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## Remarks on *Medicago citrina* (sect. *Dendrotelis*, *Leguminosae*)

### Abstract

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*Medicago* sect *Dendrotelis* includes shrubby perennial plants which produce stipitate pods with 1-3 coils, flowers with the keel equalling or slightly longer than the standard, and embryos with the radicle about half as long as seed. Three taxa with Mediterranean distributions are known: *M. arborea*, *M. citrina* and *M. strasseri*. The tetraploid number  $2n = 32$  is reported for *M. strasseri*, and the lectotype of *M. citrina*, a taxon for which the species rank is accepted, is also designated. Diagnostic characters, ecology and distribution areas are commented for all of them. Conservation remarks on *M. citrina* are reported. Finally, an identification key is also presented.

### Introduction

The genus *Medicago* comprises about 80 species, mainly annual herbs and herbaceous perennial, though there are few taxa with a woody perennial habit (cf. Small & Jomphe 1989). Taxa of this genus present a cosmopolitan distribution, growing in quite different habitats (e.g. coastal sand dunes, pastures, rocky hillsides, and some different halonitrophilous and nitrophilous plant communities). Moreover, taxa of *Medicago* show a great economical importance in agriculture since including “alfafa”, one of the most important forage crops (Villax 1963; Hill 1965; Lesins & Lesins 1979; Small & Jomphe 1989), or other plants with curative uses such as the “tree medic” aggregate (Champeval 1947).

Among the species of *Medicago*, several morphological features such as the growing habit, indument, relative size of the petals or the pods are usually used to segregate infrageneric taxa. With regard to the woody plants related to *Medicago arborea*, several peculiar characters such as the shrubby perennial habit, stipitate pod with 1-3 coils, keel equalling or slightly longer than the standard and embryos with the radicle about half as long as seed, are unique as a whole in the genus. For this reason, many authors (cf. Willkomm 1877; Casellas 1962; Lesins & Lesins 1979; Greuter & al. 1982; Small & Jomphe 1989) have deserved recognition of this interesting group as a different section. This section is currently named *Dendrotelis* (Vassilcz.) Lassen ex Greuter & al., and includes three Mediterranean species: *M. arborea* L., *M. strasseri* Greuter, Matthäs & Risse, and *M. citrina* (Font Quer) Greuter. The two former are native to the littoral areas and islands from the eastern Mediterranean, whereas the latter is distributed on small islands from the western

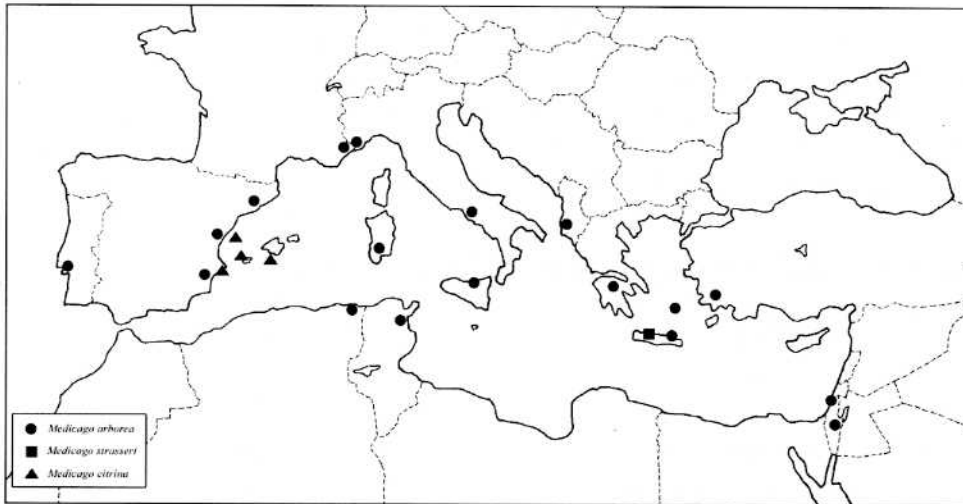


Fig. 1. Distributions of taxa of *Medicago* sect. *Dendrotelis*.

Mediterranean. Nevertheless, *M. arborea* presents a wider distribution through the western Mediterranean territories, in which it is commonly cultivated to improve soil conditions. As regards to *M. strasseri* and *M. citrina*, both show very reduced populations. The former is endemic to a few sites in Crete (Greuter & al. 1982), and the latter is only known from the Balearics, the Columbretes archipelago and a small islet in the northern Alicante province, near the eastern Iberian Peninsula (Bolòs & Vigo 1984; Serra & al. 2001).

The limited distribution area of *M. citrina* led the Spanish Government to regard this endemic as “threatened with extinction” (Spanish Royal Decree 439/1990), and Aizpuru & al. (2000) have recently labelled it as endangered (EN: B1+2e), according to the new categories of the IUCN (1994).

