: meiosis and fertilization (Figure 1.5) without the need for male fertilization, the resulting seed germinates a plant that develops as a maternal clone. This dramatic shift in reproductive process has been documented in many flowering plant species (Hand and Koltunow, 2014).

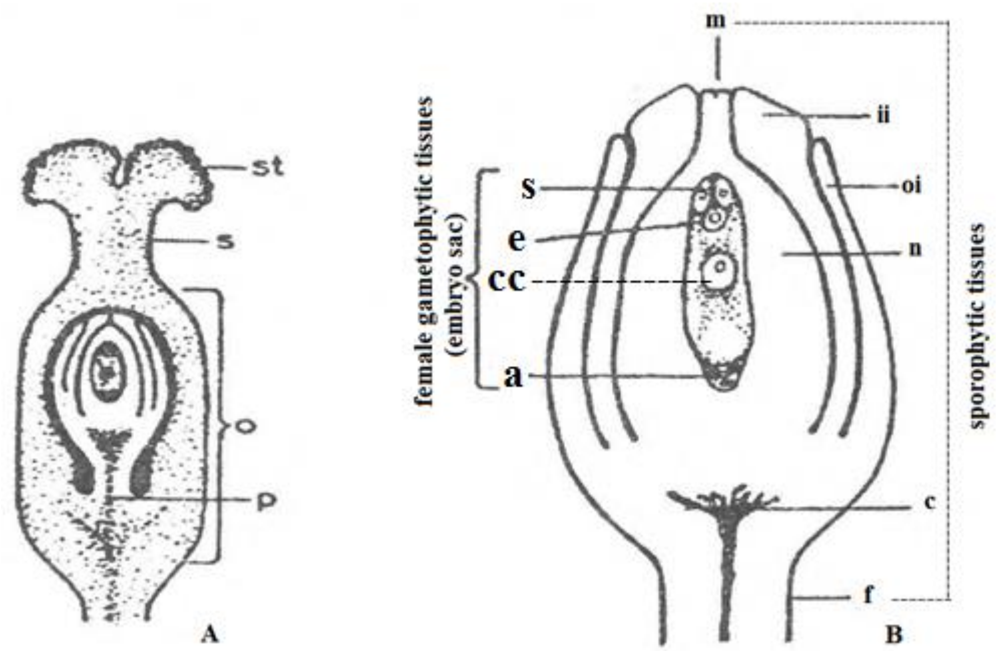

Figure 1.5. A pistil bearing one ovule and *Polygonum*-type embryo sac in the sexual seed formation (amphimixis). A – pistil; o- ovarium, p- placenta, s- style, st- stigma, B – ovule; a-antipodes, c- chalaza, f-funiculus, e- egg cell, cc-central cell (2 polar nuclei), ii-inner integument, oi- outer integument, m-micropyle, n- nucellus, si- synergids (modified from Yakar-Tan and Bilge, 1976).

Sporophytic tissues of a differentiated ovule are nucellus, integuments and funiculus, gametophytic tissue is embryo sac. The megaspore mother cell (MMC) in the nucellus differentiates sub-epidermally, and undergoes meiosis to differentiate a single functional megaspore that divides mitotically to form a female gametophyte composed of gametophytic tissues (embryo sac) which are an egg cell, two synergids, three antipodal and a binucleated central cell whose nuclei fuse prior to fertilization (Figure 1.5). Following double fertilization, the egg cell and the central cell give rise to the embryo and the endosperm respectively; while the function of synergids is to attract the pollen tube, the function of the antipodal remains unknown (Armenta-Medina, 2013).

In contrast to sexual seed formation (amphimixis), apomixis can occur by various mechanisms that share three common developmental components: (i) a bypass of meiosis during embryo sac formation (apomeiosis), (ii) development of an embryo independent of fertilization (a process known as parthenogenesis), and (iii) formation of viable endosperm either via fertilization-independent means or following fertilization (Hand and Koltunow, 2014; Koltunow and Grossniklaus, 2003). Derivation of the egg from a diploid maternal cell without meiotic reduction, and its subsequent fertilization-independent development into an embryo, means that the progeny derived from apomictic development are clonal and therefore genetically identical to the maternal parent.

Apomixis mechanisms are historically subdivided into two categories and classified as either gametophytic or sporophytic (see Figure 1.6 and Table 1.1 for definitions), based on whether the embryo develops via a gametophyte (embryo sac) or directly from diploid somatic (sporophytic) cells within the ovule (Hand and Koltunow, 2014; Nogler, 1984; Koltunow, 1993).

Table 1.1. Definitions for gametophytic apomixis and sporophytic apomixis (modified from Hand and Koltunow, 2014).

Term	**Definition**
Apomixis	Formation of seeds with asexual reproduction in Spermatophyte (seeded plants). Progeny of an apomictic plant are genetically identical to the maternal plant.
Embryo sac	Multicellular female gamete-producing structure of seeded plants. Also known as the female gametophyte.
Apomeiosis	Avoidance or failure of meiosis division during the development of an embryo sac.
Sporophytic apomixis (Adventitious embryony)	An embryo develops directly from a vegetative (sporophyte) cell of the ovule (without an intervening gametophyte)
Gametophytic apomixis	Gametophytic apomixis relates to mechanisms where an embryo sac is mitotically formed from a diploid cell in the ovule, by passing meiosis. Apo meiotic embryo sac development is further subdivided into two types (diplospory and apospory) based upon the origin of the diploid precursor cell that ultimately gives rise to the mitotically derived embryo sac.
Diplospory	Apomeiosis pathway where a diploid embryo sac develops from the megaspore mother cell.
Apospory	Apomeiosis pathway where a diploid embryo sac develops from a somatic ovule cell that is not the megaspore mother cell, called the aposporous initial (AI) cell.
Parthenogenesis	Development of an egg found in a diplosporous or aposporous embryo sac into an embryo without fertilization.

Endosperm development in the apomictic seed formation can occur without fertilization of the central cell (autonomous endosperm type), occurring predominantly in members of the daisy family (Asteraceae). Apomicts that require fertilization to produce pseudomamma’s endosperm type have disturbed maternal (m) and paternal (p) genome contributions (m: p) in the endosperm. For example, in such apomicts, fertilization of a tetraploid central cell may lead to a 4m:1p endosperm genome ratio, in contrast to the typical 2m:1p ratio of fully sexually reproducing species. Those apomicts that require fertilization to develop endosperm have therefore developed multiple strategies to ensure seed viability (Koltunow and Grossniklaus, 2003; Curtis and Grossniklaus, 2008).

Because of high percentage of the genus *Artemisia* species are polyploid, numerous apospory and diplospory apomictic are reported for the genus *Artemisia* (Noyes, 2007; Carman, 1997; Czapik, 1996; Pullaiah, 1984; Davis, 1967; Battaglia, 1951; Gustafsson, 1946 – 1947).

Apomicts in the family Asteraceae, as in other plant families are almost always restricted to polyploids at triploid and higher levels (Noyes, 2007). The reasons for this may include genetic lethality that prevents the maintenance of apomixis at the diploid level, either affecting developing embryos or preventing haploid gametes from carrying apomixis genes (Noyes, 2007; Nogler, 1984). Lethality of this type would mean that apomixis genes (either through egg or sperm cells) could be effectively transferred only through diploid or higher-level ploidy gametes. Consequently, novel apomictic genotypes resulting from sexual hybrid apomictic genotypes must always be polyploid. Sexual reproduction populations may occur at the diploid level or usually even higher ploidal levels, while apomictic plants are normally exclusively polyploidy (Grant, 1981).

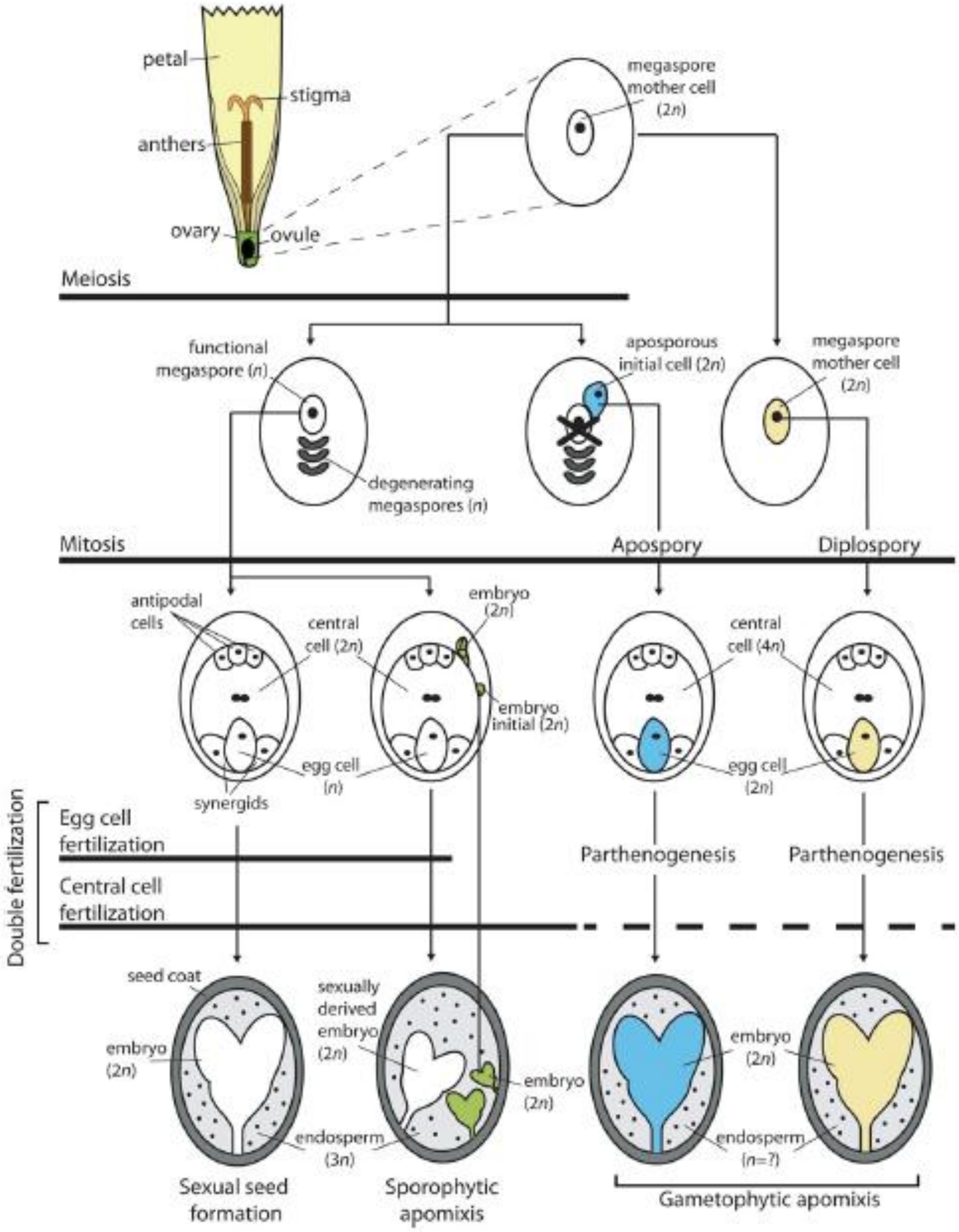

Figure 1.6. Mechanisms of sexual and asexual (apomictic) seed development (Hand and Koltunow, 2014). Seed developmental processes occur within the ovule of the flower, which is depicted as a single floret typical of *Hieracium* species in this figure. This diagram compares the major differences in the seed development pathway for sexual seed formation and the apomictic mechanisms of sporophytic and gametophytic apomixis. Meiosis, mitosis, and double fertilization constitute the majör components of the seed formation pathway. Arrows passing through each of these components represents the involvement of a given component within a particular pathway. In the process of gametophytic apomixis, embryo sac formation can occur via either apospory or diplospory, which are distinguished by different embyro sac precursor cells. In gametophytic apomixis, embryo formation is

initiated in the absence of fertilization (parthenogenesis); however, endosperm formation can occur either with or without fertilization, which is represented by a dashed line. The relative ploidy level of cells (n) is tracked for various components throughout each pathway. The ploidy level of endosperm formed through gametophytic apomixis is variable, depends on a number of factors, and is therefore represented by a question mark (?). In the depicted apospory pathway, the sexual pathway is shown to terminate once the aposporous initial cell undergoes mitosis. Different colors track the precursor cells that form the embryo for each pathway: sexual (white), sporophytic apomixis or adventitious embryony (green), diplospory (yellow), and apospory (blue).

1.1.4. The identification key for subgenera of the genus *Artemisia* L. in Turkey (Civelek *et al.*, 2010; Kursat, 2010)

1a. Capitula (flower heads) discoid with few (2 - 10) disc florets (i. e. tubular, actinomorphic and hermaphrodite (never pistillate)); homogamous with all disc florets hermaphrodite and fertile and setting fruits; involucre with 3-6 rows of imbricate, unequal bracts; receptacle glabrous **Subgenus *Seriphidium***

1b. Capitula (flower heads) disciform with (1-) 3 – 70 peripheral (marginal, outer or radial) pistillate florets and (4-) 7 – 120 central disc florets; heterogamous with peripheral female florets and central hermaphrodite disc florets, both fertile and setting fruits or only outer female florets fertile and setting fruits, but central disc florets sterile and not setting fruits; involucre with 2-3 rows of bracts differing very little in size; receptacle glabrous or hairy **2**

2a. Both of peripheral female (pistillate) and central perfect disc (hermaphrodite) florets fertile and setting fruits; receptacle glabrous or hairy **Subgenus *Artemisia***

2b. Only peripheral female (pistillate) florets fertile and setting fruits, but central reduced hermaphrodite florets (with abortive ovaries / with rudimentary pistils, functionally staminate and sterile); receptacle glabrous **Subgenus *Dracunculus***

1.1.5. Description of the subgenus *Dracunculus* (Bess.) Rydberg (Figures 1.1, 1.2, 1.7 – 1.29; Tables 1.2, 1.3 and 1.4)

Subgenus *Dracunculus* (Bess.) Rydberg (Besser, 1835; Rydberg, 1916; Schinskin and Bobrov, 1995; Tutin & Persson, 1976; Rechinger, 1986; Civelek *et al.*, 2010; Kursat, 2010)

Annual, biennial or perennial herbs, semi shrubs with woody perennial shoots at base, shrubs, puberulent or pubescent, often glabrescent, rarely tomentose, without glandular or viscid hairs (sessile glands often present). Leaves 1- or 2-pinnatisect to -pinnatipartite, or 3–7-subpalmatisect or sub palmatipartite or entire; lobules 0.3–4(–12) mm wide, linear, lanceolate, elliptic, linear-lanceolate or pectinate or serrate. Capitula globose to ovoid, sessile or pedunculate, in spicate, racemose or paniculate, less often in dense capitate synflorescence. Involucral bracts (phyllaries) in (2-) 3 -4 (-5) rows, oval, round, oblong – lanceolate, herbaceous, glabrous or hairy, with more or less wide scarious margin, usually not incised – toothed, uniformly long but outer involucral bracts smaller than inner bracts. Receptacle flat or somewhat convex, glabrous. Capitula (flower heads) disciform and heterogamous with peripheral fertile female (pistillate) florets and sterile central reduced hermaphrodite disc florets (with abortive ovaries or with rudimentary pistils) functionally staminate. Peripheral (outer, margin or radial) florets 2–21(–29), pistillate, always fertile, their corollas tubular or narrowly conical, often slightly enlarged at base, with 2-3 teeth, glabrous, stigma lobes 2, less often 3, narrowly linear, subacute or obtuse; pollen – receptive area as continuous strip bordering margin lobe. Achenes (cypselae) small, pyriform, ovoid or oblong somewhat flat, narrowed at base, very finely ribbed brown; papus absent; Central disk florets few or rather numerous (2–35), male (staminate) but with rudiment of pistil, their corollas usually narrowly campanulate, with 5 acute, straight, yellow or pinkish teeth, glabrous or hairy in upper part; anthers linear, apical appendages of anthers obtuse or acute, basal appendages smaller, sub obtuse, weakly developed, “antheropodia*” well-developed, usually convex, their pistils abortive as style (ovaries absent or minute), style shorter than corolla, with undivided clavate, funnel- or goblet shaped, densely ciliate stigma, less often stigma with 2 short, erect, basally connate lobes (2-cleft), lobes usually not divergent.

* Antheropodium (plural antheropodia) – literally “anther foot”; a region of usually thick-walled cells in a staminal filament just proximal to its anther; the collar may be

baluster form (as in *Senecio*), i.e., proximally with enlarged cells, or straight and (semi)cylindric and made up of uniformly sized cells (as in *Ligularia* and *Parasenecio*).

The type species of subgenus *Dracunculus* (Bess.) Rydb. is the species *Artemisia dracunculus* L. The type species *A. dracunculus* -tarragon- deserves special attention, since it accounts for a great economic value. This plant is popular worldwide because it is used as culinary condiment in many countries.

There are two basic numbers (x = 9 and x = 8) of chromosome which are known as dysploidy in taxa of the subgenus *Dracunculus* in Turkey (Civelek *et al.* 2010; Kursat 2010). For example, three varieties of the species *A. campestre* 2n=4x=36 (x=9) and the species *A. scoparia* 2n=2x=16 (x=8) (Table 4.1).

As for the whole of the genus *Artemisia*, the representatives of the subgenus *Dracunculus* are widely spread across the Northern Hemisphere, mainly in the arid zones and semiarid steppes from Europe to Asia, where the subgenus has its main hotspot, but also reaching North America. They are mostly subshrubs and herbs, basically perennial, with few annuals such as *Artemisia demissa* Krasch., *Artemisia edgeworthii* Balakr., *Artemisia pewzowii* C. Winkl., and *Artemisia scoparia* Waldst. & Kit. (Pellicer *et al.*, 2011).

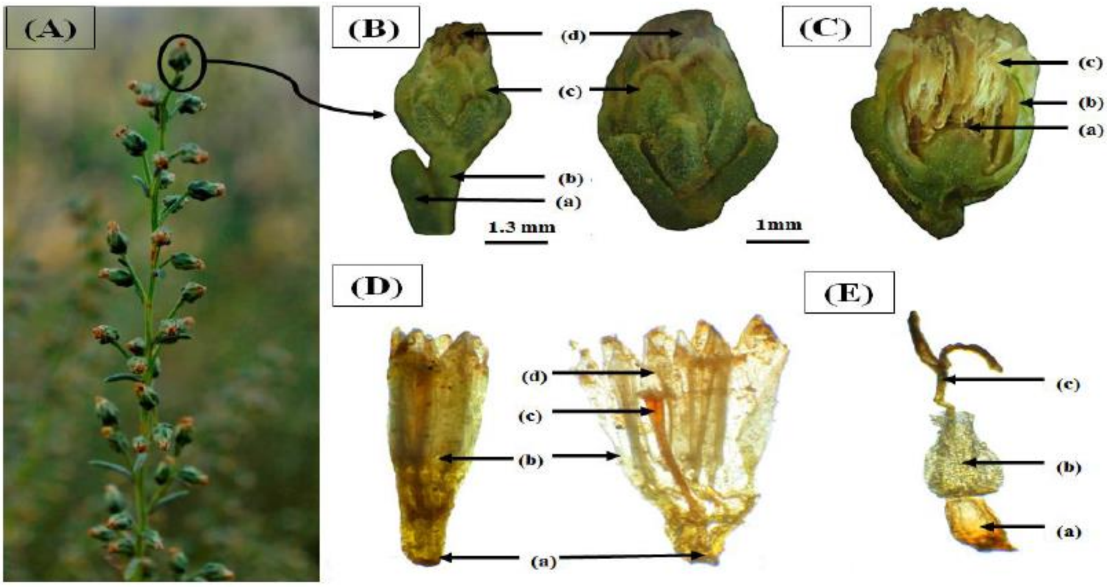

Figure 1.7. The Morphological traits of the species *A. campestris* L. (Dib *et al.*, 2017). A- general shape of synflorescence, B- capitula; Ba- leaf, Bb- peduncle, Bc- involucral bracts (phyllaries), Bd- flowers. C- longitudinal section of capitula; Ca- convex receptacle, Cb- involucral bracts (phyllaries), Cc- flower. D- male flower (tubular flower); Da- abortive ovary, Db- 5 fused petals, Dc- style and stigma, Dd- 5 fused stamens. E- female flower; Ea- functional ovary, Eb- style, Ec- bi-lobed stigma.