In the present contribution, some morphological, chorological, chromosomal and taxonomic data which complete the current knowledge of sect. *Dendrotelis* are reported.

## Material and methods

Observations of all morphological characters studied were carried out with a binocular microscope on both fresh and dried materials. Data on herbarium specimens were obtained from sheets of all taxa in the section conserved at ABH, B, BC and MA (Holmgren & al. 1990; Holmgren & Holmgren 1993). Observations of living specimens were carried out on 30 individuals per population. For *M. citrina*, wild plants growing in the natural populations of Columbretes, the Balearics and Alicante, were studied, and data were compared with those obtained from plants grown at the living collection of the CIDA (Centro de Investigaciones y Desarrollo Agroalimentario, Murcia, Spain). For both *M. arborea* and *M. strasseri*, data came mostly from plants growing at the living collection of the CIDA, though data were also taken from wild populations of *M. arborea* from Thira island (Greece). No significant differences were found in any case among wild or cultivated plants.

Karyological observations of *M. strasseri* are based on materials collected at the CIDA (Murcia, Spain). Somatic chromosomes were observed from root tips of mature plants grown in experimental pots. The root tips were fixed in glacial acetic acid: ethanol (1:3) after a pretreatment of 2-3 hours in 0,002 M hydroxyquinoline at 4 °C. After about 30 min of hydrolysis in 5 M HCl at room temperature, the root tips were briefly rinsed in distilled water. For staining, Feulgen method was used (Sharma & Sharma 1980), and after 1 hour in Schiffs reagent at room temperature, the root tips were squashed in carmin acetic on a slide.

Nomenclature of plant taxa follows Greuter & al. (1989), Castroviejo & al. (1986-2001) and Mateo & Crespo (2001).

## Results and discussion

### Taxonomic characters

*Habit* — Morphological features are relevant only after direct observation of living plants. On the one hand, *M. arborea* and *M. strasseri* show erect-patent branches, just from the beginning of their development, and the main stem grows indefinitely. On the other, *M. citrina* shows branches growing almost horizontally, since the main stem stops growth quite early and withers, as remarked by Robledo & al. (1993a). This latter pattern could be interpreted as an adaptation to the particular life strategy conditioned by hard marine winds blowing in the habitats *M. citrina* colonises.

*Leaf morphology* — Petiole length varies from c. 10-37 mm in *M. citrina*, almost 1,5-2 times longer than in the rest. In all taxa, leaves are mainly 3-foliolate, though 4- and 5-foliolate ones have been found rather frequently in plants of *M. citrina* from La Foradada island grown at Murcia (Robledo & al. 1993a). However, this character was never seen in the wild. Leaflets are greater (in both length and width) in *M. citrina* (13,0-31,0 × 8,0-18,8 mm), whereas they are the smallest in *M. arborea* (11,3-21,0 × 8,0-11,0 mm). Leaflet morphology is quite similar (obovate-cuneate) in all taxa, although *M. strasseri* shows obovate-spathulate leaflets (twice longer than wide). The apex is quite similar, excepting *M. citrina* which presents emarginate leaflets (Table 1).

*Leaf anatomy* — Relevant anatomical differences between *M. citrina* and its relatives have been observed (Chebbi & al. 1994). *Medicago citrina* shows a large layer of waxes covering the cuticular surface, which give its typical leaf glaucescence. However, the lower surface of leaflets of this species presents a higher number (8-10%) of trichomes. Moreover, parenchyma cells of leaflets are larger again in *M. citrina*, which makes the leaf section thicker.

*Corolla colour* — This feature is quite relevant to distinguish easily the two groups of *Medicago*, which is also correlated to a different Mediterranean distribution. Both taxa from the eastern Mediterranean (*M. arborea* and *M. strasseri*) show orange-yellow corollas, whereas the unique taxa in the western Mediterranean (*M. citrina*) shows distinctive lemon-yellow corollas (Table 1).

*Pods* — Taxa of sect. *Dendrotelis* are characterised by the fruit morphology (Greuter &

Table 1. Some morphological and karyological characters of *Medicago* sect. *Dendrotelis* based on the studied material (all measurements in mm)

|                                   | <i>M. citrina</i>              | <i>M. arborea</i>               | <i>M. strasseri</i>                |
|-----------------------------------|--------------------------------|---------------------------------|------------------------------------|
| Standard length                   | 11,3-14,0                      | 9,7-11,5                        | 9,7-12,0                           |
| Corolla colour                    | Yellow-lemon                   | Orange                          | Orange                             |
| Petiole length                    | 10-37                          | 10-20                           | 10-18                              |
| Leaflet shape                     | Obovate-cuneate and emarginate | Obovate-cuneate, not emarginate | Obovate-spathulate, not emarginate |
| Fruit diameter                    | 11-20                          | 11-17                           | 6-9                                |
| Fruit surface                     | Weakly veined                  | Almost smooth                   | Strongly veined                    |
| Central opening diameter          | 0,5-1,0                        | 1,7-2,0                         | 0,3-0,5                            |
| Number of coils                   | 1-2                            | 1                               | 2-3                                |
| Stipe length with regard to calyx | Twice longer                   | Shorter or equalling            | Slightly longer                    |
| Ventral/dorsal pod suture         | Usually similar                | Usually thicker                 | Thicker                            |
| Number of ovules per pod          | 4-8                            | 10-14                           | 10-13                              |
| Seed size                         | 4,2-5,9                        | 3,5-4,5                         | 2,0-2,5                            |
| Chromosome number                 | 2n = 48                        | 2n = 32                         | 2n = 32                            |

al. 1982; Robledo & al. 1993b). Pods are quite different in size. *Medicago strasseri* shows the smallest fruits (5,8-9,8 mm) whilst *M. citrina* has the largest ones (c. 11-20 mm). The fruit stipe is clearly visible in *M. citrina*, being up to twice longer than the calyx, whereas in *M. arborea* is equalling or shorter than the calyx. The central orifice varies from about 0,5-1 mm in diameter (*M. citrina*) to up to 2 mm (*M. arborea*). However, the number of the coils varies among the species, from one (*M. arborea*) to 2-3 (*M. strasseri*). The pod surface offers interesting differences on venation: *M. strasseri* shows strongly veined pods with a characteristic ornamentation, *M. arborea* usually bears pods almost smooth, and *M. citrina* shows an intermediate ornamentation between both cited types. The number of ovules per pod is also a relevant character: *M. citrina* produces only 4-8 ovules whilst *M. arborea* and *M. strasseri* produce 10-14 in all cases. All these features altogether are relevant in the taxonomy of the section (Table 1).

*Seeds* — Seeds of taxa of sect. *Dendrotelis* are kidney-shaped, and their size could be used with taxonomic value (Table 1). *Medicago citrina* produces the largest seeds (4,2-5,9 mm), whilst *M. strasseri* has the smallest ones (2,0-2,5 mm).

*Ploidy levels* — The basic chromosome number of sect. *Dendrotelis* is  $x=8$  (Fernandes & Santos 1971). Counts made on materials of *M. arborea* from Portugal yielded a

tetraploid number  $2n = 32$  (Fernandes & Santos 1971). Greuter & al. (1982) reported that S'Espartar populations (Balearic Islands) of *M. citrina* conforms the hexaploid level ( $2n = 48$ ) of the aggregate, a number that has been confirmed for materials from the Columbretes populations (Boscaiu & al. 1997). However, no references were found about the chromosome number of *M. strasseri*. In our recent studies, we found this species to be tetraploid ( $2n = 32$ ), and not diploid as it had been thought up to date. Thus, *M. strasseri* should not be regarded as the closest putative ancestor of the whole section, as suggested by other authors (Greuter & al. 1986; Robledo & al. 1993a). After this new data, two ploidy geographical groups are found in the section: the tetraploid taxa, *M. strasseri* and *M. arborea*, native to the eastern Mediterranean, and the hexaploid, *M. citrina*, from the western Mediterranean.

*Molecular data* — By using RAPDs (random amplified polymorphic DNA), Chebbi & al. (1995) found that *M. arborea* had the highest intraspecific variation (mean frequency of polymorphism = 21,7%), whereas the endemic *M. citrina* showed the lowest (mean frequency of polymorphism = 9,4%). They also concluded that the eastern taxa (*M. arborea* and *M. strasseri*) were genetically much closer each other than they are to the western *M. citrina*. However, their studies were based on samples from a single seed accession for *M. citrina* and *M. strasseri*, which could justify the narrow variation observed for both taxa. Recent molecular studies (Juan & al. in press) based on AFLP™ (amplified fragment length polymorphism) and including samples from all known populations of *M. citrina*, have demonstrated that this taxon exhibits a much higher genetic variability than reported before, and microspeciation processes are currently active in each single population of the species. Other studies on sequences of chloroplast DNA (*trnL-trnF* region) and ribosome DNA (internal transcribed spacers, ITS) we are carrying out confirm the closer genetic relationship between *M. arborea* and *M. strasseri*, as reported by Chebbi & al. (1995). This points out to a longer shared evolutionary history.