1.1.6. Taxonomical information about the subgenus *Dracunculus* (Bess.) Rydberg

Cassini (1817) described the genus *Oligosporus*, which included the taxa that are currently considered as part of the subgenus *Dracunculus* of the genus *Artemisia*. This genus (*Oligosporus*), with functionally separate sexes, that is, radial female florets and central male ones as consequence of the abortive ovaries, is composed of about 80 taxa (Poljakov, 1961a and 1961b).

As mentioned in the introduction chapter, *Dracunculus* has been described in section and subgenus levels in the past and the currently accepted its status is subgenus (Besser, 1829; Rydberg, 1916).

Recently, Ling *et al.* (2006) in their revision of the Anthemideae tribe have proposed a new classification, and as a consequence, the subgenus *Dracunculus* of the genus *Artemisia* would be divided into two sections, *Dracunculus* Besser and *Latilobus* Y. R. Ling on the basis of their leaf morphology and ovaries of disc florets.

The identification key for these two sections as below (Ling *et al.*, 2006):

1a. Lobules of leaf blade filiform, narrowly linear, lanceolate, or subulate and less than 1.5 mm wide, or pectinate and 1–2.5 × 1–2.5 mm, or leaf blade lanceolate or linear-lanceolate; ovaries of disk florets usually minute **sect. *Dracunculus***

1b. Lobules of leaf blade broadly linear to lanceolate or elliptic, more than (1–) 1.5 mm wide, or leaf blade spathulate or obovate; ovaries of disk florets usually absent **sect. *Latilobus***

If we consider this classification, there are taxa of the section *Dracunculus* in Turkey, but there is no taxa of the section *Latilobus*.

Table 1.2. Taxonomic applications of the subgenus *Dracunculus* at sectional, subgeneric or generic levels

Cassini (1817)	Besser (1829)	Rydberg (1916)	Ling *et al.* (2006)
Genus *Oligosporus*	**Genus** *Artemisia* **Section** *Dracunculus*	**Genus** *Artemisia* **Subgenus** *Dracunculus*	**Genus** *Artemisia* **Subgenus** *Dracunculus* **Section** *Dracunculus* **Section** *Latilobus*

In summary, the taxa that are currently considered as part of the subgenus *Dracunculus* of the genus *Artemisia* were identified at levels of genus, section and subgenus by Cassini (1817), Besser (1829) and Rydberg (1916) respectively. In addition, A new classification of the subgenus *Dracunculus* was proposed by Ling *et al.* (2006) and the subgenus *Dracunculus* was divided into two sections on the basis of their leaf morphology and ovaries of disc florets (Table 2).

There are total of 23 species without any infraspecific taxa that belong to the genus *Artemisia* in the 5th and 10th volumes of the Flora of Turkey. The species *A. campestris, A. marschalliana*, *A. araratica* and *A. scoparia* are four of 23 independent species (Cullen, 1975; Davis, 1975; Davis *et al.*, 1988). In fact, the four species belong to the subgenus *Dracunculus*, but the genus *Artemisia* in the Flora of Turkey didn't divide to subgenera.

According to results of the revisionary study based on the morphological features, there are two species and four taxa belong to the subgenus *Dracunculus* in Turkey. These species in the subgenus *Dracunculus* in Turkey are *A. scoparia* and *A. campestris,* and these taxa in the subgenus *Dracunculus* in Turkey of the subgenus are *A. scoparia*, *A. campestris* var. *campestris, A. campestris* var. *marschalliana, A. campestris* var. *araratica* (Civelek *et al.,* 2010; Kursat 2010).

1.1.7. The identification key for taxa of the subgenus *Dracunculus* (Bess.) Rydberg in Turkey (Civelek *et al.,* 2010; Kursat, 2010)

1a. Annual or biennial herbs; stem usually single **_A. scoparia_**
1b. Perennial herbs or semi shrubs with woody root stock; stems several **2**
2a. Plant very dense hairy at pre - flowering stage, sparse hairy at flowering stage; phyllaries sparse pilose hairy or glabrous, punctate glands (glands-dotted or sessile glands) present or absent at flowering stage **3**
3a. Plant obvious hairy and without or with sparse punctate glands (glands-dotted or sessile glands) at flowering stage; phyllaries only sparse pilose hairy, without punctate glands (glands-dotted or sessile glands) at flowering stage **_A. campestris_ var. _marschalliana_**
3b. Plant glabrous or sparse pilose hairy and with dense punctate glands (glands-dotted) at flowering stage; phyllaries glabrous, with only dense punctate glands (glands-dotted) present at flowering stage **_A. campestris_ var. _araratica_**
2b. Plant glabrous or only sparse pilose hairy, without punctate glands (glands-dotted) at pre - flowering stage, glabrous at flowering stage; phyllaries glabrous, with only punctate glands (glands-dotted) at flowering stage **_A. campestris_ var. _campestris_**

1.1.8. Taxa of the subgenus *Dracunculus* (Bess.) Rydberg in Turkey

1.1.8.1. Description of the species *Artemisia campestris* L. (Figures 1.7 – 1.23; Tables 1.3 and 1.4) (Cullen, 1975; Davis, 1975; Tutin & Persson, 1976; Schinskin and Bobrov,1995; Civelek *et al.*, 2010; Kursat, 2010)

***Artemisia campestris* L.**

Perennial without or with a stout woody stock. Whole plant sparsely covered with short, semi appressed hairs, sometimes almost glabrous; root vertical, woody, with sterile and leafy shoots. Flowering shoots strong, (15-) 50-75 cm high, usually erect, branched, longitudinally ribbed, brown or slightly reddish. Leaves of sterile shoots and lower cauline leaves long-petiolate, 1-8 x 2-4 cm, twice or less often thrice pinnately (pinnatisect) incised, lobes narrowly linear, most often 3-10(-20) mm long, sub acuminate; middle and upper cauline leaves sessile, 0.5-2 (-6) x 0.5-1(-4) cm, more simply divided, usually pinnately incised (once or twice pinnatisect) or divided into 3-7 lobes, uppermost (floral) leaves bracteal, small, narrowly linear, sometimes with 2-4 lobules at base, 0.1-1.5(-2.5) x 0.1-1(-1.5) cm. Capitula numerous, erect, sessile, ovate, 1.5-3.5(-4) mm x 1.5-3 mm, crowded on branches in more or less dense or lax spikes forming elongated, rather narrow, conical-paniculate synflorescence. Involucral bracts (phyllaries) in 3 -4 (-5) rows, oblong – lanceolate, herbaceous with scarious margin, scarious margin of phyllaries wider gradually from outer to inner ones, with only punctuated glands or pilose hairs and punctuated glands together, outer involucral bracts smaller than middle and inner bracts, middle involucral bracts smaller than inner bracts. Outer involucral bracts (phyllaries) oval, almost round, convex, green on outer side, 0.8-1.2 x 0.4-1 mm; middle phyllaries 1-2 x 0.8-1.5 mm, inner bracts (phyllaries) oblanceolate-oblong, 2-2.5x 1-2 mm. Receptacle glabrous. Peripheral florets pistillate, fertile, 4 - 6 (-8), their corollas narrowly tubular, 1.4-2.5 x 0.2-0.5 mm, with 2 apical teeth, with only punctate-glandular (glands-dotted or sessile glands) or together simple hairs and sessile glands, yellow or yellow - reddish; pistils 1.8 – 2.2 mm long, ovaries 0.3-0.8 x 0.1-0.5 mm, styles 0.8-1 mm long, stigma lobes exerted from corolla tube, narrowly linear, erect or weakly divergent, 0.3- 0.7 mm; central disk florets staminate with abortive pistil, (4-)7-9, their corollas conical, glabrous, 2.5-3 x 0.5-1 mm, yellow - reddish; styles of abortive pistils 1-1.5 mm long, stigma lobes 2, erect, ciliate, 0.1-0.8 mm long, stamens 1.8- 3mm long, filaments short, 0.5-1 mm, anthers 1.3-2.2 x 0.1-0.3 mm, lanceolate - linear, apical appendages of anthers obtuse, basal appendages short, subacute. Achenes (cypsela's) 0.8-1.8 x 0.3-1 mm, ovoid, terete, dark brown to black, longitudinally ribbed. Flowering July to September. *Steps, slopes, roadsides. 2n=4x=36* (in three varieties)

Based on revisionary study of the morphological features, the three varieties of the species *Artemisia campestris* L. can be distinguished in Turkey (Table 1.3).

Table 1.3. Comparison in terms of morphological features that distinguish three varieties of the species of *A. campestris* in Turkey

Characters	**var. *campestris***	**var. *marschalliana***	**var. *araratica***
Woody stock	present or rarely absent	present	present
Leaves of sterile shoots and lower cauline leaves	2 - 7 × 2 – 4 cm	1 - 8 × 2 – 4 cm	2 - 7 × 2 – 4 cm
Indumentum of sterile and leafy shoots	sparse hairy in pre - flowering stages, glabrous in post - flowering stages	dense pilose hairy in pre - flowering stages, sparse hairy in post - flowering stages	sparse hairy or glabrous in pre - flowering stages, glabrous in post - flowering stages
Indumentum of leaves	sparse hairy in pre - flowering stages, glabrous in post - flowering stages	dense pilose hairy in pre - flowering stages, sparse hairy in post - flowering stages	dense pilose hairy in pre - flowering stages, sparse hairy or glabrous in post - flowering stages
Dimensions of middle and upper cauline leaves (cm)	0.5-2 × 0.5-1 cm	1-6 × 2 - 4 cm	0.5-2 × 0.5-1 cm
Dimensions of uppermost (floral) leaves	0.1-1.5 × 0.1-1cm	0.1-2.5 × 0.1-1.5 cm	0.1-1.5 × 0.1-1cm
Dimensions of capitula	2 - 3.2 × 1.5-3 mm	2-3.5 × 1.8-2.2 mm	2.8-3.5 × 1.5-3 mm
Indumentum of involucral bracts (phyllaries)	punctate-glandulose (glands-dotted or sessile glands)	simple and punctate-glandulose (glands-dotted or sessile glands)	punctate-glandulose (glands-dotted or sessile glands)
Outer phyllaries dimensions	0.8-1 × 0.8-1mm	0.8-1 × 0.8-1mm	1-1.2 × 0.4-0.6 mm
Middle phyllaries dimensions	1.2-2 × 1-1.5 mm	1.2-2 × 1-1.5 mm	1-1.3× 0.8-1mm
Inner phyllaries dimensions	2-2.5 × 1-2 mm	2-2.5 × 1-2 mm	2-2.4× 1.4-1.6 mm
Corolla color of peripheral pistillate florets	Yellow	yellow	yellow - reddish
Corolla dimensions of peripheral pistillate florets (mm)	2-2.5 × 0.2-0.3 mm	2-2.5 × 0.2-0.3 mm	1.4-2.5 × 0.2-0.5 mm
Pistils length of peripheral pistillate florets (mm)	2 – 2.2 mm	2 – 2.2 mm	1.8 – 2.2 mm

Ovaries dimensions of peripheral pistillate florets (mm)	0.3-0.8×0.1-0.3 mm	0.3-0.8×0.1-0.3 mm	0.3-0.8 × 0.2-0.5 mm
Number of staminate central disk florets with abortive pistil	7-9	7-9	4-8
Styles length of staminate central disk florets with abortive pistil	1-1.5 mm	1-1.5 mm	1.2-1.5 mm
Stigma lobes length of staminate central disk florets with abortive pistil	0.1- 0.3 mm	0.5- 0.8 mm	0.1- 0.3 mm
Stamens length of staminate central disk florets with abortive pistil	1.8-2.3 mm	1.8-2.3 mm	2.8-3mm
Stamens length of staminate central disk florets with abortive pistil	0.5-0.8 mm	0.6-0.8 mm	0.8-1 mm
Filaments length of staminate central disk florets with abortive pistil	1.3-1.5 × 0.1-0.3 mm	1.3-1.5 × 0.1-0.3 mm	2-2.2 × 0.1-0.3 mm
Achenes (cypsela's) dimensions (mm)	0.8-1.5× 0.3-0.8 mm	0.8-1.5× 0.3-0.8 mm	0.9-1.8 × 0.3-1 mm

The taxon *A. campestris* var. *campestris* is spreaded in all regions of Turkey except for Black Sea and South - East regions. The taxon *A. campestris* var. *marschalliana* is spreaded in the Eastern Anatolia region and in the inner areas of the Black Sea region in Turkey. The taxon *A. campestris* var. *araratica* is spreaded in the Central Anatolia and West parts of Eastern Anatolia in Turkey (Figure 1.8). The taxon *A. campestris* var. *araratica* is Irano – Turanian phytogeographic region element.

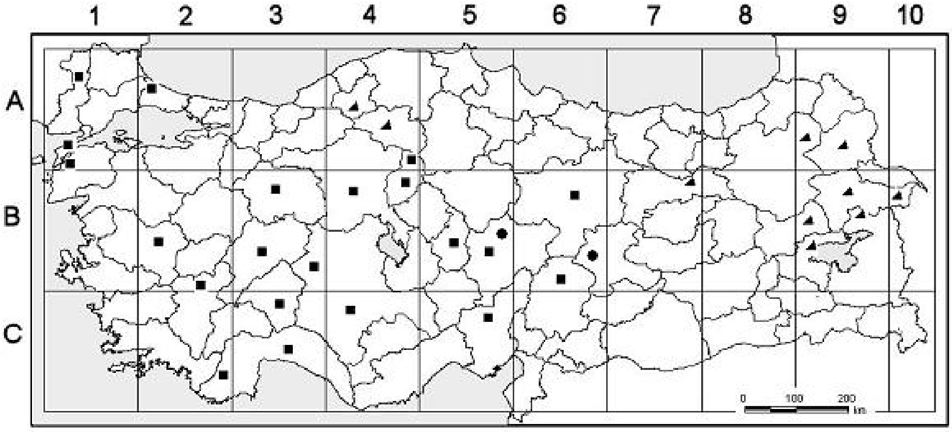

Figure 1.8. Geographic distribution of three varieties of the species *A. campestris* in Turkey (var. *campestris* (■), var. *marschalliana* (▲) and var. *araratica* (●) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.9. The overview in the nature habitat of the taxon *A. campestris* var. *campestris* (a), b and c -orientation of capitula from M. Kursat 1022 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.10. The herbarium specimens of the taxon *A. campestris* var. *campestris* from Civelek and M. Kursat 1022 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.11. Detailed appearance of lower and cauline leaves of the taxon *A. campestris* var. *campestris*. a- detailed appearance of different sized lower leaves, b- detailed appearance of different sized cauline leaves from below to uppermost (floral), from Civelek and M. Kursat (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

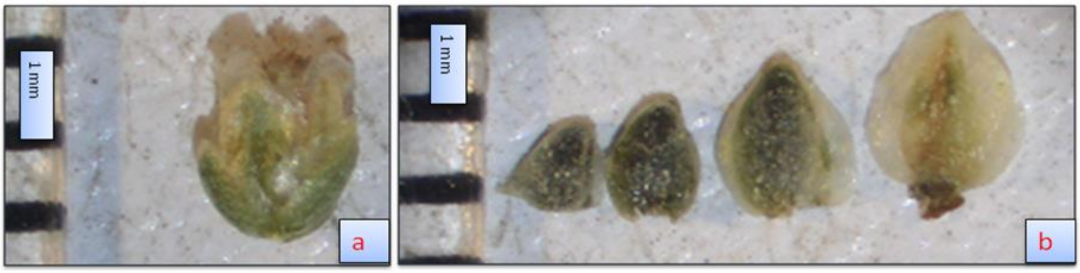

Figure 1.12. Capitulum (head) and phyllaries of the taxon *A. campestris* var. *campestris*, a- capitulum (head), b- phyllaries from outer to inner, from Civelek and M. Kursat 1022 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

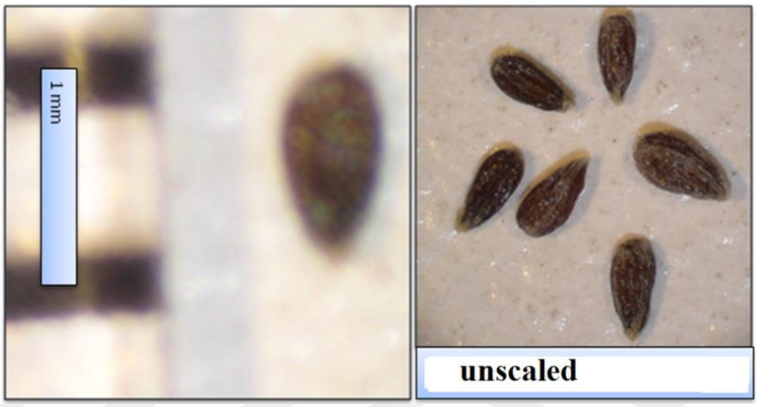

Figure 1.13. The fruit (cypsela or achene) of the taxon *A. campestris* var. *campestris* from M. Kursat, 1096 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.14. The overview in the nature habitat of the taxon *A. campestris* var. *marschalliana* from Civelek and M. Kursat 1046 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.15. The herbarium specimens of the taxon *A. campestris* var. *marschalliana* from Civelek and M. Kursat 1046 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.16. Detailed appearance of lower and cauline leaves of the taxon *A. campestris* var. *marschalliana,* a- detailed appearance of different sized lower leaves, b- detailed appearance of different sized cauline leaves from below to uppermost (floral), from Civelek and M. Kursat 1046 (FUH) (Civelek *et al.* 2010; Kursat 2010).