*Ecological adaptations* — Experimental studies carried out on the three taxa of the section (Correal, pers. comm.; Robledo & al. 1993a; Chebbi & al. 1994) demonstrated that *M. citrina* endured better drought and freeze. This plant is a real xerophyte, since up to 85% of leaves remain on branches in the summer. Contrarily, *M. arborea* and *M. strasseri* can be regarded as a semideciduous plants, since most of their leaves fall off within the dry period. Other remarkable characteristics pointing out to the adaptation of *M. citrina* to stressing conditions are that this plant presents a highly developed root system and produces the highest amount of hard seeds like most of the typical Mediterranean wild plants (Chebbi & al. 1994).

#### Taxonomic remarks

- Medicago* sect. *Dendrotelis* (Vassilcz.) Lassen ex Greuter, Matthäs & Risse in Willdenowia 12: 202 (1982).
- ≡ *Trigonella* sect. *Dendrotelis* Vassilcz. in Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk SSSR 14: 229 (1951).
- *Medicago* sect. *Arboreae* K. Lesins & I. Lesins, Gen. Medic.: 131 (1979), *nom. inval.*

As said before, taxa of *Medicago* with a shrubby habit or being woody only at the base

(e.g. *M. arborea*, *M. falcata*, *M. sativa*, *M. suffruticosa*, *M. marina*) were first grouped in a section called *Falcago* (Willkomm 1877; Casellas 1962). Later, Lesins & Lesins (1971), in a comprehensive study on the genus, rearranged sect. *Falcago* from which they excluded *M. marina*, *M. suffruticosa* and *M. arborea*. Moreover, these latter authors proposed the new section *Arboreae* to segregate *M. arborea* (incl. *M. arborea* var. *citrina*), which included shrubs up to 4 m, showing pods with 0,5-1,5 coils and a large central orifice, flowers with a yellow corolla, wings shorter than the keel and the standard shorter or equalling the keel. However, this new section proves to be an invalid name (Art. 36.1, ICBN), since lacking a Latin description. More recently, Greuter & al. (1982) validated a new combination attributed to Lassen on the basis of *Trigonella* sect. *Dendrotelis* previously described by Vassilczenko (1951). They included there three taxa with Mediterranean distributions: *M. arborea*, *M. arborea* var. *citrina* and *M. strasseri*. Later, Greuter & Raus (1986) raised var. *citrina* to species rank, with which the section definitely included three species corresponding to different levels of ploidy in the same chromosome series. However, Small & Jomphe (1989) treated *M. citrina* as a mere variety of *M. arborea*, and added some other diagnostic characters for the section (e.g. embryos with the radicle about half as long as seed, cotyledons epulvinate, and seeds smooth). The most important differences among them are summarised in Table 1.

***Medicago arborea* L., Sp. Pl.: 778 (1753).**

*Lectotypus*: Designated by Heyns (1959: 161). Herb. Clifford: 377, *Medicago* 6 (BM).

#### *Typification*

*Medicago arborea* was described by Linnaeus (1753) in *Species Plantarum* with the following protologue: "*MEDICAGO leguminibus lunatis margine integerrimis, caule arboreo*", and adding a note about the locality as follows: "*Habitat in Rhodo, Neapoli*". This diagnosis was based on several earlier works: Hort. Cliff., Hort. Ups., and Roy Lugdb, where this taxon had been already cited.

Typification by Heyn (1959) was based on materials from BM. As she indicated, there was a slight modification in the diagnosis phrase which appears in Hortus Cliffortianus and in *Species Plantarum*. This change affected the characteristics of the stem. In fact, in the former Linnaeus wrote "caule frutescente", whereas in the latter he rewrote "caule arboreo". Perhaps, as Heyn (*loc. cit.*) mentioned, this correction was due to a direct observation of the plants in the field and not on dried herbarium materials in which the collected material usually corresponds to young parts. Therefore, the sheet Hort. Cliff. 377-6 is to be regarded as the lectotype (not holotype as indicated by Heyn), since it is accompanied with the same phrase as in Hortus Cliffortianus.

#### *Description*

Perennial shrub (0,5-)1-3 m. Stem with erect branches, young twigs whitish-pubescent. Leaves 3-foliolate; leaflets generally obovate-cuneate, entire or slightly denticulate, sometimes retuse. Petiole length 10,0-20,0 mm. Stipules 3,8-7,5 mm long, entire, lanceolate. Inflorescence with 8-15 flowers arranged on dense racemes. Calyx 2,7-3,7 mm long. Corolla 9,7-11,5 mm long, orange-yellow. Fruit 11-17 mm in diameter, with one coil and a central opening 1,7-2,0 mm, stipe usually shorter than the calyx (seldom equalling

calyx). Pod faces reticulate-veined, glabrous to glabrescent, without spines. Ventral suture of the pod usually thicker than the dorsal one. Fruit pedicels 2-5 mm. Ovules 10-14 per pod. Seeds 3,5-4,5 mm, kidney-shaped. Flowering from December to April.