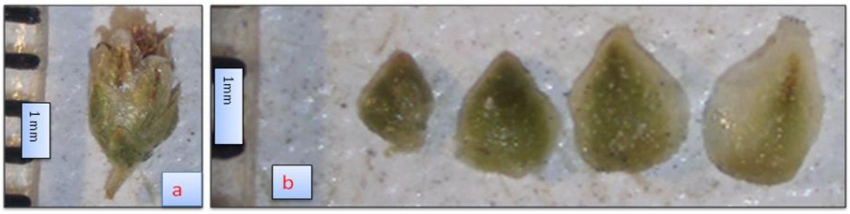

Figure 1.17. Capitulum (head) and phyllaries of the taxon *A. campestris* var. *marschalliana*, a- capitulum (head), b- phyllaries from outer to inner, from Civelek and M. Kursat 1046 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.18. The fruit (cypsela or achene) of the taxon *A. campestris* var. *marschalliana* from Civelek and M. Kursat 1124 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.19. The overview in the nature habitat of the taxon *A. campestris* var. *araratica* (a), b- orientation of capitula from Civelek and M. Kursat 1013 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.20. The herbarium specimens of the taxon *A. campestris* var. *araratica* from Civelek and M. Kursat 1013 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

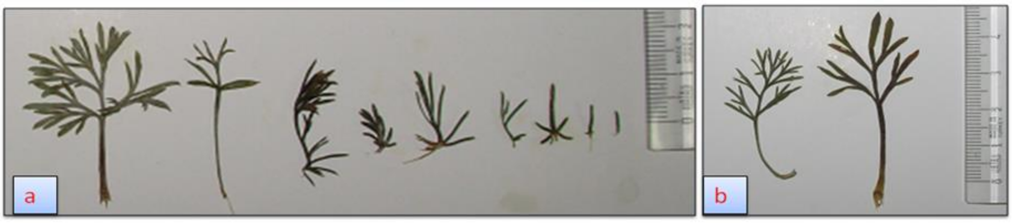

Figure 1.21. Detailed appearance of lower and cauline leaves of the taxon *A. campestris* var. *araratica,* a- detailed appearance of different sized cauline leaves from below to uppermost (floral), b- detailed appearance of different sized lower leaves, from Civelek and M. Kursat 1013 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

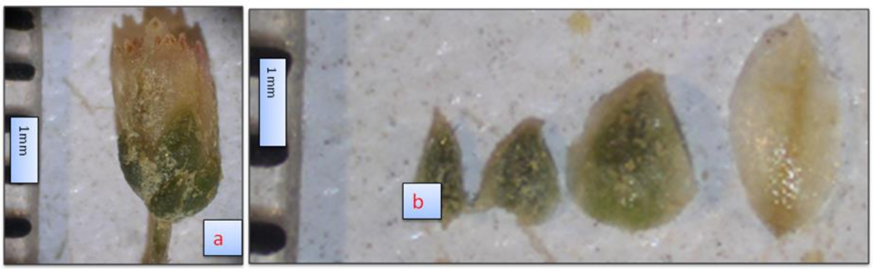

Figure 1.22. Capitulum (head) and phyllaries of the taxon *A. campestris* var. *araratica,* a- capitulum (head), b- phyllaries from outer to inner, from Civelek and M. Kursat, 1013 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.23. The fruit (cypsela or achene) of the taxon *A. campestris* var *araratica* from Civelek and M. Kursat 1084 (FUH) (Civelek *et al.,* 2010; Kursat, 2010).

1.1.8.2. Description of the species *Artemisia scoparia* Waldst. & Kit. (Figures 1.24 - 1.28; Table 1.4)

Artemisia scoparia **Waldst. & Kit.** (Figures 1.24 – 129; 1.4) (Cullen, 1975; Davis, 1975; Tutin & Persson, 1976; Rechinger, 1986; Civelek *et al.*, 2010; Kursat, 2010)

Annual or biennial herbs. Root slender, straight, vertical. Stem 20-100 cm high, solitary, less often 2-3, erect, pubescent, later glabrous, reddish-violet or brown, longitudinally ribbed, strongly branched in middle and upper parts, with divergent branches. Young leaves pubescent (pilose), older ones glabrous; lower leaves petiolate, twice or thrice pinnately (pinnatisect) incised into linear- lanceolate - acute lobes, 1.5-10 x 1.5-2.5 cm, withering before anthesis; cauline leaves petiolate, 1-4 cm long, shortened and becoming sessile to upwards, pinnatisect, 1-2 x 0.5-1 cm, with narrowly linear or filiform-linear lobes, apex of lobes acute. Uppermost (floral) leaves bracteal, small, sessile, linear to ternate or pinnate with 2-9 lobules at base. Capitula small, 1.5-2.2 x 1-1.6 mm, ovate or oblong-ovate, on 1-3 mm peduncles or sessile, divergent or drooping, with punctuated glands (glands-dotted or sessile glands), on branches in secund racemes forming pyramidal panicle synflorescence. Involucral bracts (phyllaries) in 3 -4 (-5) rows, oblong – broadly lanceolate, herbaceous with scarious margin, scarious margin of phyllaries wider gradually from outer to inner ones, with punctuated glands, outer involucral bracts smaller than middle and inner bracts, middle involucral bracts smaller than inner bracts. Outer involucral bracts (phyllaries) 0.2-0.4 x 0.2-0.4 mm; middle phyllaries 0.6-0.8 x 0.3-0.5 mm, inner bracts (phyllaries), 1.5-1.7 x 0.8-1 mm, with longitudinal red stripes. Receptacle glabrous. Peripheral florets pistillate, fertile, 5-10, their corollas narrowly tubular, 1.5-2.1 x 0.1-0.3 mm, with only punctate-glandular (glands-dotted or sessile glands), yellow; ovaries

0.4-0.6 × 0.1-0.3 mm, styles 0.6-0.8 mm mm long, stigma lobes narrowly linear, acuminate, divergent, brown, 0.5-0.7 mm long; central disk florets staminate with abortive pistil, 5-6, their corollas tubular, with only punctate-glandular, 1.8-2 × 0.2-0.4mm long, yellow - reddish; styles of abortive pistils 1-1.2 mm long, stigma lobes 2 or not lobed, ciliate, 0.5- 0.8 mm mm long, filaments short, 0.5-0.8 mm long, anthers 0.9-1.1 × 0.1-0.3 mm, lanceolate - linear, apical appendages of anthers acute, basal appendages subacute. Achenes (cypselas) 0.8-1×0.2-0.8 mm, oblong-obovate, somewhat flat, finely longitudinal ribbed, brown. Flowering July to September. *Steps, slopes, roadsides, fields. 2n=2x=16*

The species *A. scoparia* is one of the species with a very wide spread in Turkey. It shows the spread in almost all regions. It usually grows at the roadsides. Among the taxa of the genus *Artemisia* grown naturally in Turkey, only the species *A. scoparia* have both annual and biennial forms. It is reported that only biennial form in Flora of Turkey (Cullen, 1975; Davis, 1975). In field studies of revisionary research, specimens belong to annual form were collected. It was also is indicated in the Flora of Russian that this species has both annual and biennial forms (Civelek *et al.*, 2010; Kursat, 2010).

In terms of their morphological characteristics, the closely related taxon to the the species *A. scoparia* in Flora of Turkey is only *A. campestris* var. *campestris.* For this reason, the specimens of the taxa *A. campestris* var. *campestris* and *A. scoparia* in Turkish herbariums were sometimes confused with each other and one of them was identified instead of other by mistake. These naming inaccuracies in Turkish Herbariums were corrected during the revisionary study.

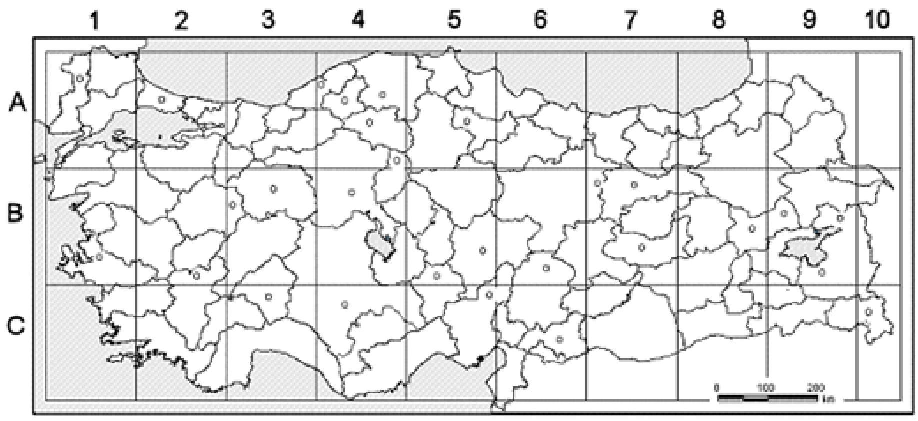

Figure 1.24. Geographic distribution of the species *A. scoparia* in Turkey (Civelek *et al.*, 2010, Kursat, 2010).

A. scoparia and *A. campestris* var. *campestris* are distributed together at the roadsides in the Central Anatolia Region (Figure 1.24).

Figure 1.25. The overview in the nature habitat of the species *A. scoparia* (a), b and c- orientation of capitula from Civelek and M. Kursat 1016 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.26. The herbarium specimens of the species *A. scoparia* from Civelek and M. Kursat 1016 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.27. Detailed appearance of lower and cauline leaves of the species *A. scoparia*, a- detailed appearance of different sized lower leaves, b- detailed appearance of different sized cauline leaves from below to uppermost (floral), from Civelek and M. Kursat 1016 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

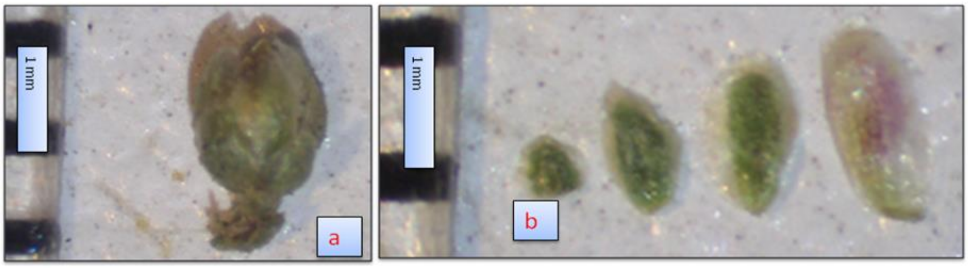

Figure 1.28. Capitulum (head) and phyllaries of the species *A. scoparia* a- capitulum (head), b- phyllaries from outer to inner, from Civelek and M. Kursat 1016 (FUH) (Civelek *et al.*, 2010; Kursat, 2010).

Figure 1.29. The fruit (cypsela or achene) of the species *A. scoparia* from Civelek and M. Kursat 1189 (FUH) (Civelek *et al*,. 2010; Kursat, 2010).

1.1.9. Taxonomic problems of taxa belong to the subgenus *Dracunculus* (Bess.) Rydberg in Turkey

There are total of 23 species without any infraspecific taxa that belong to the genus *Artemisia* L. in the 5th and 10th volumes of the Flora of Turkey. The species *A. campestris, A. marschalliana*, *A. araratica* and *A. scoparia* are four of 23 independent species (Cullen, 1975; Davis, 1975; Davis *et al.*, 1988; Civelek *et al.*, 2010; Kursat, 2010). In fact, the four species belong to the subgenus *Dracunculus*, but the genus *Artemisia* in the Flora of Turkey didn't divide to subgenera.

Civelek *et al*. (2010) have carried out a revisionary study of the genus *Artemisia* in Turkey. According to results of this revisionary study, there are 3 subgenera and 22 species which include 8 infraspecific taxa belong to the genus *Artemisia* in Turkey. (Civelek *et al.*, 2010; Kursat, 2010; Kursat *et al.* 2011a, 2011b, 2014, 2015 and 2018).

Nowadays, taxa of the genus *Artemisia* are classified under the subgenera or sections, because it is a very complex genus. The taxa of genus *Artemisia* in Turkey were also classified under the subgenera during revisionary study (Civelek *et al.*, 2010; Kursat, 2010).

According to results of the revisionary study of the genus *Artemisia*, subgenera *Artemisia*, *Dracunculus* and *Seriphidium* have taxa in Turkey, but the subgenus *Tridentatae* which is endemic to North America has not taxa in Turkey (Civelek *et al.*, 2010; Kursat, 2010; Guner *et al.*, 2012).

According to results of the revisionary study based on the morphological features, there are two species and four taxa belong to the subgenus *Dracunculus* in Turkey (Table 1.4). These species in the subgenus *Dracunculus* in Turkey are *A. scoparia* and *A. campestris,* and these taxa in the subgenus *Dracunculus* in Turkey are *A. scoparia, A. campestris* var. *campestris, A. campestris* var. *marschalliana, A. campestris* var. *araratica* (Civelek *et al.,* 2010; Kursat, 2010).

During revisionary study of the genus *Artemisia* in Turkey, it was observed that the closely related independent three species *A. campestris, A. marschalliana* and *A. araratica* in Flora of Turkey are quite approximate to one another in terms of morphological characters (Table 1.3; Civelek *et al.*, 2010; Kursat, 2010). On the other hand, the two taxa *A. scoparia* and *A. campestris* var. *campestris* in Flora of Turkey are also similar to each other morphologically.

During revisionary study of the genus *Artemisia,* the same time, it was also observed that distribution areas of three closely related independent species *A. campestris, A. marschalliana* and *A. araratica* in Flora of Turkey have sympatric distribution which are partially mixed together (Civelek *et al.,* 2010; Kursat, 2010).

Their distributions in Turkey and morphological features in mind, the three closely related independent species *A. campestris, A. marschalliana* and *A. araratica* in Flora of Turkey were reduced to variety levels and these varieties were linked to the species *A. campestris* (Table 1.4).

As a result, the taxonomic positions and combinations of closely related independent three species *A. campestris, A. marschalliana* and *A. araratica* in Flora of Turkey have been changed in the revisionary study of the genus *Artemisia* in Turkey as follows: *A. campestris* var. *campestris*, *A. campestris* var. *marschalliana* and *A. campestris* var. *araratica*. Thus, it has been adapted to their taxonomical positions in the Russian Flora

(Table 1.4) (Cullen, 1975; Davis, 1975; Shinskin & Bobrov, 1995; Civelek *et al.*, 2010; Kursat 2010; Kursat *et al*, 2015). However, because they were needed to molecular data, the accuracy of the classification based on morphological data in the revisionary study could not be guaranteed. Therefore, this research was planned.

The taxonomic positions and combinations of closely related independent three species *A. campestris*, *A. marschalliana* and *A. araratica* in Flora of Turkey were also changed in Floras of Europa and Russia that were written after The Flora of Turkey (Table 1.4). For example, these closely related independent species in Flora of Turkey are the subspecies of the species *A. campestris* in Flora of Europa, despite ones are the varieties of the species *A. campestris* in Flora of Russia (Podlech, 1986; Cullen, 1975; Davis, 1975; Tutin and Persson 1976; Shinskin and Bobrov, 1995; The plant list, 2019; The Euro Med Plant Base, 2019).

Two subspecies of Flora Europa are described *A. campestris* subsp. *campestris* and *A. campestris* subsp. *inodora* are located in Turkey as three varieties of the species *A. campestris (*Table 1.4). These three varieties are *A. campestris* var. *campestris, A. campestris* var. *marschalliana* and *A. campestris* var. *araratica* (Table 1.4). Because, two varieties *A.campestris* var. *marschalliana* and *A. campestris* var. *araratica* were combined and made synonyms of the subspecies *A. campestris* subsp. *inodora* Nyman in Flora Europa (Tutin & Persson 1976; The plant list, 2019; The Euro+Med Plant Base, 2019; Civelek *et al.,* 2010; Kursat, 2010).

There are two varieties *A. campestris* var. *marschalliana* and *A. campestris* var. *araratica* in Flora of Russia, but there is no variety *A. campestris* subsp. *campestris* (Shinskin & Bobrov, 1995). There is no species *A. campestris* and its varieties in Flora Iran (Table 1.4) (Rechinger,1986).

The species *A. scoparia* in Floras of Turkey, Russia, Europa and Iran were found (Table 1.4) (Civelek *et al.*, 2010; Davis, 1975; Tutin & Persson, 1976; Shinskin & Bobrov, 1995; Rechinger,1986).

Flower colors and indumentum of the plants change, when passing from pre-flowering stage to flowering stage or from flowering stage to fruiting stage (especially their hairs are usually shed when passing from flowering stage to fruiting stage). For this reason, the specimens were collected at different times from the same location for the same taxon which show also different general appearances in different stages (Civelek *et al.*, 2010; Kursat, 2010; Kursat *et al.,* 2015).

Table 1.4. The different taxonomic positions and combinations of taxa of subgenus *Dracunculus* grown in Turkey

Revisionary study (Civelek *et al.*, 2010)	**Flora of Turkey (Davis, 1975)**	**Flora Europa (Tutin & Persson, 1976**	**Flora URSS (Shinskin&Bobrov, 1995)**	**Flora Iran (Rechinger,1986)**
A. campestris var. *campestris*	*A. campestris*	*A.campestris* subsp. *campestris*	no distribution	no distribution
A. campestris var. *marschalliana*	*A. marschalliana*	*A. campestris* subsp. *inodora*	*A. campestris* var. *marschalliana*	no distribution
A. campestris var. *araratica*	*A. araratica*	*A. campestris* subsp. *inodora*	*A. campestris* var. *araratica*	no distribution
A. scoparia	*A. scoparia*	*A. scoparia*	*A. scoparia*	*A. scoparia*

Like the other members of genus *Artemisia,* the plants of the subgenus *Dracunculus* also show some ontogenic (developmental) variations in terms of flower colors and indumentum forms (hair cover of surfaces). Flower colors and indumentum of the plants change, when passing from pre-flowering stage to flowering stage or from flowering stage to fruiting stage (especially their hairs are usually shed when passing from flowering stage to fruiting stage). Therefore, different specimens with different developmental stages must be collected from the same population of the same taxon for correct identification in systematic studies (Civelek *et al.,* 2010; Kursat, 2010; Kursat *et al.*, 2015). For example, two taxa *A. campestris* var. *marschalliana* and *A. campestris* var. *araratica* resemble to each other at their pre - flowering stages because of densely hairy cover. Two taxa *A. campestris* var. *campestris* and *A. campestris* var. *araratica* resemble to each other at their flowering and fruiting stages because of less hairy cover as a result of their losing hairy cover (Civelek *et al.*, 2010, Kursat, 2010).

For these reasons, the specimens of the taxa *A. campestris* var. *campestris, A. campestris* var. *marschalliana, A. campestris* var. *araratica* and *A. scoparia* in Turkish herbaria were frequently confused with each other and one of them was identified instead of others by mistake. These naming inaccuracies in Turkish Herbariums were corrected during the revisionary study (Civelek *et al.*, 2010, Kursat, 2010).

1.2. General information about the scientific study field

1.2.1. Structure and features of chloroplast genome

Chloroplasts are plastids in plant cells that contain chlorophyll, and where photosynthesis takes place. It contains its own DNA, which is called chloroplast DNA, abbreviated as cpDNA and also known as plastome.

A chloroplast genome is a self-replicating circular, double-stranded DNA molecule located in stroma of chloroplast. Chloroplast genomes are highly conserved among plant species. Like the mitochondria, there is more than one copy of genome in each chloroplast. The exact number varies during development, but mesophyll cells in young leaves contain about 100 copies of genome.

The chloroplast genome includes 120–130 genes, primarily participating in photosynthesis, transcription and translation. Recent studies have identified considerable diversity within non-coding intergenic spacer regions, which often include important regulatory sequences. Despite the overall conservation in structure, chloroplast genome size varies between species, ranging from 107 kb (*Cathaya argyrophylla* Chun & Kuang) to 218 kb (*Pelargonium* L' Herit.), and is independent of nuclear genome size (Daniell *et al.*, 2016).

The chloroplast genome contains two inverted repeats called IR_A and IR_B, therefore many genes encoded by chloroplast genome have two copies (Figures 1.30 and 1.32 b). Both transcription and translation procedure are similar to prokaryotes.

Among the expressed genes in chloroplast genome, 70 to 90% of the genes encode proteins including those involved in photosynthesis, four genes code for rRNAs (one each for 16S, 23S, 4.5S and 5S), and about 30 genes encode tRNAs (Daniell *et al.*, 2016). Many chloroplasts contain introns which form two classes: (i) Introns of tRNA located on anticodon loop (Figure 1.33), (ii) Introns present in protein encoding genes. The proportion of introns in chloroplast DNA could be high (38% in *Euglena*).

The unique characteristics of the chloroplast make it a useful tool for taxonomic studies. The most important of these features is the evolutionary conservation of chloroplasts genomes. The chloroplast genome of land plants have highly conserved structures and organization of content; they comprise a single circular molecule with a quadripartite structure that includes two copies of an IR regions (IR_A and IR_B) that separate large and small single-copy (LSC and SSC) regions (Figures 1.30 and 1.32 b) (Daniell *et al.*, 2016).

The LSC region is less conserved than the SSC region, making this region ideal for low taxonomic evaluations (Figures 1.30 and 1.32 b) (Grivet *et al.*, 2001). The average size of the angiosperm chloroplast genome is approximately 148 kilobases (kb), providing a model size for restriction site analyses and direct sequencing comparisons (Olmstead *et al.*, 1994).

Like the genes, the introns in land-plant chloroplast genomes are also generally conserved, but the loss of introns within protein-coding genes has been reported in several plant species, including barley (*Hordeum vulgare*), bamboo (*Bambusa* sp.), cassava (*Manihot esculenta*), and chickpea (*Cicer arietinum*). The proteins encoded by genes in which intron loss is known to occur have diverse functions; they include an ATP synthase (atpF), a Clp protease (clpP), an RNA polymerase (rpoC2), and ribosomal proteins (rpl2, rps12, and rps16) (Daniell *et al.*, 2016).

As a result, the evolutionary conservation of chloroplasts genomes has made them convenient genetic regions for reconstructing evolutionary relationships, studying migration between populations and identifying species with DNA barcodes (Daniell *et al.*, 2016).

Several other features of the chloroplast genome are uniparental inheritance, and nonrecombination. Specifically, the chloroplast genome is inherited maternally in most angiosperms (Ferris *et al.*, 1997). Thus, directionality of seed and/or pollen dispersal can be followed, as well as their contributions to the overall genetic arrangement of plant populations (Provan *et al.*, 2001). Additionally, nonrecombination of the chloroplast genome demonstrates how the chloroplast is inherited as a unit, and is, for the most part, responsible for the lack of cpDNA variation in populations. Therefore, questions of gene introgression and sex-biased dispersal may be addressed by organellar polymorphism comparisons within and between populations (Wills *et al*., 2005).

The frequency rate of mutations of the protein coding regions in the chloroplast genome is low, resulting in a lack of variation within these regions between species (Small *et al.*, 2005). However, noncoding regions of cpDNA, such as intergenic spacers and introns, are more likely to show a greater amount of variation because they are less functional and more likely to mutate (Shaw *et al.*, 2005). Additionally, evolutionary changes of cpDNA such as small insertions and deletions of 1 – 100 base pairs (bp) have been documented.

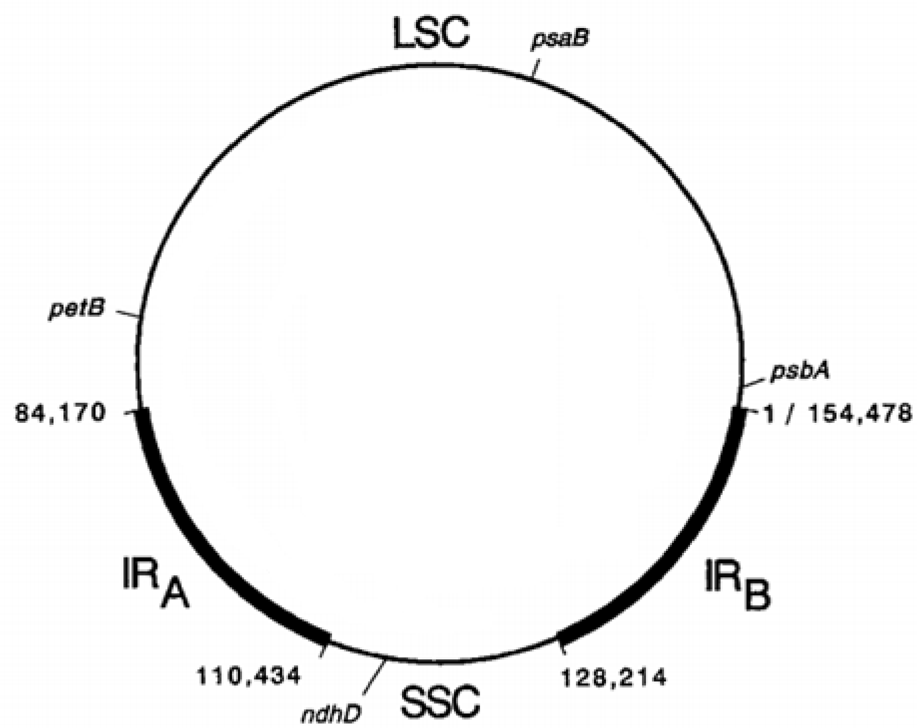

Figure 1.30. Structure of chloroplast genome in the species *Arabidopsis thaliana* (L.) Heynh. (Sato *et al.*, 1999) The outer circle shows the overall structure of the chloroplast genome consisting of a large single-copy region (LSC), a small single-copy region (SSC) and two - copies inverted repeat two regions (IRA and IRB) represented by thick lines.

1.2.2. Barcoding of plant dna markers and applications of DNA-based species identification

Taxonomists have been using morphological features for the identification of both plants and animals since before the time of Carl von Linnaeus. Yet, even after hundreds of years of work by taxonomists perhaps only 20% of the species on earth have been formally recognized and named (Kress, 2017; Wilson, 2016).

DNA barcoding provides a relatively new and significant tool to aid in the determination of species boundaries and discovery of new taxa (Kress, 2017).

A DNA barcode is one or few relatively short gene sequences present in the genome which is unique enough to identify species. DNA barcoding is a useful tool for taxonomic classification and identification of species by sequencing a very short standardized DNA sequence in a well-defined gene. In this technique, complete information of the species can be obtained from a single specimen irrespective to morphological or life stage characters. It is an effective technique in which extracted DNA from the collected sample is processed following the standard protocol (Figure 1.31).

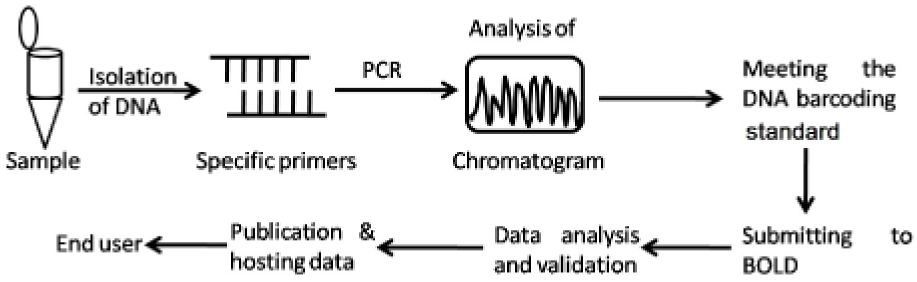

Figure 1.31. A general DNA barcoding process flow (Purty and Chatterjee, 2016).

Identification of the species is carried out by amplifying highly variable region i.e., DNA barcode region of the nuclear, chloroplast or mitochondrial genome using Polymerase Chain Reaction (PCR). Region widely used for DNA barcoding include nuclear DNA (*e.g. ITS regions of ribosomal RNA gene*) and single copy sequences of intergenic regions of the chloroplast DNA (*e.g. rbc*L, *trnL*-F, *mat*K, *psbA*, *trn*H, *psb*K) and region of cytochrome c oxidase 1 gene of mitochondrial DNA (*e.g.* COI) (Figures 1.30, 1.32,1.33, 1.34 and 1.35). The COI barcode is not effective for identifying plants because it evolves too slowly. But gene regions of internal transcribed spacer (ITS) in the nuclear DNA and intergenic regions with single copy in the chloroplast DNA have been approved as the barcode regions for land plants (Figures 1.30, 1.32,1.33, 1.34 and 1.35). The use of two or more chloroplast barcodes has been advocated for the best discrimination in estimating biodiversity, and impressive progress has been made in using chloroplast DNA barcodes for identifying plant species (Kress and Erickson, 2007).

DNA barcodes can be used as a tool for grouping unknown species based on barcode sequence to earlier known species or new species. It can also be used for grouping specimens to known species in those cases where morphologic features are missing or misleading. It can also be used as a supplement to other taxonomic datasets in the process of delimiting species boundaries (Purty and Chatterjee, 2016; Schindel and Miller, 2005).

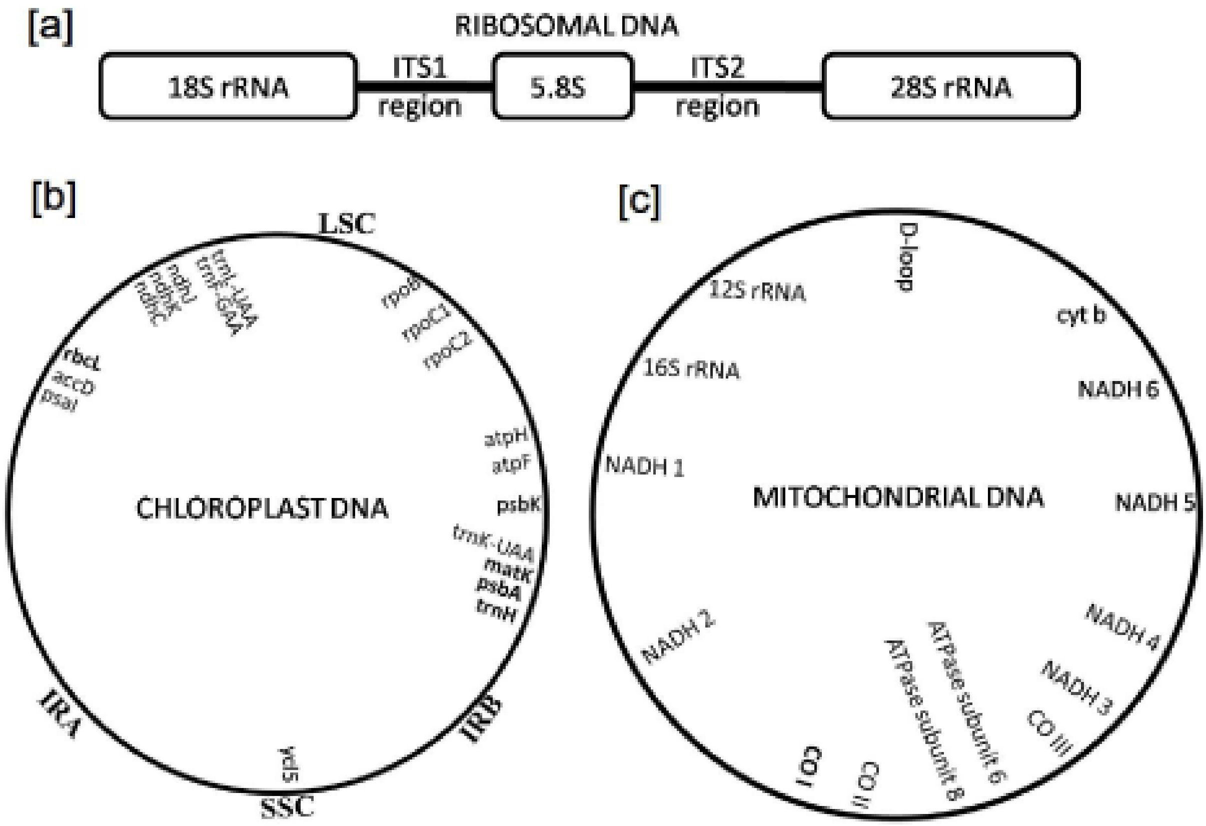

Figure 1.32. The DNA barcoding locuses (a) ITS regions of ribosomal RNA gene in nuclear DNA (b) Chloroplast DNA (c) Mitochondrial DNA (Purty and Chatterjee, 2016).

1.2.3. Characteristics of studied DNA sequences in this research

The gene regions that have been used for phylogeographic and phylogenetic inferences in plants come from the single copy portions of the chloroplast genome, and internal transcribed spacer (ITS) regions of nuclear ribosomal DNA (Shaw *et al.*, 2002).

In this research, for each individual belong to the subgenus *Dracunculus* taxa, the single copy sequences of *psb*A-*trn*H intergenic region of the chloroplast DNA and the sequences of internal transcribed spacer (ITS) regions of nuclear DNA were tried to be determined separately (Figures 1.30, 1.32,1.33, 1.34 and 1.35).

Intergenic chloroplast DNA regions contain information for inquiries in population genetics and lower taxonomic level systematics (McCauley, 1995; Provan *et al.*, 2001). The *psb*A-*trn*H intergenic region is among the most variable regions in the angiosperm chloroplast genome (Figures 1.32 b and 1.33). It is a popular tool for plant population genetics and species level phylogenetics and has been proposed as suitable for DNA barcoding studies. This region contains two parts differing in their evolutionary conservation: (i) the psbA 3′UTR (untranslated region) and (ii) the *psb*A-*trn*H intergenic non-transcribed spacer (Štorchová and Olson, 2017).

Figure 1.33. Diagrammatic representation of the *psb*A-*trn*H intergenic region in dicotyledonous angiosperms. Different lengths of the overall region and the RNA loop can be found in different species. Additional protein coding genes can be found in this region in monocots. The non-transcribed intergenic spacer can exhibit extreme variability within species and among species within genera. TATA refers to a putatively conserved functional motif upstream of the stem-loop. *psb*A and H refer to the commonly-used universal primers for this region developed by Hamilton (1999).

The ribosomal RNA gene in the nuclear DNA is called ribosomal DNA (rDNA). Ribosomal DNA (rDNA) is the DNA segments of that provide the gene code for the ribosomal RNA (rRNA) that are made inside the cell nucleus. Ribosomal DNA provides the genetic coding from which rRNA molecules are constructed. As the DNA double helix unwinds, other RNA molecules read the template that is provided from this DNA sequence and an rRNA molecule is formed. Since these DNA segments do not provide the code for specific proteins, the rRNA products produced from these DNA genes are considered their end products.

The more variable internal transcribed spacer (ITS) region of nuclear ribosomal RNA genes has been in plants for molecular studies at the specific and sometimes infraspecific levels (Baldwin, 1992; Baldwin *et al.,* 1995). Whilst in most eukaryotes, both 5S and 45S (18S-5.8S-26S) genes are usually arranged in separated tandem arrays which are transcribed by different RNA polymerases, there are some exceptions to this organization in some other organisms (Pellicer *et al.,* 2011) (Figure 1.35).

Ribosomal RNA genes occur as arrays of tandem repeats that are dispersed in a variable number of locations across the genome (Figures 1.32 a, 1.34 and 1.35). Repeat units, each consisting of the 18S ribosomal RNA gene, ITS1, the 5.8S rRNA gene, ITS2, and the 26S rRNA gene, are separated by non-transcribed intergenic spacers (IGS). The IGS is said to often be even more variable than ITS1 and ITS2. Capesius (1997) reported an IGS sequence from *Fumaria hygrometrica* Hedw. ITS-1, which is generally 300-600 bp in length (in mosses), is frequently more variable than ITS-2, which is typically 150-300 bp. The 5.8S ribosomal RNA gene, typically is amplified along with ITS-1 and 2, is highly conserved, and therefore generally constant (or nearly so) within species. The 5.8S gene is more or less uniformly 158 bp in length (Shaw *et al.*, 2002).

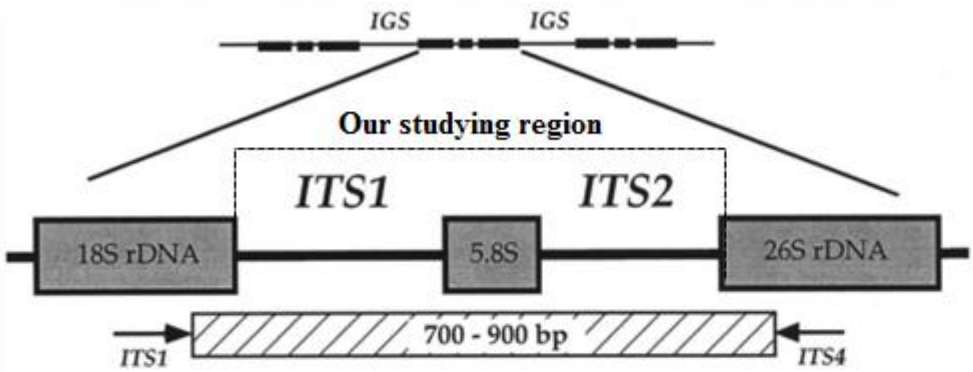

Figure 1.34. The diagram of the internal transcribed spacer (ITS) regions of nuclear ribosomal gene arrays (Shaw *et al.*, 2002). (IGS non-transcribed intergenic spacers).

In the genus *Artemisia* and other related genera, where a co-localized (linked) organization of both 5S and 45S (18S-5.8S-26S) ribosomal sub-units were detected by fluorescent *in situ* hybridization (Figure 1.35).

Figure 1.35. Linked structure of rRNA gene both 5S and 18S-5.8S-26S regions in the genus *Artemisia* (Pellicer *et al.*, 2011).

1.3. The purposes of this research

According to results of the revisionary study based on the morphological features, there are four taxa of the subgenus *Dracunculus* in Turkey. These taxa are *A. scoparia, A. campestris var. campestris, A. campestris var. marschalliana and A. campestris var. araratica* (Civelek *et al.*, 2010; Kursat, 2010). However, because they were needed to molecular data, the accuracy of the classification based on morphological data in the revisionary study could not be guaranteed. Therefore, this research was planned.

In this study, 60 individuals of 21 specimens taken from 17 different populations belong to taxa of the subgenus *Dracunculus* were examined. Depending on the width of the populations belong to the taxa, between 1 and 4 individuals with the same label information were used for each taxon. For all examined individuals from the same and different populations belong to taxa of the subgenus *Dracunculus*, it has been tried to determine the sequences of regions both *psb*A-*trn*H of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2) (Figures 1.30, 1.32,1.33, 1.34 and 1.35).