Chromosome number:  $2n = 32$  (tetraploid).

#### *Distribution and ecology*

*M. arborea* grows on littoral areas, in Mediterranean climatic conditions with no freeze risk. This taxon is native to the eastern Mediterranean area (Fig. 1). Its wild populations are located mainly in coastal places in Greece, Crete and the Aegean Greek islands, as well as in some places of Albania, Turkey and Italy (Greuter & al. 1989). Moreover, it has been reported in other Mediterranean countries (Map 1) such as Sicily (Pignatti 1982), France (Coste 1906), Spain (Bolòs & Vigo 1984; Sales & Hedge 2000), Israel (Post 1896), Jordan (Baierle & al. 1989), Portugal (Coutinho 1939) Algeria and Tunisia (Villax 1963), in which it appears to be naturalised or cultivated due to its ornamental or forage value.

#### *Studied materials*

Spain. Alicante: Camino Vistahermosa a la Albufereta, YH2250, 20 m, 20 Apr 1997, M.B. Crespo (ABH 35022). Callosa de Segura, S<sup>a</sup> de Callosa, Bco. de Enmedio, XH8421, 300 m, 7 Jun 1997, Herrero-Borgoñón, L. Serra & A. Olivares (ABH 35796). Barcelona: Massif du Tibidabo, Vedado du Marquis de Sentmenat, May 1911, F. Sennen (MA 62206). Idem, (MA 62205-2). Idem, (MA 62206-2). Montjuich, 26 Apr 1963, A. Segura Zubizarreta (MA 361283). Tibidabo, Vedado del Marqués de Sentmenat, Reyes? (MA 62204). Castellón: Vall d'Uxò, YK31, introducido, 125 m, 16 Apr 1995, J. Sanchis Pla (ABH 14299).

France: Alpes maritimes, Villefranche-sur-Mer, vallar de Libac sons la chapelle St Michel, 250 m, 11 May 1977, A. Charpin n° 13735 (MA 361364).

Greece: Sparta, Jul 1981, Fernando Giner & A. Segura Zubizarreta (MA 361278). Attika, slopes of Mt. Lykabettos near Athens, 30 Mar 1864, Ph. Ch. L. Lentwein- de Fellenberg (MA 262924). Partenón, Jul 1977, M<sup>a</sup> Segura Fragoso (MA 361255). Athica, MA Lycubettus, 1932, Ment (BC 75271). In rupibus Lycabetti prope Athenas, Flor Graec. tab. 767, 8 Apr 1866 (BC 15103). Isla de Santorini, Thira, 16 Nov 1997, A. Juan & C. Pérez (ABH 37757). Atenas, Plaka Agora griega, 22 Nov 1997, A. Juan & C. Pérez (ABH 37758).

Italy: Portici, Napoli, in muris vetustis prope mare, 15 Jul 1912, G. Pellanda (MA 62210-2). Idem, (MA 212407). Cagliari ad sepres prope domum Medusae, 9 Apr 1894, V. Martelli, (MA 62209). Monte-Carlo, Pte de Monaco, naturalizé, talus, haies, bords voie ferre, 30 Mar 1963, G. Gauelle (MA 178613).

#### *Cultivated specimens*

Spain: Murcia. La Alberca, CIDA, XH6401, 60 m, 30 Mar 1999, A. Juan (ABH 43333).

***Medicago citrina*** (Font Quer) Greuter in Willdenowia 16: 112 (1986).

≡ *Medicago arborea* L., Sp. Pl.: 778 (1753) var. *citrina* Font Quer in Mem. Mus. Ci. Nat. Barcelona, Sér. Bot., 1(2): 7 (1924)

≡ *Medicago arborea* L., Sp. Pl.: 778 (1753) subsp. *citrina* (Font Quer) O. Bolòs & Vigo

in Butll. Inst. Cat. Hist. Nat., Sec. Bot. 38(1): 69 (1974)

*Lectotypus* (here designated): "Espartar" dicta, pr. Ebuso, ubi Gros, d 23 May 1918.", (BC 15100). The fragment in the central part of the sheet (Fig. 2).

#### Typification

*Medicago arborea* var. *citrina* was described by Font Quer (1924) with the following protologue: «*A typo petalis citrinis, leguminibus latissimis, usque 17 mm diam., fortiter elevato-nervosis, differt. Hab. in rupestribus calcareis parva insula "Espartar" dicta, pr. Ebuso, ubi Gros, d. 23-V-1918, legit*».