The purposes of this research are as follows:

1. To obtain molecular data to solve taxonomic problems of taxa belong to the subgenus *Dracunculus* in Turkey,
2. To determine based on data at the molecular level, whether the morphological differences mentioned in Table 1.3 are intra-specific variations of the species *A. campestre* or inter-specific variations of the independent three species which are *A. campestre*, *A. marschalliana* and *A. araratica*
3. To determine the genetic diversity of each taxon, based on the polymorphism degree of DNA sequences of individuals taken from the same and different populations belong to each taxon,
4. To establish a phylogenetic tree for all individuals of taxa belong to the subgenus *Dracunculus*, based on their molecular diversity parameters,
5. To interpret the kinship relations of the individuals taken from populations of taxa belong to the subgenus Dracunculus,
6. To determine the level of gene flow and hybridization between populations of taxa belong to the subgenus *Dracunculus* in Turkey, and to find whether each taxon has completed own speciation,
7. To test the correctness of the classification of taxa belong to the subgenus *Dracunculus* based on morphological characteristics during revisionary study (Civelek *et al.* 2010; Kursat 2010) and to determine the most accurate classification of these taxa,
8. To obtain original data for use in new scientific molecular studies of Science World on the taxa of genus *Artemisia,*
9. To provide the haplotypes of *psb*A-*trn*H and ITS regions for the subgenus *Dracunculus* taxa in Turkey for the GenBank database.

2. MATERIAL AND METHOD

In this research, all individuals examined belong to taxa of the subgenus *Dracunculus*, have been used to determine their sequences of regions both the *psb*A-*trn*H of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2) (Figures 1.32 a, 1.34 and 1.35).

The studies of this section consist of several steps, one after the other. In the first step is supply of plant specimens, the second step is the isolation of DNA from the leaves of plant specimens, the third step is PCR (Polymerase Chain Reaction) studies, the fourth step is the observation of PCR products, the fifth step is the DNA sequence analysis (sequencing and reading) and the final step is the evaluation of the data.

2.1. Supply of plant specimens belong to taxa of the subgenus *Dracunculus*

In our study, taken from different populations of taxa belong to the subgenus *Dracunculus* grown in Turkey individuals were used. The plant specimens which are study materials were collected from the natural habitats of all over the country in flowering and fruiting periods by Murat Kursat and Semsettin Civelek between the years 2007-2008 during extensive field surveys (Civelek *et al.*, 2010; Kursat, 2010). Then specimens were pressed and transformed into herbarium materials. The specimens were deposited at Herbarium of Bitlis Eren University (BUFH) and Herbarium of the Faculty of Science of Fırat University (FUH).

In this study, 60 individuals of 21 specimens taken from 17 different populations of taxa belong to the subgenus *Dracunculus* were examined. Depending on the width of the populations belong to taxa, between 1 and 4 individuals with the same label information were used for each taxa.

Table 2.1 shows the number of examined individuals from both the same and different populations belong to taxa of the subgenus *Dracunculus*, their label information and detailed localities of their populations. In the sections of conclusion and discussion, to give information about different individuals with the same collection number, after the same collection number followed by writing a, b, c was expressed. For example, S. Civelek and M. Kursat 1030 a, M. Kursat 1147 b.

The same time, the label informations of the collected specimens have been given according to geographic locations and the grid system in the Flora of Turkey (Figure 2.1). To easily watch the distribution of species in Turkey, has been developed a grid (square) system by Davis (1965). Turkey is located beetwen the 36 ° - 42 ° North latitudes and beetwen the 26 ° 45 ° East longitudes. This system is based on the degrees of latitude and longitude in Turkey. Acording to this system, the two degrees of longitude and two degrees of latitud create a square inside the their joint points, and Turkey divides into total of 29 square. Thus, there are 9 A squares, 10 B squares and 10 C squares in Turkey (Figure 2.1 and Table 2.1).

Table 2.1. The label information of examined individuals of specimens belong to taxa of the subgenus *Dracunculus* used in the study and detailed localities of populations (Civelek *et al.*, 2010; Kursat, 2010)

Taxa of The Subgenus *Dracunculus*	**Number of examined individuals**	**Collector and number of specimens**	**Collection date**	**Detailed localities of specimens' populations**
A. campestris var. *campestris*	2	M. Kursat 1096	10.09.2007	B4 Ankara: The highway from Ankara to Polatlı, 27 km to Polatlı and 3 km toTemelli, roadsides, N 39º 43.997, E 32º 23.860, 843m (Population no: 3)
A. campestris var. *campestris*	3	S. Civelek and M. Kursat 1015	01.09.2007	B6 Kahramanmaras: The highway from Elbistan to Goksun, 45 km to Goksun, the upper slopes of the road, N 38º 12.495, E 36º 56.488, 1231 m (Population no: 4)
A. campestris var. *campestris*	3	M. Kursat 1017	02.09.2007	B6 Kahramanmaras: The highway from Kahramanmaras to Goksun, road separation of Kurucuova village, roadsides, around the Puren tunnel, N 37º 56.285, E 36º 34.540,1380 m (Population no: 5)
A. campestris var. *campestris*	3	S. Civelek and M. Kursat 1018	02.09.2007	B6 Kahramanmaras: The highway from Kahramanmaraş to Goksun, road separation of Kurucuova village, roadsides, around the Puren tunnel, N 37º 56.285, E 36º 34.540,1380 m (Population no: 5)
A. campestris var. *campestris*	3	M. Kursat 1022	05.09.2007	C2 Antalya: The highway from Korkuteli to Fethiye, 7 km to Sogut town and 200 m to Yesilova village, N 37º 02.114, E 29º 53.304,1430 m (Population no: 16)
A. campestris var. *campestris*	3	M. Kursat 1039	11.09.2007	C5 Adana: The highway from Ulukışla to Pozantı, 29 km to Pozantı, roadsides, N 37º 31.449, E 34º 39.159, 1185 m (Population no: 17)
A. campestris var. *marschaliana*	3	M. Kursat 1102	28.10.2007	A4 Çankırı: Cerkes, the highway from Gerede to Ilgaz, 18 km to Cerkes, N 40º 50.364, E 32º

				42.350, 1070 m (Population no: 1)
A. campestris var. *marschaliana*	4	M. Kursat 1176	27.08.2008	A9 Kars: Susuz, 5 km to Susuz, roadsides, slopes, N 40º 38.480 E 43º 04.524, 2010m (Population no: 2)
A. campestris var. *marschaliana*	2	S. Civelek and M. Kursat 1046	19.09.2007	B9 Mus: The highway from Mus toTatvan, arounds of 2nd Karasu bridge, 1 km to road separation of Agrı, roadsides, N 38º 38.904, E 42º 47,182, 1284 m (Population no: 10)
A. campestris var. *marschaliana*	3	M. Kursat 1187	02.11.2008	B9 Bitlis: Adilcevaz, between Adilcevaz and Harmantepe, around of Harmantepe village, roadsides and field edges N 38º 50.396, E 42º 46.917, 1975 m (Population no: 12)
A. campestris var. *marschaliana*	3	M. Kursat 1147	22.06.2008	B9 Bitlis: Tatvan, the highway from Tatvan to Ahlat, after 8 km from Tatvan district, Sorgun, around of military area, roadsides, N 38º 32.486, E 42º 21.303, 1715 m (Population no: 11)
A. campestris var. *marschaliana*	3	S. Civelek and M. Kursat 1066	22.09.2007	B10 Agri: Doğubeyazıt, Igdır highway, between Cengelli pass and Ararat mountain, Karabulak, Girasor mountain, north slopes of Bardaklı village, rocky places, N 39º 42.618, 1728 m (Population no: 14)
A. campestris var. *marschaliana*	1	M. Kursat 1114	26.11.2007	B10 Agri: The highway from Hamur toTutak, after 4 km from Hamur, roadsides, steppe, N 39º 35.994, E 42º 55.698, 1605 m (Population no: 15)
A. campestris var. *araratica*	3	M. Kursat 1001	04.07.2007	B6 Malatya: Dogansehir, Dedeyazı village, around of Canakcı, steppe, N 38º 11.942, E 37º 50.622, 1495 m (Population no: 6)
A. campestris var. *araratica*	3	M. Kursat 1002	04.07.2007	B6 Malatya: The highway from Malatya to Golbası, 58 km to Golbası, around of Surgu dam lake, roadsides, N 38º 01.335, E 37º 55.289, 1280 m (Population no: 8)
A. scoparia	3	S. Civelek and M. Kursat 1030	10.09.2007	B4 Ankara: The highway from Ankara to Polatlı, 20 km to Polatlı and 3 km to Temelli, roadsides, N 39º 42.876, E 32º 17.941, 796 m (Population no: 3)
A. scoparia	2	M. Kursat 1003	04.07.2007	B6 Kahramanmaras: The highway from Kahramanmaraş to Goksun, road separation of Kurucuova, around of Puren tunnel, roadsides, N 37º 56. 285, E 36º 34.540, 1380 m (Population no: 5)
A. scoparia	3	M. Kursat 1189	03.11.2008	B7 Elazığ: The highway from Elazığ to Baskil, around of Sinan village, roadsides, N 38º 37.031, E

				39º 02.095, 1160 m (Population no: 8)
A. scoparia	4	M. Kursat 1169	26.08.2008	B9 Van: Gurpınar, between Edremit and Gurpınar, 2 km to Gurpınar, roadsides, N 38º 34.300, E 43º 38.770, 1750 m (Population no: 13)
A. scoparia	3	M. Kursat 1038	11.09.2007	C5 Adana: The highway from Ulukışla to Pozantı, 29 km to Pozantı, roadsides, N 37º 31.449, E 34º 39.159, 1185 m (Population no: 17)
A. scoparia	3	S. Civelek and M. Kursat 1078	24.09.2007	B9 Mus: Malazgirt, the highway from Malazgirt to Aktuzla, around of Nurettin village, N 39º 14.210, E 42º 25.223, 1620 m (Population no: 9)

The 17 main stations (populations) where the plant specimens are collected are :

1. **A4 Cankırı:** Cerkes, the highway from Gerede to Ilgaz, 18 km to Cerkes,
2. **A9 Kars**: Susuz, 5 km to Susuz,
3. **B4 Ankara:** Polatlı highway, 20 km to Polatlı and 3 km to Temelli
4. **B6 Kahramanmaras:** The highway from Elbistan to Goksun, 45 km to Goksun,
5. **B6 Kahramanmaras:** The highway from Kahramanmaraş to Goksun, road separation of Kurucuova village,
6. **B6 Malatya:** Dogansehir, Dedeyazı village, arround of Canakcı,
7. **B6 Malatya:** The highway from Malatya to Golbası, 58 km to Golbası,
8. **B7 Elazıg :** The highway from Elazıg to Baskil, arround of Sinan village,
9. **B9 Mus:** Malazgirt, the highway from Malazgirt to Aktuzla, arround of Nurettin village,
10. **B9 Mus:** The highway from Mus toTatvan, arounds of 2^{nd} Karasu bridge,
11. **B9 Bitlis:** Tatvan, the highway from Tatvan to Ahlat, after 8 km from Tatvan district Sorgun,
12. **B9 Bitlis :** Adilcevaz, between Adilcevaz and Harmantepe, arround of Harmantepe village,
13. **B9 Van :** Gurpınar, between Edremit and Gurpınar, 2 km to Gurpınar,
14. **B10 Agri:** Doğubeyazıt, Igdır highway, between Cengelli pass and Ararat mountain, Karabulak, Girasor mountain, north slopes of Bardaklı village,
15. **B10 Agri:** The highway from Hamur to Tutak, after 4 km from Hamur,
16. **C2 Antalya:** The highway from Korkuteli to Fethiye,

17. C5 Adana: The highway from Ulukışla to Pozantı, 29 km to Pozantı.

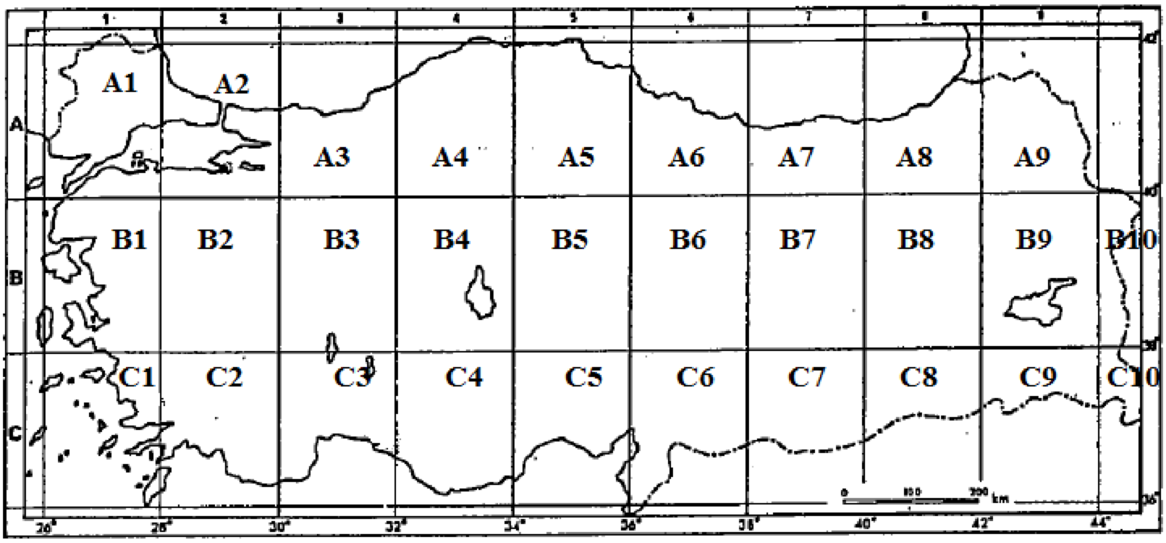

Figure 2.1. The grid system in the Flora of Turkey (Davis, 1965).

2.2. DNA isolation from leaves of examined individuals of plant specimens

The dark green colored and suitably dried leaves from plant specimen which were collected by KURSAT and CİVELEK and transformed into herbarium materials were selected and labeled separately according to their localization and population information and taken to sample storage bags（Civelek *et al.*, 2010; Kursat, 2010）. All of steps of this thesis up to reading of DNA sequences were carried out at the Molecular Genetics Laboratory of Fırat University Biology Department.

DNA was isolated from the plant leaves manually, and in the isolation process, the method of CTAB (Cetyl Trimethyl Ammonium Bromide) was applied by modifying in various ways (Doyle and Doyle, 1987). For this purpose, buffer solutions were prepared first for use in isolation. The preparation and concentrations of the solutions are as follows in Table 2.2.

Table 2.2. Preparation of buffer solutions used in DNA isolation

Solution	**Concentration**
CTAB	2%
NaCl (5 M)	1.4 M
EDTA (0,5 M) pH 8,0	0.2 M
TRIS-HCl (1 M) pH 8,0	0.1 M

In this method, the following steps of operations were performed :

1. First, the plant leaves were ground in a porcelain mortar until powdered.
2. 0.5 grams of milled plant samples were placed into 1.5 ml sterile centrifuge tubes and mixed with vortex until 500 µl of CTAB buffer was added to the fluid.
3. 5 µl of Beta-Mercaptoethanol was added to the tubes which gained a fluid appearance and mixed with the vortex again.
4. The tubes were left to a pre-heated water bath at 65 ° C and stirred for each10 min for a hour.
5. After this, the tubes were centrifuged at + 20 ° C and 14,000 rpm for 10 minutes.
6. As a result of centrifugation, two phases were observed; (i) the upper phase containing the supernatant DNA and (ii) the bottom phase containing plant parts. The supernatant was taken to a new sterile centrifuge tube with a sterile pipette tip.
7. 750 µl of chloroform: isoamyl alcohol (24: 1) was added to new sterile centrifuge tubes with supernatant phase and centrifuged again at + 20 ° C and 14,000 rpm for 10 minutes.
8. Centrifugation resulted in the formation of three phases in the tubes; (i) The bottom phase with chlorophorm containing protein, lipid and many secondary components, (ii) middle phase containing a excess amount of cell residue and a small amount of collapsed proteins, and (iii) the liquid colorless upper phase containing the DNA.
9. The liquid colorless upper phase containing the DNA was taken to new centrifuge tubes with sterile pipette tips, without intervening the intermediate phase.
10. Adding 450 µl of cold isopropanol to the new centrifuge tubes, the tubes were stored at -20 ° C in a freezer for 24 hours.

11. At the end of this period, the tubes removed from the freezer were centrifuged at + 4 ° C and 14,000 rpm for 10 minutes.

12. After this procedure, three phases were observed in the centrifuge tubes; (i) upper phase with colorless liquid alcohol (ii) middle phase containing the colloid-structured phenolic compounds, and bottom phase containing a white DNA pellet. When the first two phases are cast from the tube, the DNA pellet can be seen better.

13. 500 µl of 70% ethyl alcohol was added to the tubes containing only DNA pellets and gently shaken, then centrifuged at 14,000 rpm for 5 minutes and so the first washing was done.

14. After the centrifugation, the contaminated ethyl alcohol was poured, 500 µl of 70% ethyl alcohol was added to the tube, and gently shaken, then centrifuged at 14,000 rpm for 5 minutes and so the second washing was done.

15. The ethyl alcohol contaminated by the second wash was poured again and the tubes allowed to dry for about 1 hour.

16. 50 µl TE (TRIS-EDTA) solvent was added to the dried tubes and the DNA was dissolved.

17. DNA samples isolated from all these processes were stored in the freezer at -20 ° C for later use (Civelek *et al.*, 2018; Sancar, 2017; Sancar, *et al.*, 2019).

Isolated DNAs were loaded into a 1% agarose gel and run for 45 minutes at 80 volts in electrophoresis. At the end of this period, the agarose gel was visualized with the help of a UV translimunator with capable of illumination from the bottom and DNA concentration in the samples was also measured with the help of Nanodrop Spectrophotometer. The nanodrop spectrophotometer shows the DNA-protein purity with absorbance values at 260/280 nm and shows the purity of DNA-RNA with absorbance values at 230/260 nm. In terms of quality assessments, the quality of the DNA is expected to be the absorption rate is beetwen 1.8-2.0 at 260/280 nm. If this value is higher than 2.0, DNA sample was contaminated with RNA and chloroform or phenol, if this value is less than 1.8, DNA sample was contaminated with proteins or polyphenols (Hoisington, 1992).

Before the DNA measurements were made, the DNA portion to be loaded into the Nanodrop Spectrophotometer was cleaned with a clean cloth, then loaded up to 1 µL of DNA with a fine tip pipette. The quality and quantity of DNA were determined. In the process of reading DNA samples, Tris-EDTA solution was used as the blank. Best quality and quantity of DNAs were selected for PCR amplification (Civelek *et al.*, 2018; Sancar, 2017; Sancar, *et al.*, 2019).

2.3. DNA amplification studies in PCR

In PCR studies on the chloroplast and nuclear DNAs of 60 individuals of 21 specimens belong to taxa of the subgenus *Dracunculus* grown Turkey, by using the ITS4-ITS5 and *psb*A-*trn*H pairs of universal primers, the nucleotide sequences of regions both psbA-trnH of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2) were amplified. The PCR products obtained as a result of these processes were run in the 1xTBE buffer at 1% agarose gel electrophoresis and the bands were visualized under UV light. PCR mix and PCR profiles shown in Table 2.3 were applied depending on the working conditions of the enzymes used in our study. Since the optimization process was tried in our previous studies, the conditions specified in this study were used (Civelek *et al.*, 2018; Sancar, 2017; Sancar, *et al.*, 2019).