At BC (Institut Botànic de Barcelona), there are two sheets including relevant materials for lectotypification. On the one hand, BC 113961 includes materials collected by Gros at Espartar Island, near Ibiza (Balearic Islands). Nevertheless, the collection date was not indicated, and Font Quer wrote: "8-V-19??". On the other, sheet numbered BC 15100 bears the following notes in Font Quer's handwriting: "Hab. [press] Pythiuses, Illa de l'Espartar / Legit [press] Gros, 23 maig 1918 / Com. [press] Font Quer". This latter sheet fits fully the protologue and is here selected to include the lectotype.

Materials in BC 15100 consist of three fragments of *Medicago citrina*. Only the one on the central part of the sheet bears both flowers and ripen fruits, and therefore is here designated as the lectotype.

#### Description

Perennial shrub up to 2-3 m. Stem with erect-patent branches, young twigs whitish-pubescent. Leaves 14-31 × 14-20 mm, mostly 3-foliolate; leaflets obovate-cuneate, generally densely pubescent, entire or denticulate, mostly emarginate. Petiole length 10,0-37,5 mm. Stipules 3,5-9,8 mm long, entire and lanceolate. Inflorescence with 8-17 flowers, arranged on pedunculate dense racemes. Peduncle of flowering inflorescence 7-17 mm. Calyx 3,0-4,7 mm long. Corolla 11,3-14,0 mm long, yellow-lemon. Fruit 10,9-19,1 mm in diameter, pubescent, with 1-2 coils and a central orifice 0,5-1,0 mm, stipe up to twice longer than the calyx and always manifest. Ventral suture of the pod usually similar or slightly thicker than the dorsal one. Ovules 4-8 per pod. Seeds 4,2-5,9 mm, kidney-shaped. Flowering from January to May.

Chromosome number:  $2n = 48$  (hexaploid).

Note: Robledo & al. (1993a,b) found sometimes 4- and 5-foliolate leaves on young branches of the specimens cultivated at the CIDA (Murcia province). However, this feature has not been observed in the wild populations of Columbretes, Balearic archipelago and Alicante, where all individuals have 3-foliolate leaves.

#### Distribution and ecology

*Medicago citrina* is endemic to western Mediterranean small islands from the Columbretes and Balearic archipelagos, and northeastern Alicante province (Fig. 1). In Columbretes, *M. citrina* grows mostly in the northern rocky slopes of the Foradada and Ferrera islands. In the Balearics, it is found on small islets close to Cabrera (S'Estells and Ses Bledes) and Ibiza (Ses Malvins, Ses Bledes and S'Espartar). In Alicante, it is only