Table 2.3. Working conditions of used enzymes.

PCR Mix	
Taq buffer (Colorless)	5 µl
$MgCl_2$ (25 mM)	1,5 µl
dNTP mix (100 mM)	0,5 µl
Forward P. (100 mM)	0,25 µl
Reverse P. (100 mM)	0,25 µl
Template DNA	1,35 µl
Go Taq polymerase	0,25 µl
d H_2O	17, 00 µl
25 µl	

PCR Profile			
Temperature	**Time**	**Cycle**	**Goal**
95 °C	2 min	1	Preliminary Denaturation
95 °C	1 min		Denaturation
49 °C (ITS) 55 °C (psbA-trnH)	40 sec	30	Binding
72 °C	1 min		Elongation
72 °C	5 min	1	Termination
4 °C	10 min	-	Waiting

2.4. Monitoring of PCR products

The products obtained after PCR processing were loaded in the 1xTBE buffer at 1% agarose gel electrophoresis to determine if amplification was performed. The preparation steps of 1% agarose gel were performed as follows;

1. Weighed 1 g of agarose and added 100 ml of 1xTBE buffer onto it, boiled until the agarose dissolved in the microwave oven (about 2 minutes).
2. The boiled gel was cooled under cold water to about 50-60 ° C.
3. Once the gel has cooled down, 5 µl of Ethidium Bromide (dyestuff that connects the bases in the DNA between the hydrogen bonds and makes them visible under UV light) has been added.
4. The gel was poured into the agar tank after being brought to 40-50 ° C and the comb teeth were placed inside it.
5. After about 25-30 minutes, the comb teeth were carefully removed from the solid gel and placed in the electrophoresis tank filled with 1xTBE buffer.

Thanks to the gel placed in the electrophoresis tank, the system has become ready. Then, 5 µl of PCR product was stained with DNA loading dye (approximately 1-2 µl) and loaded into wells created by comb teeth. Electrophoresis was run at 80 volts for 60 minutes, then the status of the DNA bands in the gel was monitored using a UV transilluminator capable of bottom lighting (Civelek *et al.*, 2018; Sancar, 2017; Sancar, *et al.* 2019).

2.5. The processes of DNA sequence analysis

Purification of PCR products and reading of DNA sequences was performed by Macrogen (Amsterdam-The Netherlands). All of the nucleotide sequences of regions both *psb*A-*trn*H of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2) were determined in the automatic sequencing device bi-directional as forward and reverse (Civelek *et al.*, 2018; Sancar, 2017; Sancar, *et al.* 2019).

2.6. Evaluation of DNA sequences data of examined individuals

In the analysis, nucleotide sequences belong to the ITS regions (ITS1-5.8 gene - ITS2) of the nuclear DNA and the *psb*A-*trn*H region of Chloroplast DNA were used. The chloroplast and nuclear DNAs have been obtained from 60 individuals of 21 specimens belong to taxa of the subgenus *Dracunculus* in Turkey. When arranged in FASTA format, it was seen that the raw sequences were longer than the sequences analyzed. The reason for this is the removal of unreliable parts from the head and the end (Civelek *et al.,* 2018; Sancar, 2017; Sancar, *et al.,* 2019).

After the alignment of the sequences, statistical analyses were performed using the 7.1 version of the Mega program. In this context, the ratios of A, T, G and C bases, the percentages of AT and GC base pairs, conservated regions, variation regions, informative regions, single parts and homologous base pairs in individuals were determined.

In order to confirm the accuracy of the studied DNA regions, the data previously recorded by another investigators of the individuals belong to the species *A. campestris* (JX0517362.1 and JX073894.1) and *A. scoparia* (KX581818.1 and KX581973.1) were included in our analysis. As an external group, statistical analyzes were performed using the sequences of ITS and psbA-trnH regions belong to individuals of the species *Anthemis cotula* L. which were registered with the accesion numbers of KR150162.1 and EU547794.1 respectively in the NCBI database. During the phylogenetic and evolutionary analyzes, the estimation model algorithm in Mega 7.1 was used to determine the most appropriate method for our study. As a result, maximum likelihood model was chosen as the most suitable model for our study. Phylogenetic tree based on individuals was prepared by Timura-3 method in this model (Civelek *et al.,* 2018; Sancar, 2017; Sancar, *et al.* 2019).

3. RESULTS

3.1. DNA isolation results of examined individuals

In order to detect the clean ones of the isolated DNAs and to amplify them in PCR, the quantity and quality of the genomic DNAs obtained from all examined individuals were determined by the Maestrogen Nano Micro-Volume Spectrophotometer. First, the avarage DNA concentrations between two values for different individuals with the same collection number of the same specimens were found. The data obtained as a result of this procedure are given in Table 3.1. The variable DNA concentrations of different specimens for taxa were given between two values, the upper and the lower values. Measurements were performed for each individual and the purity rates of DNAs were observed to vary between 1.8-2.0. Once the concentration values of the clean DNAs were determined, they were stored at -20 ° C for use in PCR amplification.

Table 3.1. DNA concentrations of examined specimens for taxa of the subgenus *Dracunculus*

Taxa of the subgenus *Dracunculus*	**Number of individuals**	**Location information of specimens**	**DNA concentration**
A. scoparia	2	B6 Kahramanmaras, MK 1003	700,98 - 1685,18 ng
A. scoparia	3	B7 Elazığ, MK 1189	1500,15 - 1783,67 ng
A. scoparia	4	B9 Van, MK 1169	320,55 -1940,48 ng
A. scoparia	3	C5 Adana, MK 1038	280,94 - 1470,64 ng
A. scoparia	3	B4 Ankara, SC and MK 1030	659,20 - 2697,47 ng
A. scoparia	3	B9 Mus, SC and MK 1078	905,73 - 1130,32 ng
A. campestris var. *marschaliana*	2	B9 Mus, SC and MK 1046	560,23 - 3052,81 ng
A. campestris var. *marschaliana*	3	B9 Bitlis, MK 1147	689,15 - 2700,12 ng
A. campestris var. *marschaliana*	3	B10 Agrı, MK 1066	694,34 - 1792,57 ng
A. campestris var. *marschaliana*	4	A9 Kars, MK 1176	1165,42 - 2540,18 ng
A. campestris var. *marschaliana*	1	B10 Agrı, MK 1114	1294,53 - 3913,79 ng
A. campestris var. *marschaliana*	3	B9 Bitlis, MK 1187	843,20 - 2146,75 ng
A. campestris var. *marschaliana*	3	A4 Çankırı, MK 1102	1923,85 - 2509,54 ng
A. campestris var. *araratica*	3	B6 Malatya, MK 1001	734,90 - 2600,61 ng
A. campestris var. *araratica*	3	B6 Malatya, MK1002	1016,90 - 2981,45 ng

A. campestris var. *campestris*	3	B6 Kahramanmaras, SC and MK 1015	1123,06 - 2299,50 ng
A. campestris var. *campestris*	3	B6 Kahramanmaras, MK 1017	490,34 - 919,63 ng
A. campestris var. *campestris*	3	B6 Kahramanmaras, SC and MK 1018	800,26 - 1963,61 ng
A. campestris var. *campestris*	3	C2 Antalya, MK 1022	2040,03 - 2102,45 ng
A. campestris var. *campestris*	3	C5 Adana, MK 1039	459,69 - 1100,22 ng
A. campestris var. *campestris*	2	B4 Ankara, MK 1096	980,40 – 2293,65 ng

3.2. Amplification of studied DNA regions of examined individuals

Under the enzyme conditions specified in the material and method part by using the ITS4-ITS5 and *psb*A-*trn*H pairs of universal primers, products obtained by PCR amplification of regions both *psb*A-*trn*H of Chloroplast DNA and ITS of the nuclear DNA (ITS1-5.8 gene - ITS2) from individuals were run in the 1xTBE buffer at 1% agarose gel electrophoresis and the bands were visualized under UV light. The DNA bands were obtained as shown in Figure 3.1.

a

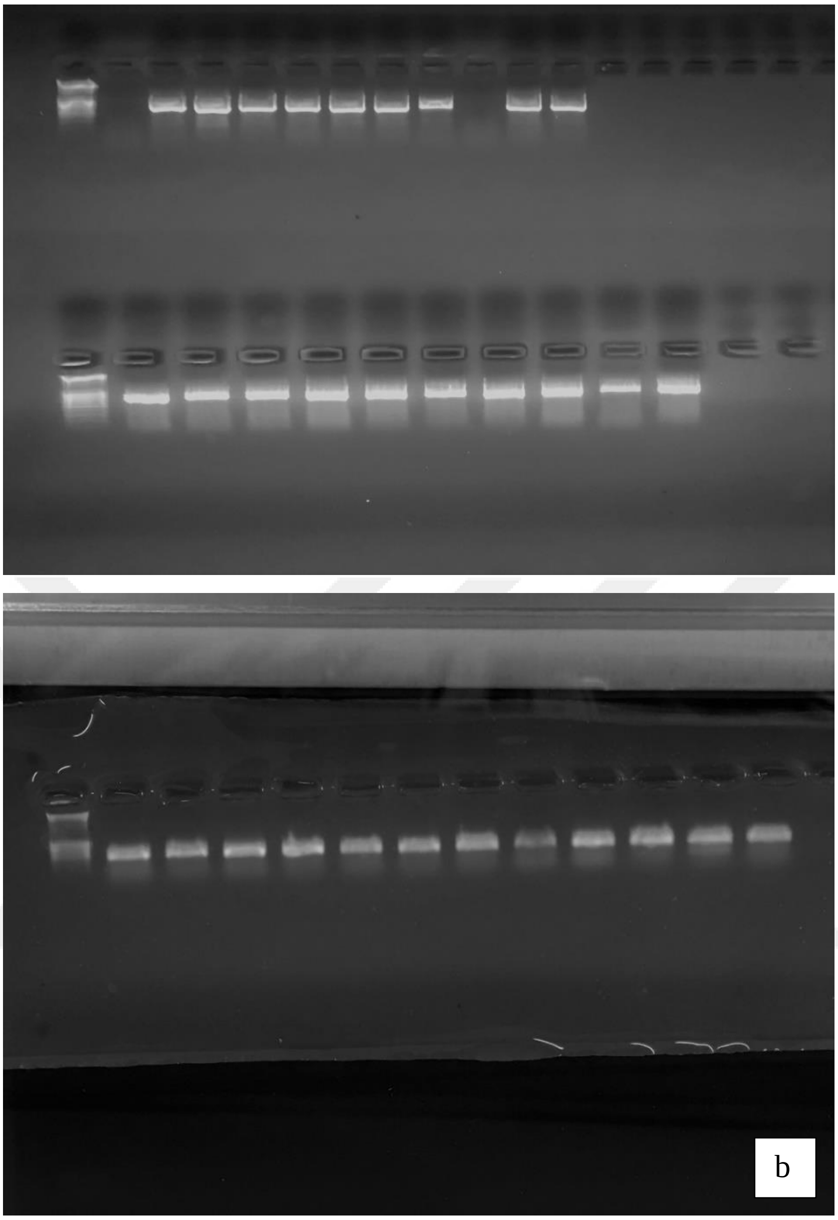

Figure 3.1. DNA bands of ITS and *psb*A-*trn*H regions. a- ITS1-5.8 gene - ITS2 regions, b- psbA-*trn*H region

The base sequences of the primers we use are given in the Table 3.2.

Table 3.2. The base sequences of the primers used.

Primers	**Base sequences (5' – 3')**
ITS5	GAA AGT AAA AGT CGT AAC AAG G
ITS4	TCC TCC GCT TAT TGA TAT GC
*psb*A	GTT ATG CAT GAA CGT AAT GCT C
*trn*H	CGC GCA TGG TGG ATT CAC AAT CC

3.3. Sequence analysis results of examined individuals

In this research, 60 individuals of 21 specimens taken from 17 different populations belong to taxa of the subgenus *Dracunculus* were examined. Depending on the width of the populations belong to the taxa, between 1 and 4 individuals with the same label information were used for each taxa. For all examined individuals from the same and different populations belong to taxa of the subgenus *Dracunculus*, they have been used to determine the sequences of regions both *psb*A-*trn*H of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2) (Figures 1.32 a, 1.34 and 1.35).

The peak results of the bi-directional sequences sent to us from Macro gene were evaluated using the Version 1 of the Finch TV program. Using "Multiple Alignment Blast System" of the automatic sequencing systems, sequences were aligned. The differences in the noticeable were manually corrected.

As a result of scans performed in the NCBI (National Center for Biotechnology Information) database site, for two taxa of the genus *Artemisia*, two reference regions were obtained. These reference regions were an ITS with 700-750 bases (ITS1-5.8gene-ITS2) and a *psb*A-*trn*H with 450-500 bases. The reference base sequences of two individuals belong to species *A. campestris* (JX051736.1 and JX073894.1) and *A. scoparia* (KX581818.1 and KX581973.1) were also included in our analysis to demonstrate the accuracy of the study. For a more accurate visualization of the results of the alignment, about 50-100 base from the head and the end were not evaluated by us. For this reason, approximately 689 base pairs for the ITS regions and 488 base pairs for the *psb*A - *trn*H regions were used and the sequences of these regions of examined 60 individuals were given in the part of appendices (Appendix, Table 6.1).

3.4. Data analysis of examined individuals

In the phylogenetic tree drawing, the DNA sequences of the ITS (ITS1-5.8gene-ITS2) regions in the nuclear genome and the DNA sequences of the psbA-trnH region in the chloroplast genome were co-evaluated using version 7.1 of the Mega program. A single phylogenetic tree was obtained belong to 63 individuals, a total of 63 individuals, 60 of which were examined, 2 of which were control group (the species *A. campestris* and *A.*

scoparia) and one of which was an external group (the species *Anthemis cotula* L.) (Civelek *et al.*, 2018; Sancar, 2017; Sancar, *et al.* 2019).

3.4.1. Nucleotide compositions of examined individuals

In this study, The results of ITS and *psb*A-*trn*H regions sequences were co-evaluated. The DNA sequences of 62 individuals examined were transferred to the Mega 7.1 program and aligned in "Clustal W" step and total of 1177 base pairs overlapped. The nucleotide composition of the individuals was determined as a result of the statistical analyzes performed by cutting the excess parts at the head and end of the DNA sequences (Table 3.2 and 3.3). When the values given in Table 3.2 are examined, it is seen that individuals are not very different in terms of ratio of T, C, A and G bases. At the same time, it was found that when the average values of the base contents of the individuals were calculated, the A-T ratio was 55.7% and the G-C ratio was 44.3%, and the A-T base pair was richer than G-C base pair.

Table 3.3. Nucleotide compositions in the co-evaluation of ITS and *psb*A-*trn*H regions of examined individuals.

Individuals of Taxa	**T**	**C**	**A**	**G**	**Total**
A. scoparia 1003a	30,5	21,4	24,9	23,2	1148
A. scoparia 1003b	30,5	21,4	25,0	23,1	1148
A. scoparia 1089a	30,5	21,4	25,0	23,1	1148
A. scoparia 1089b	30,4	21,5	25,0	23,1	1148
A. scoparia 1089c	30,4	21,5	25,0	23,1	1148
A. scoparia 1169a	30,4	21,5	25,0	23,1	1148
A. scoparia 1169b	30,4	21,5	25,0	23,1	1148
A. scoparia 1169c	30,4	21,5	25,0	23,1	1148
A. scoparia 1169d	30,4	21,5	25,0	23,1	1148
A. scoparia 1038a	30,4	21,5	25,0	23,1	1148
A. scoparia 1038b	30,4	21,5	25,0	23,1	1148
A. scoparia 1038c	30,4	21,5	25,0	23,1	1148
A. scoparia 1030a	30,4	21,5	25,0	23,1	1148
A. scoparia 1030b	30,4	21,5	25,0	23,1	1148
A. scoparia 1030c	30,4	21,5	25,0	23,1	1148
A. scoparia 1078a	30,4	21,5	25,0	23,1	1148
A. scoparia 1078b	30,4	21,5	25,0	23,1	1148
A. scoparia 1078c	30,4	21,5	25,0	23,1	1148
A. scoparia KX581818.1	30,4	21,5	25,0	23,1	1148
A. campestris var. *marschaliana 1046a*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1046b*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1147a*	30,5	21,0	25,2	23,2	1133

A. campestris var. *marschaliana 1147b*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1147c*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1066a*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1066b*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1066c*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1176a*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1176b*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1176c*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1176d*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1114a*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1187a*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1187c*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1187b*	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1102a*	30,5	21,0	25,2	23,2	1133
A. campestris var marschaliana 1102b	30,5	21,0	25,2	23,2	1133
A. campestris var. *marschaliana 1102c*	30,5	21,0	25,2	23,2	1133
A. campestris var. *araratica 1001a*	30,5	21,4	25,2	22,9	1142
A. campestris var. *araratica 1001b*	30,5	21,4	25,2	22,9	1142
A. campestris var. *araratica 1001c*	30,5	21,4	25,2	22,9	1142
A. campestris var. *araratica 1002a*	30,5	21,4	25,2	22,9	1142
A. campestris var. *araratica 1002b*	30,5	21,4	25,2	22,9	1142
A. campestris var. *araratica 1002c*	30,5	21,4	25,2	22,9	1142
A. campestris JX051736.1	30,7	21,4	24,8	23,1	1098
A. campestris var. *campestris 1015a*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1015b*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1015c*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1017a*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1017b*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1017c*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1018a*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1018b*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1018c*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1022a*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1022b*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1022c*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1039a*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1039b*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1039c*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1096a*	30,8	21,5	24,9	22,8	1147
A. campestris var. *campestris 1096b*	30,8	21,6	24,8	22,8	1147
Anthemis cotula KR150162.1	31,9	19,7	27,4	21,1	1102
Avg.	30,6	21,3	25,1	23,0	1141,1

3.4.2. Molecular diversity parameters of examined individuals

The DNA sequences of the ITS and the *psb*A-*trn*H regions of 60 individuals belong to 21 specimens and 17 different populations were analyzed statistically (Table 3.2 and 3.3). In the both separate and co-evaluations of sequences of the *psb*A-*trn*H and ITS regions of examined individuals, the some parameters of molecular diversity like conservated regions (C), variation regions (V), parsimony informative regions (Pi), single parts (S), homologous base pairs (ii), transitional base pairs (si), transversional base pairs (sv) and R value (si / sv) were calculated and the values obtained are given in Table 3.3. These parameters determine the distribution of individuals in the phylogenetic tree and thus gave us information about their phylogenetic relationships.

Table 3.4. Molecular diversity parameters obtained from both separate and co-evaluations of sequences of the *psb*A-*trn*H and ITS regions of examined individuals.

Parameters of Molecular Diversity	**ITS region**	***psb*A-*trn*H region**	**Co-evaluated of ITS and *psb*A-*trn*H**
Total individuals	60	60	60
Total band Length	689	488	1179
The ratio of G-C base pair (%)	55	28	44.3
Conserved regions (C)	594	415	1009
Variation regions (V)	95	49	144
Single parts (S)	85	33	119
Parsimony informative regions (Pi)	10	16	25
Homologous base pairs (ii)	675	446	1122
Transitional base pairs (si)	3.00	1.00	4.00
Transversional base pairs (sv)	3.00	5.00	7.00
R value (si/sv)	1.2	0.2	0.5

3.4.3. Determination of phylogenetic relations between examined individuals

To determination the phylogenetic relations between examined 60 individuals from both the same and different populations belong to the subgenus *Dracunculus* taxa, the DNA sequences of total of 63 individuals, 60 of which were examined, 2 of which were control group and one of which was an external group, were arranged on Mega program. The species *A. campestris* and *A. scoparia* as control group, and the species *Anthemis cotula* L. as external group were used.

Then, by using the Best DNA / Protein step in the Models menu of this program, we determined the methods that best express the phylogenetic relationship between individuals. In the list of methods given, the lowest value of BIC (Bayesian Information Criterion) was found in T92 + G (Tamura-3-parameter) method. According to T92 + G, to see phylogenetic relationships between individuals, we have seen that phylogenetic trees can be plotted using any of the methods such as Maximum Parsimony, Neighbor-Joining, UPGMA and Maximum Likelihood.

Maximum Likelihood, Neighbor-Joining, UPGMA and Maximum Parsimony methods were applied separately, but it was decided that the method that best illustrates the evolutionary and phylogenetic relations among the examined individuals, we work with is the Maximum Likelihood method. In the phylogenetic tree drawing, the DNA sequences of regions both ITS in the nuclear genome and psbA-trn*H* in the chloroplast genome were co-evaluated by using version 7.1 of the Mega program. In the Maximum Likelihood method, by entering the bootstrap value 100, a single phylogenetic tree for total of 63 individuals, 60 of which were examined, 2 of which were control group and 1 of which was an external group was obtained (Figure 3.2). The species *A. campestris* and *A. scoparia* as control group, and the species *Anthemis cotula* L. as external group were used.

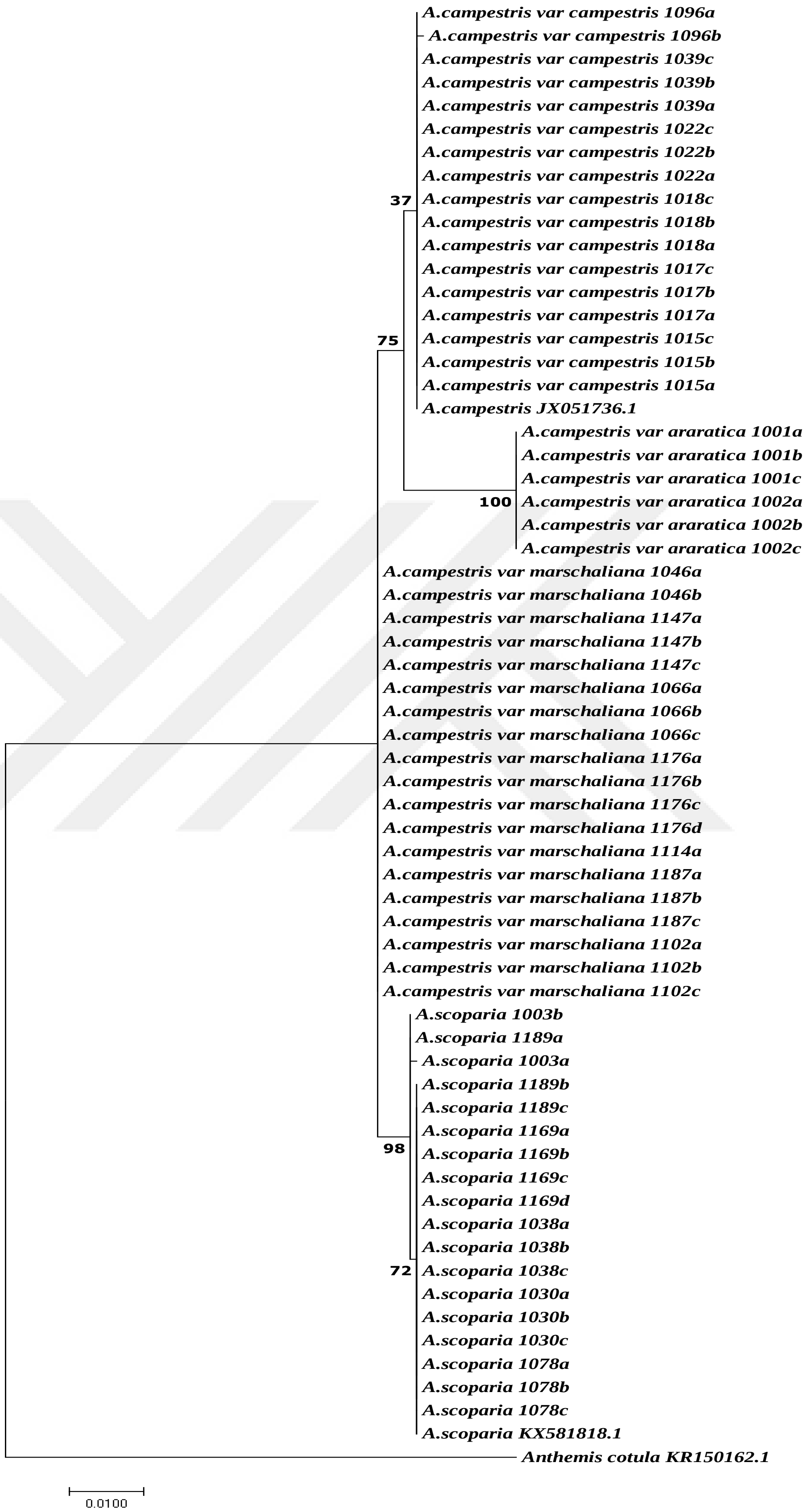

Figure 3.2. Phylogenetic tree obtained from co-evaluation of sequences of the *psb*A-*trn*H and ITS regions of individuals.

4. DISCUSSION

There are total of 23 species without any infraspecific taxa that belong to the genus *Artemisia* L. in the 5th and 10th volumes of the Flora of Turkey. The species *A. campestris*, *A. marschalliana*, *A. araratica* and *A. scoparia* are four of 23 independent species (Cullen, 1975; Davis, 1975; Davis *et al.*, 1988; Civelek *et al.*, 2010; Kursat, 2010). In fact, these four species are belong to the subgenus *Dracunculus*, but the genus *Artemisia* in the Flora of Turkey didn’t divide to subgenera.

Civelek *et al*. (2010) have carried out a revisionary study of the genus *Artemisia* in Turkey. According to results of this revisionary study, there are 3 subgenera and 22 species which include 8 infraspecific taxa belong to the genus *Artemisia* in Turkey (Civelek *et al.*, 2010; Kursat, 2010; Kursat *et al.* 2011a, 2011b, 2014, 2015 and 2018).

Nowadays, taxa of the genus *Artemisia* are classified under the subgenera or sections, because it is a very complex genus. The taxa of genus *Artemisia* in Turkey were also classified under the subgenera during revisionary study (Civelek *et al.*, 2010; Kursat, 2010).

According to results of the revisionary study of the genus *Artemisia*, subgenera *Artemisia*, *Dracunculus* and *Seriphidium* have taxa in Turkey, but the subgenus *Tridentatae* which is endemic to North America has not taxa in Turkey (Civelek *et al.*, 2010; Kursat, 2010; Guner *et al.*, 2012).

According to results of the revisionary study based on the morphological features, there are two species and four taxa belong to the subgenus *Dracunculus* in Turkey (Table 1.4). These species in the subgenus *Dracunculus* in Turkey are *A. scoparia* and *A. campestris*, and these taxa in the subgenus *Dracunculus* in Turkey are *A. scoparia*, *A. campestris var. campestris*, *A. campestris var. marschalliana*, *A. campestris var. araratica* (Civelek *et al.*, 2010; Kursat, 2010).

During revisionary study of the genus *Artemisia* in Turkey, it was observed that the closely related independent three species *A. campestris*, *A. marschalliana* and *A. araratica* in Flora of Turkey are quite approximate to one another in terms of morphological characters (Table 1.3; Civelek *et al.*, 2010; Kursat, 2010). On the other hand, the two taxa *A. scoparia* and *A. campestris* var. *campestris* in Flora of Turkey are also similar to each other morphologically.

During revisionary study of the genus *Artemisia,* the same time, it was also observed that distribution areas of three closely related independent species *A. campestris, A. marschalliana* and *A. araratica* in Flora of Turkey have sympatric distribution which are partially mixed together (Civelek *et al.,* 2010; Kursat, 2010).

Their distributions in Turkey and morphological features in mind, the three closely related independent species *A. campestris*, *A. marschalliana* and *A. araratica* in Flora of Turkey were reduced to variety levels and these varieties were linked to the species *A. campestris* (Table 1.4).

As a result, the taxonomic positions and combinations of closely related independent three species *A. campestris, A. marschalliana* and *A. araratica* in Flora of Turkey have been changed in the revisionary study of the genus *Artemisia* in Turkey as follows: *A. campestris* var. *campestris*, *A. campestris* var. *marschalliana* and *A. campestris* var. *araratica*. Thus, it has been adapted to their taxonomical positions in the Russian Flora (Table 1.4) (Cullen, 1975; Davis, 1975; Shinskin & Bobrov, 1995; Civelek *et al.,* 2010; Kursat 2010; Kursat *et al,* 2015). However, because they were needed to molecular data, the accuracy of the classification based on morphological data in the revisionary study could not be guaranteed. Therefore, this research was planned.

The taxonomic positions and combinations of closely related independent three species *A. campestris, A. marschalliana* and *A. araratica* in Flora of Turkey were also changed in Floras of Europa and Russia that were written after The Flora of Turkey (Table 1.4). For example, these closely related independent species in Flora of Turkey are the subspecies of the species *A. campestris* in Flora of Europa, despite ones are the varieties of the species *A. campestris* in Flora of Russia (Podlech, 1986; Cullen, 1975; Davis, 1975; Tutin and Persson 1976; Shinskin and Bobrov, 1995; The plant list, 2019; The Euro+Med Plant Base, 2019).

Two subspecies of Flora Europa are described *A. campestris* subsp. *campestris* and *A. campestris* subsp. *inodora* are located in Turkey as three varieties of the species *A. campestris (*Table 1.4). These three varieties are *A. campestris* var. *campestris, A. campestris* var. *marschalliana* and *A. campestris* var. *araratica* (Table 1.4). Because, two varieties *A.campestris* var. *marschalliana* and *A. campestris* var. *araratica* were combined and made synonyms of the subspecies *A. campestris* subsp. *inodora* Nyman in Flora Europa (Tutin & Persson 1976; The plant list, 2019; The Euro+Med Plant Base, 2019; Civelek *et al.,* 2010; Kursat, 2010).

There are two varieties *A. campestris* var. *marschalliana* and *A. campestris* var. *araratica* in Flora of Russia, but there is no variety *A. campestris* subsp. *campestris* (Shinskin & Bobrov, 1995). There is no species *A. campestris* and its varieties in Flora Iran (Table 1.4) (Rechinger, 1986).

The species *A. scoparia* in Floras of Turkey, Russia, Europa and Iran is found (Table 1.4) (Civelek *et al.*, 2010; Davis, 1975; Tutin & Persson, 1976; Shinskin & Bobrov, 1995; Rechinger, 1986).

Taxonomists have been using morphological features for the identification of both plants and animals since before the time of Carl von Linnaeus. Yet, even after hundreds of years of work by taxonomists perhaps only 20% of the species on earth have been formally recognized and named (Kress, 2017; Wilson, 2016).

In this researc, 60 individuals of 21 specimens taken from 17 different populations belong to taxa of the subgenus *Dracunculus* were examined. Depending on the width of the populations belong to the taxa, between 1 and 4 individuals with the same label information were used for each taxa. For all examined individuals from the same and different populations belong to taxa of the subgenus *Dracunculus*, it has been determined the sequences of regions both *psb*A-*trn*H of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2).

In the co-evaluations of sequences of the *psb*A-*trn*H and ITS regions of examined individuals, the ratios of A, T, G and C bases, the percentages of AT and GC base pairs were determined (Table 3.2). When the values given in Table 3.2 are examined, it is seen that individuals are not very different in terms of ratio of T, C, A and G bases. At the same time, it was found that when the average values of the base contents of the individuals were calculated, the A-T ratio was 55.7% and the G-C ratio was 44.3%, and the A-T base pair was richer than G-C base pair.

Molecular diversity parameters were obtained from both separate and co-evaluations of sequences of the *psb*A-*trn*H and ITS regions of examined individuals (Table 3.3). Molecular diversity parameters obtained from co-evaluations of sequences of the psbA-trnH and ITS regions of examined individuals were used only in the phylogenetic tree drawing. These parameters determine the distribution of individuals in the phylogenetic tree and thus give us information about their phylogenetic relationships.

In the co-evaluation of sequences of the *psb*A-*trn*H and ITS regions, the results of the statistical analysis of these molecular diversity parameters are as follows:

conservated regions (C) 1009, variation regions (V) 144, parsimony informative regions (Pi) 25, single parts (S) 119, homologous base pairs (ii) 1122, transitional base pairs (si) 4.00, transversional base pairs (sv) 7.00 and R value (si / sv) 0.5 (Table 3.3).

In the NCBI (National Center for Biotechnology Information) database site, for two species *A. campestris* and *A. scoparia*, two reference regions were obtained. These reference regions were an ITS with 700-750 bases and a *psb*A-*trn*H with 450-500 bases. The reference base sequences of *psb*A - *trn*H and ITS regions of two individuals belong to species *A. campestris* and *A. scoparia* were included as control group in our analysis to demonstrate the accuracy of the study. The reference base sequences of *psb*A - *trn*H and ITS regions of the species *Anthemis cotula* were also included as external group.

For a more accurate visualization of the results of the alignment, about 50-100 base from the head and the end were not evaluated by us. For this reason, approximately 689 base pairs for the ITS regions and 488 base pairs for the *psb*A - *trn*H regions were used and the sequences of these regions of examined 60 individuals were given in the part of appendices (Appendix, Table 6.1)

In the phylogenetic tree drawing (Figure 3.2), the DNA sequences of regions both ITS in the nuclear genome and *psb*A-*trn*H in the chloroplast genome were co-evaluated using version 7.1 of the Mega program. In the Maximum Likelihood method, by entering the bootstrap value 100, a single phylogenetic tree for total of 63 individuals, 60 of which were examined, 2 of which were control group and 1 of which was an external group was obtained (Figure 3.2). The species *A. campestris* and *A. scoparia* as control group, and the species *Anthemis cotula* L. as external group were used.

When we look at the phylogenetic tree carefully, it is seen that the phylogenetic tree is divided into two branches in the first stage. One of these branches carries only individuals of the species *A. scoparia*, while the other carries individuals of varieties belong to the species *A. campestris*. This situation shows that the species *A. scoparia* is an independent apart from the three varieties of the species *A. campestris* and is genetically differentiated from them.

It is a second important issue that individuals of four taxa belong to the subgenus *Dracunculus* are included only in the same branches with their own taxon individuals and not to interfere with individuals belong to other taxa. This situation is also an indication that there is reproductive isolation among four taxa and there is no gene flow and hybridization between them.

The third important finding is that individuals of species both *A. campestris* and *A. scoparia* which are used as control groups are found together with the individuals of own species, and makes the reliability of our study 100 % (Figure 3.2).

The separation of the species *A scoparia* from varieties of the species *A campestris* is a very normal result. The species *A. scoparia* is diploid in terms of chromosome number, varieties of the species of *A. campestris* are tetraploid (Civelek, 2010; Kursat, 2010) (Table 4.1). The same time, the species *A. scoparia* and varieties of the species of *A. campestris* have different basic chromosome numbers (dysploidy) as X = 8 and X = 9 respectively. Genetically, no reproduction can occur between the species *A. scoparia* and varietis of the species *A. campestris*.

The genus *Artemisia* has two basic chromosome numbers which are known as dysploidy (X=9 and X=8). The taxa of the subgenus *Dracunculus* also show dysploidy (Tables 1.3 and 4.1). Dysploidy is the situation where species in a genus or subgenus have different basic chromosome numbers. Dysploidy is something differ from aneuploidy (Figure 1.3). In aneuploidy, the chromosome change resulted from a missing or adding of a resemble (homologous) chromosome to the existing chromosome. In this case, genetic information on the given chromosome may be lost or double. While in dysploidy, the chromosome change resulted from structural change of the old chromosome; such as centric fusion, centric fission and dissociation process. The whole genetic information will still be the same (Figure 1.3). The dysploidy is then more stable within a species (Kaymak, 2007; Moore, 1976).

Table 4.1. The chromosome numbers of taxa belong to the subgenus *Dracunculus* (Civelek, 2010; Kursat, 2010).

Taxa	**Basic chromosome numbers**	**Chromosome numbers in revisionary study**
A. campestris var. *campestris*	X = 9	2n=4x=36
A. campestris var. *marschalliana*	X = 9	2n=4x=36
A. campestris var. *araratica*	X = 9	2n=4x=36
A. scoparia	X = 8	2n=2x=16

It is both abnormal and interesting for individuals belong to each variety of *A. campestris* to be in side by side but in separate groups on the same branch. Because these taxa are very similar morphologically are individuals of varieties belong to the same species (Civelek, 2010; Kursat, 2010) (Table 1.2). Normally, there is no reproductive isolation between the varieties of the same species.

It is very interesting that individuals belong to each variety of the species *A. campestris* do not interfere with individuals belong to other two varieties of the species *A. campestris* and are only found together with their own varieties individuals. The following results can be deduced from this situation:

(i). Three varieties of the species *A. campestris* are very similar morphologically (Table 1.3) However, these similarities are not dependent on the flow of genes between them. Because, the grouping of individuals of each taxon only among themselves shows that there is no gene flow between these taxa.

(ii). The tetraploid three varieties of the species *A. campestris* may claim that they have separately completed their speciations due to reproductive isolation. However, each variety is not sufficiently differentiated due to apomictic reproduction in itself. Because of high percentage of the genus *Artemisia* species are polyploid, numerous apospory and diplospory apomictics are reported for the genus *Artemisia* (Noyes, 2007; Carman, 1997; Czapik, 1996; Pullaiah, 1984; Davis, 1967; Battaglia, 1951; Gustafsson, 1946 – 1947). Apomicts in the family Asteraceae, as in other plant families are almost always restricted to polyploids at triploid and higher levels (Noyes, 2007). Progeny of an apomictic plant are genetically identical to the maternal plant. Derivation of the egg from a diploid maternal cell without meiotic reduction, and its subsequent fertilization-independent development into an embryo, means that the progeny derived from apomictic development are clonal and therefore genetically identical to the maternal parent (Hand and Koltunow, 2014).

Because they have different basic chromosome numbers ($x = 8$ and $x = 9$) and different diploid chromosome numbers ($2n = 2x = 16$ and $2n=4x=36$), the fact that a complete reproductive isolation was found between the species *A. scoparia* and three varieties of the species *A. campestris*. The fact that a complete reproductive isolation between tetraploid three varieties of the species *A. campestris* which have the same basic chromosome numbers was also found. In other words, it was found that there were no gene flow and hybridisation between the four studied taxa of the subgenus *Dracunculus,* and these four taxa were also completed their speciation.