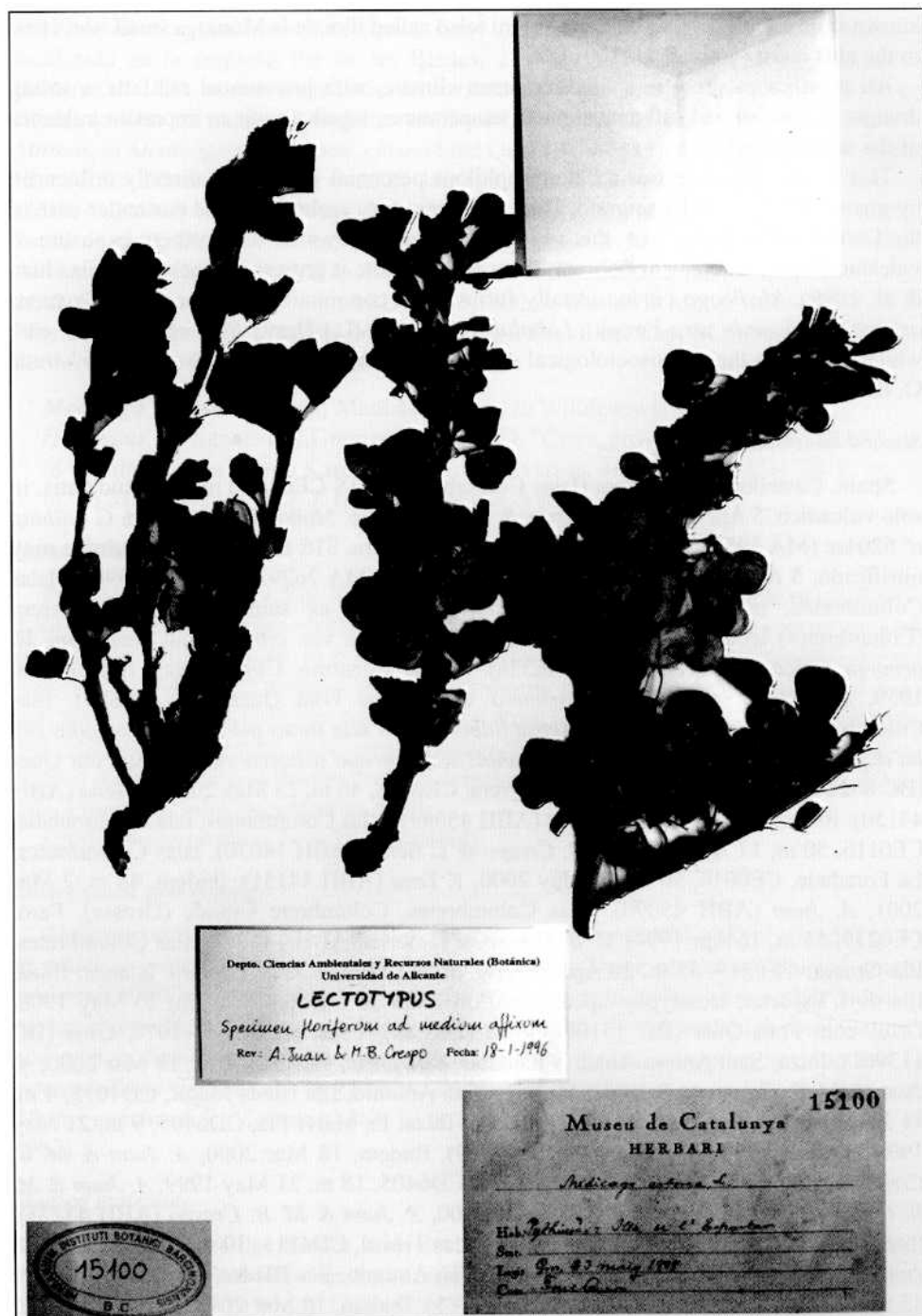


Fig. 2. Lectotype (here designated) of *Medicago citrina* (Font Quer) Greuter (BC 15100): the specimen in the central part of the sheet.

known from Escull del Cap de Sant Antoni (also called illot de la Mona), a small islet close to the cliff coast (Serra & al. 2001).

All populations grow in a Mediterranean climate, with low annual rainfalls, a strong drought in summer and soft annual mean temperatures, together with an important influence of the marine wind.

This species characterises a halonitrophilous perennial vegetation, directly influenced by guano deposits left by migratory and non-migratory seabirds. In the particular case of the Columbretes archipelago, this vegetation usually grows on the northern exposure of volcanic slopes, whereas in Cabrera, Ibiza and Alicante it grows on limestone soils (Juan & al. 1999). *Medicago citrina* usually forms plant communities together with *Lavatera arborea* L., *Suaeda vera* Forssk., *Lobularia maritima* (L.) Desv., *Beta maritima* L., etc., which belong to the phytosociological alliance *Medicagini citrinae-Lavaterion arboreae* O. Bolòs & Vigo 1984.

#### *Studied materials*

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1949, *ut Medicago arborea* var. *citrina* Font Quer (BC 109310). Cabrera, abundante y localizada en la pequeña Illa de les Bledes, 21 May 1949, *Palau Ferrer* (Plantas de Balears nº 123), *ut Medicago arborea* var. *citrina* Font Quer (BC 112309). Illa de les Bledes (a l'est de Cabrera), *escletxes profundes de les roques superiors*, 8 Jun 1933, *A. Marcos*, *ut Medicago arborea* var. *citrina* Font Quer (BC 87433). Archipiélago de Cabrera, Illot de Ses Bledes, DD9634, 6 m, 29 Jan 1999, *M. B. Crespo, A. Juan & E. Camuñas* (ABH 41045). Ibidem, 23 May 1999, *A. Juan & M.B. Crespo* (ABH 41802). Cabrera, Estell de Coll, DD9430, 35 m, 23 May 1999, *A. Juan & M. B. Crespo* (ABH 41800). Alicante: Xàbia, L'Escull del Cap, BC5698, 10 m, 15 Jun 2000, *A. Ros, A. Barber, J. Piera, M. B. Crespo & J. C. Cristóbal* (ABH 44037). Xàbia, Illot de la Mona, BC5698, 15 m, 31 May 2000, *L. Serra & al.* (ABH 44773). Xàbia, L'Escull del Cap, BC5698, 10 m, 12 Mar 2001, *A. Juan & M. B. Crespo* (ABH 45088).

***Medicago strasseri*** Greuter, Matthäs & Risse in *Willdenowia* 16: 112 (1982).

*Holotypus*: Designated by Greuter & al. (1982). "Creta, provincia et eparchia Rethimni: in faucibus Petres a pago Karoti septemtriones versus, 35°20'30"N/24°31'30"E, alt. 30 m, 26 May 1982, *W. & J. J. Greuter, Matthäs & Risse 19362* (B)".

#### Description

Perennial shrub up to 1,5 m. Stem greyish, with erect and sericeous young twigs. Leaves 3-foliolate; leaflets cuneate-spathulate and subobtusate at the apex, with the central one long pedunculate. Petiole length 10,0-18,5 mm. Stipules 3,0-6,5 mm long, triangular-subulate. Inflorescence with 6-12 flowers, arranged on shortly pedunculate racemes. Calyx 3,3-4,7 mm long. Corolla 9,7-12,0 mm, orange-yellow. Fruit 6,0-9,0 mm, with 2-3 coils and a central orifice up to 0,5 mm; stipe usually longer than the calyx (seldom equalling calyx). Ventral suture of the pod thicker than the dorsal one. Ovules 10-13 per pod. Seeds 2,0-2,5 mm. Flowering from December to April.

Chromosome number:  $2n = 32$  (tetraploid).

#### Distribution and ecology

*Medicago strasseri* is endemic to the crevices of limestone cliffs of Kriti island (Fig. 1), in which it grows in places inaccessible to livestock. These places are isolated among schistose, non-karstic substrates, and they are well-known to include many other endemics or rare plants. The climatic conditions are Mediterranean, though with high precipitation's and relative humidity. The dominant vegetation on schistose substrates is composed by sclerophyllous species such as *Quercus ilex* L. and *Rhamnus alaternus* L. together with *Myrtus communis* L., *Laurus nobilis* L. or *Hedera helix* L., among others (Greuter & al. 1982).

#### Studied materials

Crete: Nordflanke des Berges südl. des Dorfes Menetes, 35°28'40"N / 27°10'30"E, Felsbänder und Spalten in steilen kalksteinwänden ca 200 m, westl. des Ortes oberhalb der Straße, 350 m ü. NN, 17 May 1983, *Th. Raus*, (MA 540675). Ep. Pedhias: Felswände am Fuß des Berges Pirjia S von Piskopiano. 35°18'N/25°23'E. Kalkfels. klippen, ca. 350 m, 6 Sep 1984, *H. Risse* ?? (B). Ep. Pedhias: Dhikti Oros, Schlucht von Xeniakos W des Berges

Majerefta, 35°06'30"N/25°24'30"E, Felswände und Schluchtgrund, 550-600 m, 29 Sep 1984, H. Risse ?? (B). Samenherkunft: Griechenland: Kreta, Ep. Pedhias, Schlucht S von Avdhou, Kalkfelswand, 28 Oct 1984, Z. Kipriotakis (B).

#### *Cultivated specimens*

Spain: Murcia. La Alberca, CIDA, XH6401, 60 m, 16 Mar 1998, A. Juan, S. Ríos & M.B. Crespo (ABH 40627).

Germany: Kultiviert im Botanischen Garten Berlin-Dahlem. Revier: Anzucht, E+W. Acc-Nr: 005-07-85-10. Blritenfarbe: gelborange, 31 Aug 1988, *Schwerdtfeger* 24088 (B).

#### Conclusions

After the morphological, ecological, cytological and molecular data, *Medicago citrina* should be regarded at the species rank, rather than subspecies or variety. It constitutes the hexaploid level of an ancestral series of *Medicago*, which probably evolved in the western Mediterranean from a common ancestor with the tetraploid complex *M. arborea*-*M. strasseri*, perhaps extinguished today.

*Medicago citrina* is currently protected by the Spanish law. About 3500 adult plants were counted in the ten known wild populations of the species, in which a rather remarkable morphological (Juan & al., 1999) and genetic variation (Juan & al., in press) were detected. The analysis of the infraspecific genetic variation in its whole distribution range we are currently studying, will offer more consistent arguments to develop a suitable management of the known populations. By now, plant microreserves (cf. Laguna, 1996) have already been established in Escull del Cap (Alicante) and the Columbretes Archipelago by the Local Valencian Government (Generalitat Valenciana) to ensure the conservation of this peculiar west Mediterranean endemic.

#### *Key to taxa of Medicago sect. Dendrotelis*

1. Petals lemon-yellow. Leaflets broadly obovate-cuneate, emarginate at the apex. Stipe twice longer than calyx. Ovules 4-8 per pod. Seeds up to 4,2-5,9 mm long .....*M. citrina*
1. Petals orange-yellow. Leaflets narrowly obovate-cuneate to cuneate-spathulate, not emarginate at the apex. Stipe equalling or slightly longer than calyx. Ovules 10-14 per pod. Seeds 2,0-4,5 mm long .....2
2. Pods 11-17 mm in diameter, with 1 coil, and the central orifice 1,7-2,0 mm. Stipe usually shorter than calyx. Seeds 3,5-4,5 mm long .....*M. arborea*
2. Pods 6-9 mm in diameter, with 2-3 coils, and the central orifice up to 0,5 mm. Stipe usually slightly longer than calyx. Seeds 2,0-2,5 mm long ..... *M. strasseri*.

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