The correctness of the classification of taxa belong to the subgenus *Dracunculus* based on morphological characteristics during revisionary study of the genus *Artemisia* in Turkey was tested, and the most accurate classification of these taxa was determined. The fact that the subgenus *Dracunculus* have four independent species in Turkey was found in this study.

According to the results of this molecular study, *A. campestris* var. *campestris*, *A.campestris* var. *marschalliana* and *A.campestris* var. *araratica* was proposed to raise from variety level to species level. Thus, like in the Flora of Turkey, the new systematic positions and combinations of the three varieties of the species *A. campestris* will be independent species *A. campestris*, *A. marschalliana* and *A. araratica*, like the Flora of Turkey (Cullen, 1975; Davis, 1975). Another basis of this new combination, the fact that the individual of the species *A. campestris* used as one of the control groups was aggregated side by side on the same branch of phylogenetic tree with the individuals of *A. campestris* var. *campestris.*

A. campestris, A. marschalliana and *A. araratica* species are morphologically similar, but they are different genetically, it means that these species are sibling species. Intra-specific morphological differences of the species *A. campestre* given in Table 1.3 were found to be inter-specific variations of the independent three species *A. campestre*, *A. marschalliana* and *A. araratica*.

According to results of this molecular study, there are 3 subgenera, 24 species and 26 taxa which also include 5 infraspecific taxa belong to the genus *Artemisia* in Turkey.

As a result of this research, it was obtained original data for use in new scientific molecular studies on the taxa of genus *Artemisia*, and provided the haplotypes of psbA-*trn*H and ITS regions for the subgenus *Dracunculus* taxa in Turkey for the GenBank database.

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APPENDIX

Table Ap. 1 : The base sequences of regions both *psb*A-*trn*H of chloroplast DNA and ITS of nuclear DNA (ITS1-5.8 gene - ITS2) belong to 60 individuals which are examined in this study

Species name	**Collector and collection number**	**Base sequence (ITS1-5.8-ITS2)**	**Base sequence (*psb*A-*trn*H)**
A. scoparia	M. Kursat 1003a	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTCG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CGAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGG ACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat 1003b	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTCG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG

		GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGG ACCGCGGACC	TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat 1189a	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTCG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGG ACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat 1189b	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG

		GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	
A. scoparia	M. Kursat 1189c	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat 1169a	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG

		CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	
A. scoparia	M. Kursat 1169b	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat 1169c	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG

A. scoparia	M. Kursat 1169d	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat 1038a	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat	CAAGGTTTCCGTAGGTGAACCTGCG	ATTTCCCTCTAGACTTAGCT

	1038b	GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	M. Kursat 1038c	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	S. Civelek and M. Kursat	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT

	1030a	AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	S. Civelek and M. Kursat 1030b	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	S. Civelek and M. Kursat 1030c	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA

		CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	S. Civelek and M. Kursat 1078a	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. scoparia	S. Civelek and M. Kursat 1078b	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC	NNATTTCCCTCTAGACTTAG CTGCTATTGAAGCTCCATCT ACAATGGATAAGACTTTGGT CTGATTGTATAGGAGTAGTT TTTGAACTAAAAAAGGAGC AATAGCTTTCCTCTTGTTTTA TCAAGAGGTCGTTATTGCTC

		GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	CTTTTTTTATTTAGTACTATT GGCCTTACAGAGTTTCTTTA AAAATATTTTCTAGTTTGGT TCGATTCGCGTGTTTTCTCTT TGTATTCATATTCATTTATAT TATAGGTTTGTATATTCTATT CCAAATTTTTTATGAAGTTT GATTTCCAATTCAATTTCAA ATCAAAATATATAAAAATTT CATTTTTGCTTATTTATTACT TTGATTTCATAAATAAAAAA GAAATAATATGCTTTTTTTT ATGTTGAGGTAAAAATATAG ATAATACTAGATAGATATAT AGTAGAGGGGCGGATGTAG CCAAGTGGATCAAGGCAGT GG
A. scoparia	S. Civelek and M. Kursat 1078c	CAAGGTTTCCGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTCTGGACCTCGTGTGAATGTC GTCGGCGCAATAACAACCCCCGGCA CAATGTGTGCCAAGGAAAACTAAAC TCAAGAAGGCTCGTTTCGTGTAGCC CCGTTCGCGGTGCGCTCATGGGACG CGGCTTCTTTATAATCACAAACGAC TCTCGGCAACGGATATCTCGGCTCA CGCATCGATGAAGAACGTAGCAAA ATGCGATACTTGGTGTGAATTGCAG AATCCCGTGAACCATCGAGTTTTTG AACGCAAGTTGCGCCCGAAGCCTTT TGGCCGAGGGCACGTCTGCCTGGGC GTCACGCATCGCGTCGCCCCCCACA AATTCTCCGTCAGGGGAGCTTGTGT TTCGGGGGCGGATACTGGTCTCCCG TGCTCATGGCGCGGTTGGCCGAAAT AGGAGTCCCTTCGATGGACGCACGA ACTAGTGGTGGTCGTAAAAACCCTC GTCTTTTGTTTCGTGCCGTTAGTCGC GAGGGAAGCTCTTTAAAAACCCCAA CGCGTCGTCTCTTGACGGCGCTTCG GACCGCGGACC	ATTTCCCTCTAGACTTAGCT GCTATTGAAGCTCCATCTAC AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACAGAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTTCA TTTTTGCTTATTTATTACTTT GATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AAGTGGATCAAGGCAGTGG
A. campestris var. *marschaliana*	S. Civelek and M. Kursat 1046a	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT

		GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	S. Civelek and M. Kursat 1046b	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1147a	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA

		CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1147b	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1147c	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA

		CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	S. Civelek and M. Kursat 1066a	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACtGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	S. Civelek and M. Kursat 1066b	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA

		TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	S. Civelek and M. Kursat 1066c	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1176a	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG

		AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1176b	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1176c	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG

		GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	
A. campestris var. *marschaliana*	M. Kursat 1176d	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1114a	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG

A. campestris var. *marschaliana*	M. Kursat 1187a	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1187b	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1187c	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAAcGACCCGTGAACGCGTAAA	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG

		AACAACTGAGTGTCGTTAGGATCAA GCGCTCGTTTGATCCTCTCGACGCTC TGCCGATGTGCGTTCGCTCGAGTTC TTTTGGACCTCGTGTGAATGTCGTC GGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1102a	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1102b	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT

		TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *marschaliana*	M. Kursat 1102c	CAAGGTTTCGGTAGGTGAATGCGGA AGGATCATTTGTCGAACCCTGCAAA GCAGAACGACCCGTGAACGCGTAA AAACAACTGAGTGTCGTTAGGATCA AGCGCTCGTTTGATCCTCTCGACGC TCTGCCGATGTGCGTTCGCTCGAGT TCTTTTGGACCTCGTGTGAATGTCGT CGGCGCAATAACAACCCCCGGCACA ATGTGTGCCAAGGAAAACTAAACTC AAGAAGGCTCGTTTCGTGTAGCCCC GTTCGCGGTGCGCTCATGGGACGCG GCTTCTTTATAATCACAAACGACTC TCGGCAACGGATATCTCGGCTCACG CATCGATGAAGAACGTAGCAAAAT GCGATACTTGGTGTGAATTGCAGAA TCCCGTGAACCATCGAGTTTTTGAA CGCAAGTTGCGCCCGAAGCCTTTTG GCCGAGGGCACGTCTGCCTGGGCGT CACGCATCGCGTCGCCCCCCACAAA TTCTCCGTCAGGGGAGCTTGTGTTTC GGGGGCGGATACTGGTCTCCCGTGC TCATGGCGCGGTTGGCCGAAATAGG AGTCCCTTCGATGGACGCACGAACT AGTGGTGGTCGTAAAAACCCTCGTC TTTTGTTTCGTGCCGTTAGTCGCGAG GGAAGCTCTTTAAAAACCCCAACGC GTCGTCTCTTGAGGCGCTTCGACCG CGACCCC	TTAGCTGCTATTGAAGCTCC ATCTACAAATGGATAAGACT TTGGTCTGATTGTATAGGAG TAGTTTTTGAACTAAAAAAG GAGCAATAGCTTTCCTCTTG TTTTATCAAGAGGTCGTTAT TGCTCCTTTTTTTATTTAGTA CTATTGGCCTTACACAGTTT CTTTAAAAATATTTTCTAGT TTGGTTCGATTCGCGTGTTTT CTCTTTGTATTCATATTCATT TATATTATAGGTTTGTATAT TCTATTCCAAATTTTTTATGA AGTTTGATTTCCAATTCAAT TTCAAATCAAAATATATAAA AATTGAATTTTTGCTTATTTA TTACTTTGATTTCATAAATA AAAAAGAAATAATATGCTTT TTTTTATGTTGAGGTAAAAA TATAGATAATACTAGATAGA TATATAGTAGAGGGGCGGA TGTAGCCAAGTGGATCAAG GCAGTGG
A. campestris var. *araratica*	M. Kursat 1001a	CAAGGTTTCGGTAGGTGAACTTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTTATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT	TTTCCCTCTAGACTTAGCTA GCGAATTGAACTCTACAAGG GAAAAGACTTTGGTCTGATT GTATAGGAGTAGTTTTTGAA CTAAAAAAGGAGCAATAGC TTTCCTCTTGTTTATCAAGA GGTCGTTATTGCTCCTTTTTT TATTTAGTACTATTGGCCTT ACAGAGTTTCTTTAAAAATA

		CAAGAAGGCTCGTGTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTGACGGCGCTTCGAC CGCGACCCC	TTTTCTAGTTTGGTTCGATTC GCGTGTTTTCTCTTTGTATTC ATATTCATTTATATTATAGG TTTGTATATTCTATTCCAAAT TTTTTATGAAGTTTGATTTCC AATTCAATTTCAAATCAAAA TATATAAAAATTTCATTTTT GCTTATTTATTACTTTGATTT CATAAATAAAAAAGAAATA ATATGCTTTTTTTTATGTTGA GGTAAAAATATAGATAATA CTAGATAGATATATAGTAGA GGGGCGGATGTAGCCAATTT CATCAAGGCAGTGG
A. campestris var. *araratica*	M. Kursat 1001b	CAAGGTTTCGGTAGGTGAACTTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTTATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTGTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTGACGGCGCTTCGAC CGCGACCCC	TTTCCCTCTAGACTTAGCTA GCGAATTGAACTCTACAAGG GAAAAGACTTTGGTCTGATT GTATAGGAGTAGTTTTTGAA CTAAAAAAGGAGCAATAGC TTTCCTCTTGTTTATCAAGA GGTCGTTATTGCTCCTTTTTT TATTTAGTACTATTGGCCTT ACAGAGTTTCTTTAAAAATA TTTTCTAGTTTGGTTCGATTC GCGTGTTTTCTCTTTGTATTC ATATTCATTTATATTATAGG TTTGTATATTCTATTCCAAAT TTTTTATGAAGTTTGATTTCC AATTCAATTTCAAATCAAAA TATATAAAAATTTCATTTTT GCTTATTTATTACTTTGATTT CATAAATAAAAAAGAAATA ATATGCTTTTTTTTATGTTGA GGTAAAAATATAGATAATA CTAGATAGATATATAGTAGA GGGGCGGATGTAGCCAATTT CATCAAGGCAGTGG
A. campestris var. *araratica*	M. Kursat 1001c	CAAGGTTTCGGTAGGTGAACTTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTTATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTGTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC	TTTCCCTCTAGACTTAGCTA GCGAATTGAACTCTACAAGG GAAAAGACTTTGGTCTGATT GTATAGGAGTAGTTTTTGAA CTAAAAAAGGAGCAATAGC TTTCCTCTTGTTTATCAAGA GGTCGTTATTGCTCCTTTTTT TATTTAGTACTATTGGCCTT ACAGAGTTTCTTTAAAAATA TTTTCTAGTTTGGTTCGATTC GCGTGTTTTCTCTTTGTATTC

		GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTGACGGCGCTTCGAC CGCGACCCC	ATATTCATTTATATTATAGG TTTGTATATTCTATTCCAAAT TTTTTATGAAGTTTGATTTCC AATTCAATTTCAAATCAAAA TATATAAAAATTTCATTTTT GCTTATTTATTACTTTGATTT CATAAATAAAAAAGAAATA ATATGCTTTTTTTTATGTTGA GGTAAAAATATAGATAATA CTAGATAGATATATAGTAGA GGGGCGGATGTAGCCAATTT CATCAAGGCAGTGG
A. campestris var. *araratica*	M. Kursat 1002a	CAAGGTTTCGGTAGGTGAACTTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTTATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTGTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTGACGGCGCTTCGAC CGCGACCCC	TTTCCCTCTAGACTTAGCTA GCGAATTGAACTCTACAAGG GAAAAGACTTTGGTCTGATT GTATAGGAGTAGTTTTTGAA CTAAAAAAGGAGCAATAGC TTTCCTCTTGTTTATCAAGA GGTCGTTATTGCTCCTTTTTT TATTTAGTACTATTGGCCTT ACAGAGTTTCTTTAAAAATA TTTTCTAGTTTGGTTCGATTC GCGTGTTTTCTCTTTGTATTC ATATTCATTTATATTATAGG TTTGTATATTCTATTCCAAAT TTTTTATGAAGTTTGATTTCC AATTCAATTTCAAATCAAAA TATATAAAAATTTCATTTTT GCTTATTTATTACTTTGATTT CATAAATAAAAAAGAAATA ATATGCTTTTTTTTATGTTGA GGTAAAAATATAGATAATA CTAGATAGATATATAGTAGA GGGGCGGATGTAGCCAATTT CATCAAGGCAGTGG
A. campestris var. *araratica*	M. Kursat 1002b	CAAGGTTTCGGTAGGTGAACTTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTTATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTGTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC	TTTCCCTCTAGACTTAGCTA GCGAATTGAACTCTACAAGG GAAAAGACTTTGGTCTGATT GTATAGGAGTAGTTTTTGAA CTAAAAAAGGAGCAATAGC TTTCCTCTTGTTTATCAAGA GGTCGTTATTGCTCCTTTTTT TATTTAGTACTATTGGCCTT ACAGAGTTTCTTTAAAAATA TTTTCTAGTTTGGTTCGATTC GCGTGTTTTCTCTTTGTATTC ATATTCATTTATATTATAGG TTTGTATATTCTATTCCAAAT

		GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTGACGGCGCTTCGAC CGCGACCCC	TTTTTATGAAGTTTGATTTCC AATTCAATTTCAAATCAAAA TATATAAAAATTTCATTTTT GCTTATTTATTACTTTGATTT CATAAATAAAAAAGAAATA ATATGCTTTTTTTTATGTTGA GGTAAAAATATAGATAATA CTAGATAGATATATAGTAGA GGGGCGGATGTAGCCAATTT CATCAAGGCAGTGG
A. campestris var. *araratica*	M. Kursat 1002c	CAAGGTTTCGGTAGGTGAACTTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTTATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TCCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTGTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCACAA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTGACGGCGCTTCGAC CGCGACCCC	TTTCCCTCTAGACTTAGCTA GCGAATTGAACTCTACAAGG GAAAAGACTTTGGTCTGATT GTATAGGAGTAGTTTTTGAA CTAAAAAAGGAGCAATAGC TTTCCTCTTGTTTATCAAGA GGTCGTTATTGCTCCTTTTTT TATTTAGTACTATTGGCCTT ACAGAGTTTCTTTAAAAATA TTTTCTAGTTTGGTTCGATTC GCGTGTTTTCTCTTTGTATTC ATATTCATTTATATTATAGG TTTGTATATTCTATTCCAAAT TTTTTATGAAGTTTGATTTCC AATTCAATTTCAAATCAAAA TATATAAAAATTTCATTTTT GCTTATTTATTACTTTGATTT CATAAATAAAAAAGAAATA ATATGCTTTTTTTTATGTTGA GGTAAAAATATAGATAATA CTAGATAGATATATAGTAGA GGGGCGGATGTAGCCAATTT CATCAAGGCAGTGG
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		ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	S. Civelek and M. Kursat 1015b	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
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		TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
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		GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	M. Kursat 1017c	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	S. Civelek and M. Kursat 1018a	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG

		TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	
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		CCGCGACCC	
A. campestris var. *campestris*	M. Kursat 1022a	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	M. Kursat 1022b	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var.	M. Kursat 1022c	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA

campestris		AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	M. Kursat 1039a	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
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		CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	M. Kursat 1039c	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	M. Kursat 1096a	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG

		AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCATGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG
A. campestris var. *campestris*	M. Kursat 1096b	CAAGGTTTCGGTAGGTGAACCTGCG GAAGGATCATTGTCGAACCCTGCAA AGCAGAACGACCCGTGAACGCGTA AAAACAACTGAGTGTCGTTAGGATC AAGCGCTCGTTTGATCCTCTCGACG CTCTGCCGATGTGCGTTCGCTCGAG TTCTTTTGGACCTCGTGTGAATGTTG TCGGCGCAATAACAACCCCCGGCAC AATGTGTGCCAAGGAAAACTAAACT CAAGAAGGCTCGTTTCGTGTAGCCC CGTTCGCGGTGCGCTCCTGGGACGC GGCTTCTTTATAATCACAAACGACT CTCGGCAACGGATATCTCGGCTCAC GCATCGATGAAGAACGTAGCAAAA TGCGATACTTGGTGTGAATTGCAGA ATCCCGTGAACCATCGAGTTTTTGA ACGCAAGTTGCGCCCGAAGCCTTTT GGCCGAGGGCACGTCTGCCTGGGCG TCACGCATCGCGTCGCCCCCCCCCA ATTCTCCGTCAGGGGAGCTTGTGTT TCGGGGGCGGATACTGGTCTCCCGT GCTCATGGCGCGGTTGGCCGAAATA GGAGTCCCTTCGATGGACGCACGAA CTAGTGGTGGTCGTAAAAACCCTCG TCTTTTGTTTCGTGCCGTTAGTCGCG AGGGAAGCTCTTTAAAAACCCCAAC GCGTCGTCTCTTGACGGCGCTTCGA CCGCGACCC	TTTCCCTCTAGACTTAGCTG CTATTGAAGCTCCATCTACA AATGGATAAGACTTTGGTCT GATTGTATAGGAGTAGTTTT TGAACTAAAAAAGGAGCAA TAGCTTTCCTCTTGTTTTATC AAGAGGTCGTTATTGCTCCT TTTTTTATTTAGTACTATTGG CCTTACACAGTTTCTTTAAA AATATTTTCTAGTTTGGTTC GATTCGCGTGTTTTCTCTTTG TATTCATATTCATTTATATTA TAGGTTTGTATATTCTATTCC AAATTTTTTATGAAGTTTGA TTTCCAATTCAATTTCAAAT CAAAATATATAAAAATTGA ATTTTTGCTTATTTATTACTT TGATTTCATAAATAAAAAAG AAATAATATGCTTTTTTTTAT GTTGAGGTAAAAATATAGAT AATACTAGATAGATATATAG TAGAGGGGCGGATGTAGCC AATTTCATCAAGGCAGTGG

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Publications: