

The enigmatic *Salvia tingitana* (Lamiaceae): a case study in history, taxonomy and cytology

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Abstract

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Salvia tingitana has been in cultivation since at least the end of the seventeenth century, but its provenance has for long been uncertain and its taxonomic interpretation confused. With new evidence that has come to light, a more complete botanical and horticultural history of the plant is presented. It covers a period of almost 400 years. Uncertainties, however, still remain about its original introduction; today the only certain known wild locality is in Saudi Arabia. A chronological history of its treatment and misinterpretations by various authors over the centuries is given. Based on current knowledge, there is an up-dated description and discussion of its affinities. An investigation into its cytology gave a chromosome number of $2n = 42$, very unusual in the genus, the significance of which is discussed. Examination of the mucilage produced by nutlets on wetting was also revealing per se and showed differences from mucilage produced by its putative allies.

Additional key words: *Labiatae*, European botanic gardens, pre-Linnaean botany, karyology, mucilage.

Introduction

The name *Salvia tingitana* was formed and validated by Andreas Ernest Etlinger in 1777, although the plant to which it refers had been known for at least eighty years before then and possibly as far back as the early 1600s. In those days, it was cultivated in gardens but its origin was unknown or uncertain and, until very recently, no gatherings from the wild appear to have been made or are extant. Today, it is not uncommonly grown as an ornamental in different parts of the world. Uncertainties about its horticultural history combined with the discovery of a new contender for typifying the name prompted a re-investigation of its history going back to pre-Linnaean names, early literature and illustrations. Although the epithet implies a N African origin, there is now evidence that it came originally from the Arabian region and was cultivated for its aromatic properties in the early physic gardens of Europe such as those of Padua, Turin and later,

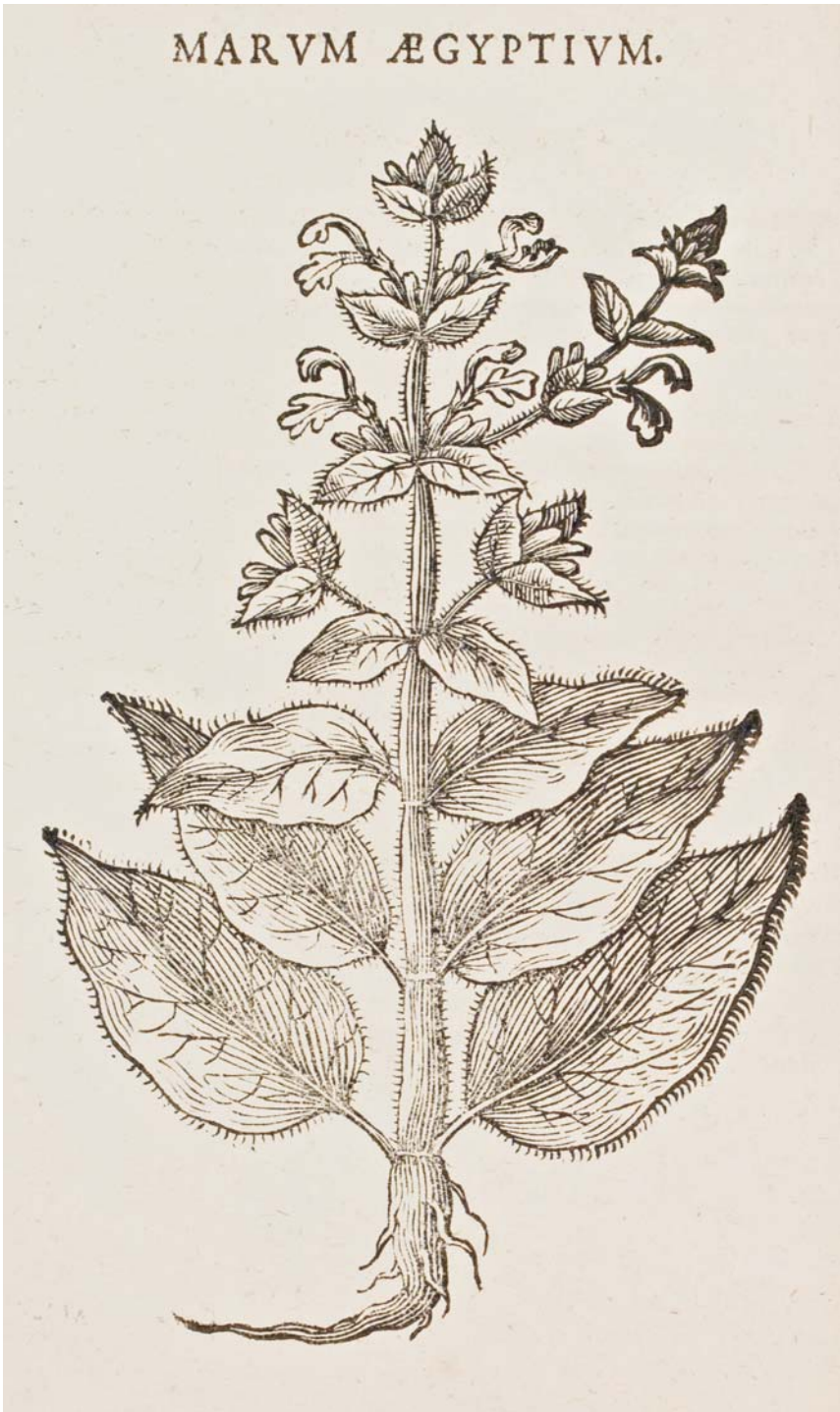


Fig. 1. From Alpino (1640), the earliest illustration traced which may be attributable to *Salvia tingitana*.

Paris. Over its long botanical history, it has been confused with several other species with various authors interpreting it differently. This case study, in interpreting pre- and post-Linnaean names, has emphasised the paramount importance of herbarium specimens in the correct application of names, the confusion that can arise from their misinterpretation, the difficulties in identifying early illustrations and in relating early discursive Latin descriptions to later names.

In the following account herbarium acronyms follow Holmgren & Holmgren (1998-); herbaria consulted: E, K, MPU, P, RIY.

A chronological taxonomic history of *Salvia tingitana*

From the 17th century to the present day, *Salvia tingitana* is represented by scattered references in botanical and horticultural literature together with only a few reliable herbarium specimens. To appreciate the complex and contorted historical background to this plant, it is useful to follow the sequence of its treatment by various authors over the past three centuries or more.

Alpino described and illustrated (Fig. 1) in his posthumously published *De Plantis Exoticis Libri Duo* (1627: 253, 1640: 71) a plant at the Padua Botanical Garden to which he gave the name “*Marum aegyptium*”. It was a “plant coming from dry places in Egypt” [nascitur in Aegypti locis siccis & squalidis] with “flores albi, sclareae seu herbas Sancti Ioannis floribus quam simili”. There is also mention of its pharmaceutical properties, Alpino being particularly interested in the medicinal properties of plants. The reference to St John is of special interest in that “erba San Giovanni” is one of the Italian common names for *Salvia sclarea* L., a species often confused with *S. tingitana*. The reason for considering Alpino’s plant to be the same as *S. tingitana*, stems from Lamarck (1805: 600) who listed the name [as “an marum aegypticum?”] among the synonyms of his *S. foetida* (= *S. tingitana*).

In 1690 Rivinus published an illustration titled “*Horminum tingitanum*” (Rivinus 1690: t. 62, see Fig. 2) but in the text of his *Ordo Plantarum* the name is absent. This is the earliest traced reference to a *Salvia* with the epithet *tingitana*.

Morison’s species with the polynomial “*Horminum salvia folio lanuginoso*” (Morison 1699: 392, t. 16, fig. 3) refers back to Alpino’s plant and gives Aleppo as its origin [“ex Aleppo quoque delatum est”]; the woodcut is very similar to that of Alpino. In the absence of any complementary specimens, it is impossible to accurately identify the plants that Alpino and Morison described and illustrated, but from the available evidence it is likely that Alpino’s and Morison’s names refer to the same taxon and the possibility that this is *S. foetida/tingitana* cannot be excluded.

In 1700, Tournefort described what we believe to be *Salvia tingitana* as “*Sclarea tingitana foetidissima hirsuta, flore albo*” (Tournefort 1700: 179) but gave no further information or comment other than “habitat in Africa”. A specimen (Fig. 3), the earliest known, is in the Tournefort herbarium (at P, specimen no. 1081, microfiche no. 53) and bears the annotation “*Sclarea tingitana foetidiss. Flore dilute coeruleo variegato. La fleur est d’ un bleu fort pale - toute la plante fut fort*”. It appears to be good *S. tingitana* despite the comment about flower colour (not normally blue) but no information about its provenance or collection date is given. Tournefort was in Madrid, Seville and Cadiz during the period September–November 1688. He was deputy of Guy-Crescent Fagon at the Jardin du Roi in Paris and his travels in Iberia were, in part, to enrich their collections with plants from Spain and Portugal. It is likely from the epithet *tingitana* (i.e. Tanger) that he believed the plant was from N Africa.

Arduino (1759: x, t. 1), like Prospero Alpino and his son Alpino prefect of the Padua Botanic Garden, described a species cultivated in this garden and considered to be new. He gave it the polynomial “*Salvia caule fruticoso, foliis ovato-sinuatis, crenatis, rugosis, hirsutis*”. From the evidence of his discussion and his description complemented by an illustration, we believe that this is the first full description of the plant the name of which was validated 18 years later by Etlinger. Possible corroboration of this deduction is the presence of a specimen in the Linnaean herbarium (no. 42.27 at LINN), on which is written (possibly by Linnaeus with whom he corresponded) “Ard” (i.e. Arduino). We believe this plant to be of *Salvia tingitana* despite it being la-



Fig. 2. The exclusive plate of “Horminum tingitanum” (Rivinus 1690: t. 62) in a copy held at the Universitätsbibliothek Erlangen-Nürnberg; to this plate Etlinger (1777) referred in the original description of *Salvia tingitana*.



Fig. 3. Tournefort's specimen (at P), the designated lectotype of *Salvia tingitana*.

belled as *S. disermas*. Some years later, Allioni (1774: 55) referred to the same plant growing at the Turin botanical garden, giving as a footnote “Haec est *Salvia villosa* & *viscosa* foliis lanceolato-ovatis versus petiolatum angulatis” and that it had been noted by Arduino in 1759 although at that time Allioni was not aware of Arduino’s publication.

The initial valid description of *Salvia tingitana* was made by Etlinger (1777) in his *Commentatio Botanico-Medica de Salvia*. He gave a brief description of *S. tingitana* and cited two pre-Linnaean elements: Tournefort (1700) and Rivinus’ illustration (Rivinus 1690: t. 62). Etlinger referred to the latter as “bon. sed male spinas calycis neglexit sculptor”, thus considering it to be a good likeness except for the calyx spines not agreeing with his own description “spinosis sulcatis”. Its habitat was given as “in Africa”. He also commented “folia *S. disermas*, sed latiora, acuta” and “verticilli, bracteae et calyces *S. spinosae*, sed hi breviores ad limbum usque profundius sulcati, brevius mucronati”. Although Etlinger made no reference here to the earlier publications of Arduino or to Allioni, he listed them as “synonyms” of *S. disermas* on the following page.

In the same publication, Etlinger also described *Salvia sclarea* L., which clearly indicated that he regarded it as distinct from *S. tingitana*. There has been considerable later confusion between the two species, which is discussed subsequently.

There is a complication regarding Etlinger’s citation of the Rivinus plate, copies of that publication being very scarce nowadays and mostly held in major libraries. Our examination of those held at various institutions failed to reveal “*Horminum tingitanum*” at plate 62 or elsewhere, and it soon became apparent that plate pagination varied from publication to publication. This presumably resulted from the pages having been left unbound subsequent to publication and then numbered by hand later (or even left unnumbered). Checks at Erlangen revealed the same situation as at the other institutions regarding their two main library copies. However, a third dormant copy held in storage did have the correctly numbered relevant plate (Fig. 2). This may be the very copy from which Etlinger worked and the pages of which he probably numbered himself. It can be argued on technical grounds that this Rivinus’ plate is a stronger candidate for consideration as the lectotype of *Salvia tingitana* than is Tournefort’s herbarium specimen (P) despite there being no doubt about the correct identity of the specimen but some doubt about the identity of the Rivinus plate. Unfortunately Rivinus’ herbarium no longer exists so that there is no specimen available to support his illustration. However, the assessment of the identity of any 17th century copper engraving especially in a genus with over 100 species in the Mediterranean region is, at best, fraught with uncertainty.

We are therefore uncertain what Rivinus’ plate represents and the fact that, other than the epithet, there is no description at all or an indication of its provenance makes its identity even more uncertain. It would seem to fall in the category of “... is demonstrably ambiguous and cannot be critically identified for purposes of the precise application of the name of the taxon” (Code, Art. 9.7, McNeill & al. 2006). From its facies, the plate could represent *Salvia tingitana* but it could also be another species with a straight corolla tube such as *S. palaestina* Benth. or *S. spinosa* L.; the leaves are very similar to *S. virgata* Jacq. If the drawing of the straight corolla tube is correct, it is not *S. sclarea*. Shortly after Etlinger’s publication, Murray (1778: 335) also made reference to *S. tingitana* and gave a description and synonyms. Roth (1787: 25), an exact contemporary of Etlinger at Erlangen, may also have been describing the same plant, although his description does not agree well with true *S. tingitana*, as neither does that of Murray.

Lamarck (1791: 69), presumably unaware of Etlinger’s *Salvia tingitana*, published his new species *S. foetida*: “ex Oriente. Planta pilosa, odore gravi, fl. albi labio inferiore luteolo” and indicated it to be a shrub. His description, in French, includes “lieu nat. le Levant; odeur forte; elle a des rapport avec la sclarée”. Why the Levant (i.e. E Mediterranean) was given as its native home is unknown. The corresponding herbarium specimen (P-LA) agrees well with *S. tingitana*. In the Thunberg herbarium in Uppsala (UPS), there are two specimens under this name (no. 574 & 575), but they are of such poor quality that we are not sure what they represent. Not long afterwards, *S. foetida* was correctly recognised, e.g., by Willdenow (1809: 42) as a synonym of *S. tingitana*.

From around the turn of the eighteenth century, *Salvia tingitana* became referred to more frequently. Willdenow (1797: 147) had seen the living plant (as “v.v.”), presumably at the Berlin Botanic Garden, and considered that it was very similar to *S. spinosa* but had a woody stem, cordate, erose-dentate, rugose leaves, ciliate bracts, and that the plant was very foetid and came from “Africa”. Sadly, there is no complementary specimen in his herbarium (B-W). Desfontaines (1798: 24), in his *Flora Atlantica* cited *S. foetida* Lam.: “tota planta odorem gravissimum spirat. Habitat in agro Tunetano” and gave the symbol for a shrub. There is a good specimen in Desfontaines’ herbarium in P-Desf. and it is probably correct to assume that the specimen had been cultivated in Paris at the Jardin du Roi, then already, due to the French Revolution renaming, the Jardin des Plantes.

Lamarck (1805: 600) again listed “*Salvia fetida* [sic] Lam.” (i.e. *S. tingitana*) with full synonymy, description and notes: “Cette espèce a des rapports avec le *Salvia sclarea* par la grandeur, la forme de les feuilles, la largeur de ses bractées, & dans tout son ensemble. Cette plante crôit naturellement dans le Levant et en Barbarie. On la cultivé au Jardin des Plantes de Paris [with symbol for shrub] v.v.” As mentioned at the start of this section, Lamarck cited among the synonyms also Alpino’s name as “An marum agyptiacum Alp. ?”

Further references to *Salvia tingitana* about this time include Persoon (1805: 28, no. 82), who recorded it for N Africa and noted it as possessing a foetid odour. He also listed *S. foetida* Desf. [non Lam.] “in agro Tunetano [Tunis]” with both entries having the symbol for woodiness. Vahl (1804-05: 274) gave a full description of *S. tingitana* and also described the new species, *S. praecox* Vahl and *S. coarctata* Vahl. The former, described from “Africa boreali”, Vahl related to *S. tingitana*, but *S. praecox*, as Bentham (1848) stated, is probably a synonym of *S. spinosa*, although there is no relevant specimen in the Vahl herbarium in C judged from the microfiche edition. The latter, *S. coarctata*, Vahl related to *S. argentea* L., a species surely distant from *S. tingitana*. Even though Bentham (1832-36) had previously considered *S. coarctata* to be a synonym of *S. tingitana*, the corresponding, far from ideal, specimen in the Vahl herbarium in C is not at all like *S. tingitana* but more similar to the E Mediterranean *S. palaestina*. Later, Bentham (1848) in his discussion about *S. argentea* also noted some similarities with *S. tingitana*.

Vahl (1804-05) also added another species name that comes into the convoluted history of *Salvia tingitana*. In his comments on Linnaeus’ *S. disermas*, he wrote “An *S. disermas* Lin. Mant. 318. eadem ac *S. tingitana* Etling?” *S. disermas* has also been misapplied and its distribution variously given as Syria, Greece, Byzantium [Istanbul]. The meaning of the epithet, which might give a clue as to the identity of the species, is also uncertain: Donn & Don (1845: 19) equated it with “long-spiked”, but it is probable that this interpretation was based on the knowledge of the plant rather than on its correct etymology. Apparently it was Bentham (1832-36) who first pointed out that *S. disermas* based on the specimen no. 42.26 in the Linnaean herbarium (at LINN) was in fact not from the Mediterranean region but a native of southern Africa (Hedge 1974). Another specimen labelled as *S. disermas* in the Linnaean herbarium (no. 42.27 at LINN) is certainly wrongly named. It was later annotated as “non *disermas*” by J. E. Smith (Savage 1945: 5). The specimen has “Ard.” (= Arduino) hand-written in small letters at its side (see above); in our opinion, it is *S. tingitana* and not *S. disermas* as listed by Williams (1890).

Other authors about this time who briefly referred to *Salvia tingitana* or *S. foetida* include Willdenow (1809: 42), Candolle (1813) and Desfontaines (1815: 67). Bentham (1832-36: 225, 718) related *S. tingitana* (*S. foetida* and *S. coarctata*) “in Afr. Bor. Agro Tunet.” to *S. spinosa*. Forbes (1833) in his catalogue described it as coming from Barbary. Don (1838: 729) gave a full description but this may not be *S. tingitana* because his symbol indicated it to be biennial and he also described it as having villous leaves; it may, in fact, be *S. argentea*. There is also a full description given by Walpers (1844-45: 614). Bentham (1848: 282) described *S. tingitana* as “foliis ... villosis; caule herbaceo” which again is not a feature of *S. tingitana*. The labels of the two relevant herbarium specimens (microfiche G-DC) have little information on them and both specimens are less than ideal. One is very similar to *S. sclarea* (that name is written on the sheet) and the other might also be the same. Bentham may, in fact, have been one of the sources of subsequent misapplication of the name *S. tingitana* and its confusion with *S. sclarea*. *S. tingitana* is

also referred to by Ball (1877-78: 616) and Loudon (1880: 24). Bonnet & Barratte (1896: 333-334), in their informative discussion on the distribution and origin of *S. tingitana*, suggested that Tournefort collected seed in the province of Cadiz, Spain, in 1688-89, and that the plant was subsequently grown at the Jardin du Roi in Paris. They emphasised that no wild collections from N Africa were currently known, as is still true today. Henriques (1890, 1898) gave a comprehensive account of Tournefort's Iberian travels and listed the plants he collected (both with Tournefortian and equivalent binomial names) but none listed could be *S. tingitana*. These lists, however, appear to refer only to native, not cultivated, plants.

A specimen from "Hab. circà Gades [Cadiz]", without further detail, was cited by Webb in his 'Iter Hispaniense' (Webb 1838) as *Salvia tingitana*. There is no exactly corresponding specimen in the Webb herbarium (FI-W), but no. 148512 has the label '*Salvia foetida* Lam.' [later changed to *S. tingitana*]; also on the label is "Herb. Cabr.". This refers to Antonio Cabrera (1762-1827), naturalist in Cadiz, whose herbarium, for the most part, went to his friend J. B. Chape, a Spanish professor of Natural History and 'boticario' (apothecary) in Cadiz. This might imply that Cabrera was interested in the domain of medicinal plants. What the link was with Webb is unknown.

In recent times, there are fewer references to *Salvia tingitana* although it is discussed by Hedge (1974). The description and line drawing by Valdés & al. (1987: 419) of *S. tingitana* gives every impression of it being *S. argentea*. Alziar (1993) possibly following Rosúa (1988) cited *S. tingitana* as a synonym of *S. sclarea*.

Mrs Sheila Collenette who, in western Saudi Arabia, made the only certain wild collections, published good photographs of *Salvia tingitana* under the name "*S. sp. nov. aff. S. dominica*" (Collenette 1999: 461). Her two specimens, collected from the same locality, i.e. Hema Figra, 72 km west of Madinah, in 1989 and 1995, were quoted by Chaudhary & Hedge (2001: 416). Slightly earlier, *S. tingitana* was discussed in some detail by Sales & Hedge (2000) although they overlooked the earlier typification of the name made by Rosúa (1988) based upon the same Tournefort specimen. Valdés & al. (2002: 519) included *S. tingitana* in their catalogue of plants of northern Morocco and gave a species key and quoted specific localities, but all known specimens there are apparently cultivated (S. L. Jury, in litt., 2006).

History of cultivation in gardens

Although the first recognition and naming of the taxon known today as *Salvia tingitana* goes back to the 1600s, it is very difficult to establish when it was first cultivated in gardens and indeed why, although its strong aroma and possible use in medicine may have been the reason. Possibly, it was in the Padua Botanical Garden in the early 1600s (Alpino 1627, 1640) and probably in the same garden in the 1750s (Arduino 1759) and also at that of Turin (Allioni 1774). Arduino (1759), one time curator (acting prefect, 1757-60) of the garden at Padua, said of this plant "This type of *Salvia* is not a native and its country of origin is uncertain. Four or five years ago it appeared and grew from imported seeds in the garden at Padua. I have been unable to find a drawing of it or a description anywhere, although I have assiduously consulted many prominent botanical writers. For this reason, I have decided to record it as a new type of *Salvia*; it seemed to merit the attention of all who study botany. The whole plant is viscid, pilose and sweet smelling ...". [Peregrina est haec *Salviae* species, deque ejus patria certi nihil affirmare possum. Quatuor vel quinque ab hinc annis, e seminibus peregrinis in Horto Patavino nata est atque alta. Ejus figuram & descriptionem nullibi reperire potui, licet Auctores multos praecipuos, qui Botanicem pertractarunt, diligenter evolverim. Quamobrem eam hic referre statui ut novam *Salviae* speciem, quae mihi visa est digna, quae omnibus Botanicis studiosis innotesceret. Tota planta viscida, pilosa & odorata est ...]. As indicated in the previous section, we consider his plant to be true *S. tingitana*.

Evidence of it also being cultivated in Paris in the 1760s comes from the annotation of a herbarium specimen at P "ex hort. r. Paris 1765". Shortly after this time, there is a particularly interesting reference in the history of *Salvia tingitana* and of sages in general. It is a catalogue of the

plants in the Jardin du Roi in Paris in 1777, i.e. the same year that Etlinger described *S. tingitana*. It is a hand-written list (Blaikie 1777, unpubl.) of all the plants cultivated there. It was compiled by the Scottish horticulturist and botanist Thomas Blaikie (1751-1838). He was a much sought-after garden designer who laid out, or was involved in, many of the major gardens of aristocrats of pre-Revolution France. One such garden was the Bagatelle, Bois de Boulogne, of the Compté d'Artois (subsequently Charles X). The entry "Chez de Compté d'Artois a Bagatelle pres Paris" is written in pencil on the catalogue. Blaikie compiled this fascinating catalogue within the space of four days! In his diary, Blaikie (1931) notes "Saturday, I thought I could do no better than to write a catalogue of the plants at the Bottonick gardins to carry with me as there was non printed so I spent the whole day writing in the garden according to the Classes names and numbers in the collection. Sunday, as the garden was not open rewrote the list and went to see the different churches in Paris". His catalogue gives a clear picture of the wealth of plants then cultivated. Bearing in mind that Linnaeus in 1753 in *Species Plantarum* dealt with an overall total of 27 species of *Salvia*, only 24 years later the Jardin du Roi was growing no fewer than 41 species. The garden, surely one of the richest in Europe at the time, was laid out in 1776 according to the system of Bernard de Jussieu and not of that of Tournefort or Linnaeus. In Blaikie's list of *Salvias*, the species listed are mostly suffixed with abbreviations of their describing authors, the majority of these being "L.", i.e. Linnaeus. There is also a small number with the suffix "j", presumably referring to de Jussieu, such as "*S. coccinea* j", "*S. praecox* j", "*S. nubia* j", and "*S. amplexicaulis* j". The implication is that these were recognised as new but as yet undescribed species. Later, they were properly described as *S. coccinea* by Etlinger (1777; also Juss. ex Murray 1778), *S. praecox* Vahl (1804-05), *S. nubia* Murray (1778) and *S. amplexicaulis* (Lamarck 1791). Of particular interest is the entry of "*S. foetida* j". This species, a sure synonym of *S. tingitana*, was formally described by Lamarck 14 years later in 1791. However, from the evidence of Blaikie's list, Paris botanists were aware in 1777 of the existence of a new species about the same time as, maybe before, Etlinger described *S. tingitana*. It is of interest to note that *S. tingitana* was unknown to Aiton at Kew (*Hortus Kewensis*) in cultivation.

Subsequently, in the first and second half of the 19th century, there were many published records of *Salvia tingitana* being cultivated in different parts of Europe: France (Dumont de Courset 1802-05; Desfontaines 1804: 56; Lamarck 1805: 600, Candolle 1813 (in Montpellier)), Berlin (Willdenow 1809: 42), Palermo (Tinéo 1827: 223). Most gave the place of origin as N Africa and indicated by a symbol that it was a shrubby plant.

In Britain, the first record is apparently that in the ninth edition (by Martyn) of Miller's 'Gardener's and Botanist's Dictionary' (Miller [ed. Martyn] 1797, re-issued 1807: *Salvia* no. 60). In the J. E. Smith herbarium (LINN), there is an 1819 specimen of *Salvia tingitana* from the Chelsea Physick Garden in London. Almost up to the turn of the 19th century it is listed in many English garden catalogues (e.g. Sweet 1818: 7, no. 67; Donn 1819: 10; 1826, Forbes 1833; Don 1838: 729; Donn & Don 1845: 19; Loudon 1880). An interesting facet of its history of cultivation in Britain is that several of the early catalogues gave, in the tabular format common in those days, the date of introduction into cultivation as 1796. We have been unable to trace why this date is cited. The only relevant horticultural publication of that year seems to be Donn's (1796) *Hortus Cantabrigiensis* but in it there is no mention of *S. tingitana* (or *S. foetida*). So in Britain as elsewhere, there are no hard facts about its provenance and origin in cultivation. In Europe during the early part of the 19th century, it appears to have always been grown under glass as a shrub (Donn & Don 1845: 19).

In the 20th century, there are far fewer references to the cultivation of *Salvia tingitana* in Britain. It is not listed in such recent standard reference works as the Royal Horticultural Dictionary of Gardening (both the first and second edition, Compton 1992), nor in the European Garden Flora (Compton 2000), which deals with almost one hundred species of *Salvia*.

In recent times, throughout the world, there has been a blossoming of interest in growing salvias, a genus of over 900 species, especially those that are rare or new to cultivation. A number of informative guides and books have been published (Yeo 1995; Sutton 1999; Clebsch

2003) and these all list *Salvia tingitana*. It is now not uncommonly grown in warmer parts of the world: USA (especially California), South Africa (Cape Town), Australia (New South Wales) and in the Mediterranean area. We have not seen a wide range of specimens from these areas and cannot comment on its variability, but there seems to be some small but not significant differences in flower colour: uniformly white with a lilac stigma; a pale yellow labellum and a white hood; or a yellowish labellum with a pale blue-lavender hood. Interestingly, the Tournefort type specimen of c. 1700 has the annotation "... flore dilute coeruleo". Many growers of today remark on the pale green leaves and the plant's strong aroma, very pleasing to some, yet too strong or even disagreeable to others. In warmer regions, it is usually described as an evergreen shrub, in less warm regions it is referred to as a deciduous herbaceous perennial. Whether all growers that list *S. tingitana* have the right plant is uncertain; the same is true for *S. disermas* in cultivation.

Salvia tingitana's relation to, or confusion with, other species

A surprising number of species have been considered to be close allies of *Salvia tingitana*, or have been confused with it, since it was described over 230 years ago. Etlinger (1777: xxxv), Willdenow (1797: 147) and Bentham (1832-36: 225, 1848: 282) all commented on the similarities between *S. spinosa* and *S. tingitana*. However, the Mediterranean *S. spinosa* is certainly quite distinct from *S. tingitana* and generally is easily recognised by its straight, c. 2 cm long calyx, clearly spiny-mucronate in fruit.

When he described *Salvia foetida*, Lamarck (1791: 69) must have been unaware of Etlinger's earlier dissertation on *Salvia* (Etlinger 1777), political upheavals and conflicts throughout Europe at the time perhaps being the reason for this. The complementary Lamarck herbarium specimen of *S. foetida* agrees well with *S. tingitana* and the name was soon recognised by contemporary botanists as a synonym of it. Confusion with *S. argentea* (Valdés & al. 1987), *S. disermas* (Vahl 1804-05), *S. praecox* (Vahl 1804-05) and *S. coarctata* (Bentham 1832-36) has already been briefly discussed above.

Most confusion with *Salvia tingitana* concerns its relation to *S. sclarea*. Since earliest times (Greek-Roman), this European to SW/Central Asiatic species has been cultivated for culinary uses, medicinally, for its aromatic oils in perfumery and as a flavouring agent in wines and vermouth. In France it is called "Toute Bonne" for its many virtues; in Britain it is "clary" [clear eye]. It is the one species that over the years has been most confused with *S. tingitana*, especially in N Africa.

Rosúa (1988) reviewed the relationship between the two species from his knowledge of them in Morocco and Spain. He emphasised their similarities in foetid odour, indumentum and corolla structure; he also noted that *Salvia sclarea* in S Spain has the common name of "amaro" and *S. tingitana* is called "maro". He stated that *S. tingitana* was unknown in the wild [which was true at that time], but had been in cultivation in Arab villages (e.g., in Morocco) for many centuries, though without giving evidence for the latter statement. He concluded that *S. tingitana* was a cul-

Table 1. Some differential characters of *Salvia tingitana*, *S. sclarea* and *S. desoleana*.

<i>Salvia tingitana</i>	<i>S. sclarea</i>	<i>S. desoleana</i>
Perennial shrub	Biennial/perennial herb	Perennial herb
Bracts shorter than calyx, green	Bracts clearly longer than calyx, pink-mauve	Bracts as long as calyx, green-violet
Corolla white/yellow	Corolla lilac/white	Corolla lilac/white
Corolla tube ± straight, esquamulate	Corolla tube strongly ventricose, squamulate	Corolla tube strongly ventricose, squamulate
Nutlets 3 × 2.2 mm	Nutlets 2 × 1.5 mm	Nutlets c. 3 × 2.5 mm
2n = 42	2n = 22	2n = 44

tivated form of *S. sclarea* and should be reduced to a synonym of it. He cited Article 28 of the then effective Berlin Code: “Plants brought from the wild into cultivation retain the names that are applied to the same taxa growing in nature” (Greuter & al. 1988). We cannot agree with his taxonomic conclusion and, although some authors have followed him (e.g., Alziar 1993), we consider the two species to be morphologically distinct but not unrelated. However, his comment on the centuries old cultivation of *S. tingitana* are illuminating and in line with our findings.

A further linking of *Salvia sclarea* with *S. tingitana* can be found by Hooker (1855). Here, the species dealt with was the western Himalayan *S. asperata* Falc. ex Benth. In the text is stated “Mr Bentham notices affinity of this species with *S. tingitana*”. Today, *S. asperata* is generally considered to be a synonym of *S. sclarea*.

The last species to mention in conjunction with *Salvia tingitana* is *S. desoleana* Atzei & Picci (1982). C. Froissart (in litt., 2006) noted that in cultivation it shared similarities in growth and aroma with *S. tingitana*. From the full original description and the informative illustration of this Sardinian endemic, it is surely a very close ally of *S. sclarea* (Table 1).

Cytology and chromosome number

In the chromosome complement of the material of *Salvia tingitana* analysed by us (provenance: ex “Seedhunt”, Freedom, California), acrocentric, submetacentrics and metacentric chromosomes according to Levan & al. (1964) are distinguishable (Fig. 4A-B). The chromosomes are small with a size range from 1.1 to 1.8 μm . Whilst primary constrictions are clearly discernible, secondary constrictions or nucleolar organiser region (NOR) satellite chromosomes are not present.

The mitotic chromosome count of $2n = 42$ for *Salvia tingitana* found here is unusual in the genus, but not the first. Of the >200 species of *Salvia* counted, the majority have $2n = 16$ or 22 chromosomes (44 and 43 species, respectively), and the next most common counts are $2n = 14$ and 20 chromosomes (24 and 20 species) (Table 2). A count of 42 somatic chromosomes was only reported for one further species, *S. merjamie* (distributed in Yemen and E Africa), as a single, uncertain count (c. 42; Hedberg & Hedberg 1977). Reese (1957), Queirós (1983) and Galland (1988) obtained counts of $2n = 42$ also for the European/SW Asiatic *S. verbenaca*, but other counts in this species ranged between $2n = 14$ and 72 (as indexed by Bolkhovskikh & al. 1969, Goldblatt 1981-88 and Goldblatt & Johnson 1990-2003). Obviously *S. verbenaca* is a species with a highly variable ploidy level and varying basic chromosome number; morphologically also, it is a very polymorphic species. Whether taxonomic uncertainties or erroneous counts are responsible for at least some variability among these counts is unknown.

The count of $2n = 42$ for *Salvia tingitana* differs from that for *S. foetida* (= *S. tingitana*) of $2n = 38$ by Yakovleva (1933) and Delestaing (1954). Unfortunately, there is no indication of a voucher specimen in either work. Of the other species with which *S. tingitana* has been confused only *S. desoleana* has a similar chromosome number with $2n = 44$ (Diana Corrias 1983). Further species linked with *S. tingitana* have very different mitotic numbers. *S. sclarea* and *S. argentea*, regularly quoted as such by different authors, have $2n = 22$ chromosomes (as indexed by Bolkhovskikh & al. 1969, Goldblatt 1981-88 and Goldblatt & Johnson 1990-2003). *S. palaestina*

Table 2. Summary of chromosome counts of 212 species in *Salvia*, excluding *S. tingitana*, giving the number of species per chromosome number present in *Salvia*. – Sources: Bolkhovskikh & al. 1969, Goldblatt 1981-88, Goldblatt & Johnson 1990-2003.

$2n$	12	14	16	18	20	22	24	26	28	30	32
No	3	24	44	13	20	43	2	1	2	7	6
$2n$	34	36	38	40	42	44	48	64	66	v	
No	2	4	2	1	1	5	2	1	1	28	
v = species with variable counts											

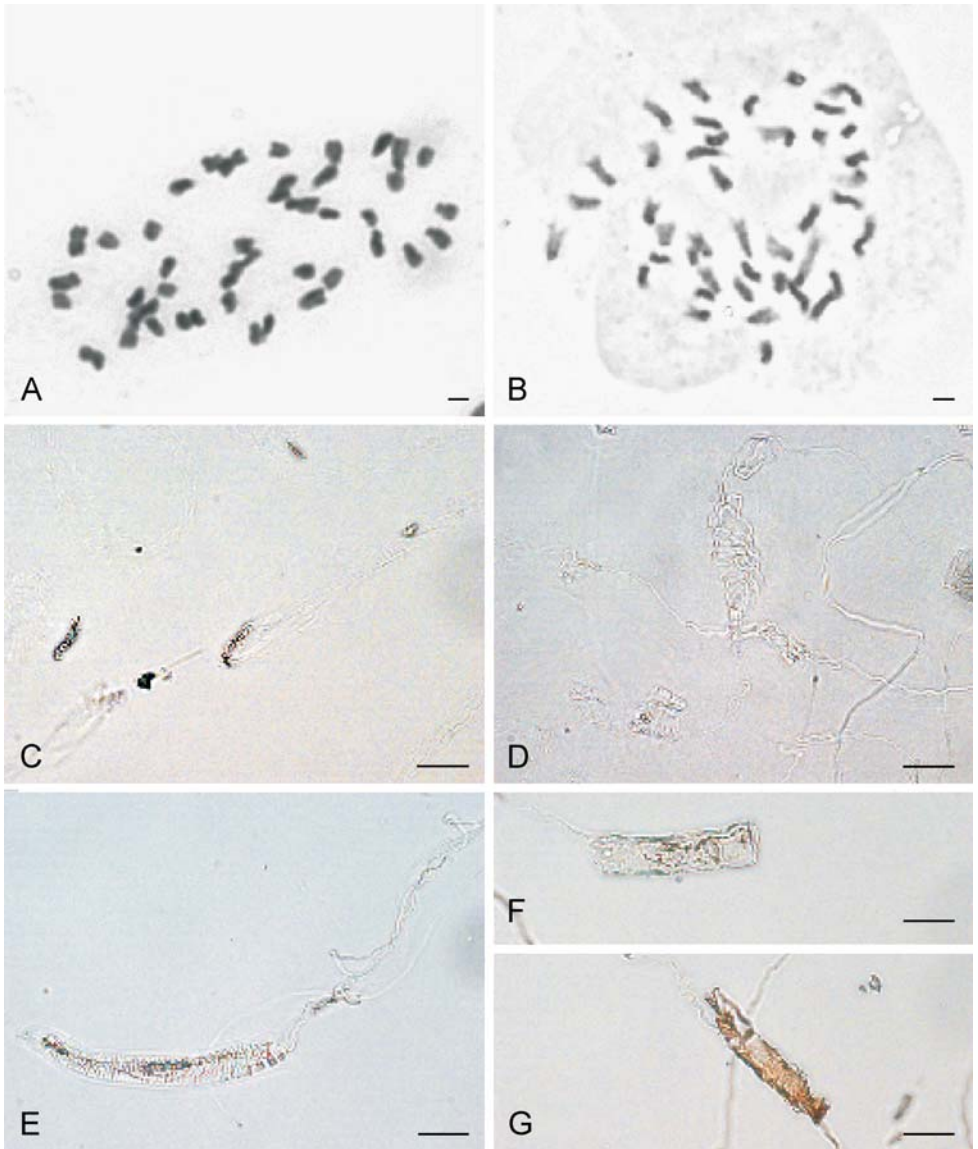


Fig. 4. A-B. Mitotic chromosome spreads of *Salvia tingitana* with $2n = 42$, metaphase (A), pro-metaphase under phase contrast (B). – C-G. Mucilage characteristics of diverse *Salvia* species – *S. tingitana* (C), *S. spinosa* (D), *S. sclarea* (E), *S. disermas* (F-G). – Scale bars: A-B = 1 μm , C-G = 20 μm .

(Afzal-Rafii 1981) and *S. spinosa* both have $2n = 20$ chromosomes (Yakovleva 1933; Patudin & al. 1975, Kliphuis & Barkoudah 1977), whilst *S. disermas* has never been investigated cytologically.

Even though these species, i.e. *Salvia sclarea*, *S. argentea* and *S. spinosa*, are morphologically related to *S. tingitana*, most possess a very different number of chromosomes (even if considering the counts published for “*S. foetida*”), this making them easily distinguishable from *S. tingitana*. Variation in somatic and basic chromosome number is not unusual in *Salvia* (Table 2). While most

Salvia species possess a rather low chromosome number between 14 and 22, *S. tingitana* (and “*S. foetida*”), appear to be of polyploid origin. A diploid count of 42 chromosomes may result from a hexaploidisation of a diploid with $2n = 14$. Loss of some ‘redundant’ chromosomes may result in a count of $2n = 38$. However, an alternative reason for $2n = 38$ may be an amphidiploid origin between species with $2n = 16$ and $2n = 22$ (the most commonly determined numbers). Whether the scenario involves autopolyploidy or allopolyploidy and hybridization is not determinable without further, preferably molecular, data; this we hope to investigate in the future.

Walker & al. (2004) and Walker & Sytsma (2006) analysed phylogenetic relationships among 83 *Salvia* species, including *S. sclarea* but not *S. tingitana*. It is interesting to note that the relationships of their clades correlated well with chromosome numbers. Inclusion of *S. tingitana* and related species may give valuable insights into its origin.

Cytological technique applied. – Root tips were pre-treated in saturated aqueous 1-bromonaphthalene for 3 hours at room temperature and then fixed in freshly prepared Farmer’s Fluid (3 ethanol: 1 glacial acetic acid). After hydrolysis for 30 minutes in 5 M HCl at room temperature followed by thorough washing through several changes of distilled water, the roots were transferred to Feulgen Reagent prepared according to Fox (1969) for 2 hours. To facilitate squashing, the stained material was treated with an enzyme mixture of 4 % pectinase (Sigma 2401) and 4 % cellulase (BDH or Calbiochem 21947) at 36 °C for 30 minutes and squashed in counterstain (0.4 % aceto-carmine in 45 % acetic acid). Counterstaining with aceto-carmine greatly enhances viewing under a bright field. Images were digitally captured with an Axiocam HR (Zeiss) digital camera mounted on an Axiophot microscope (Zeiss). Metaphase cells were usually more favourable for chromosome morphology (Fig. 1A), whilst pro-metaphase spreads were more suitable for counting (Fig. 1B).

Mucilage

In an earlier paper dealing with the nutlets of *Salvia* species in Afghanistan (Hedge 1970), it was shown that most species were markedly mucilaginous on wetting and there were structural differences between them. Here, we studied five relevant species: *Salvia tingitana*, *S. sclarea*, *S. spinosa*, *S. disermas* and *S. aethiopsis* L., following the methodology of Hedge (1970). In the material studied, nutlet size varied, with *S. tingitana* possessing the largest (3×2.2 mm), followed by *S. spinosa* (2.8×2.1 mm), *S. aethiopsis* (2.7×1.9 mm), *S. sclarea* (2×1.5 mm) and *S. disermas* having the smallest (1.9×1.5 mm). Apparently, the seed size does not correlate with the chromosome numbers.

All these species produced mucilage, some quickly (*Salvia disermas*, *S. spinosa*), others more slowly (*S. aethiopsis*). Some produced fine cotton-wool-like long threads while others had more coarse mucilage (*S. aethiopsis*, *S. sclarea*). The mucilage of the species investigated was very different from *S. tingitana*, with *S. spinosa* being the closest.

The mucilage threads of *Salvia tingitana* were long and split into several individual strands. Some loosely coiled threads were visible, but with little, and more or less clear cell content present. In contrast, the mucilage of *S. spinosa* was highly curled even when uncoiled, with little or no inclusions; sometimes, densely coiled clusters were present. A mucilaginous tube or sheath was present in the remaining three species, *S. aethiopsis*, *S. disermas* and *S. sclarea*. For the latter, this was different from the observations in Hedge (1970), which showed mucilage of Afghan material of *S. sclarea* without such a sheath. The tube was c. 100 µm long in this species, shorter in *S. disermas* and often > 200 µm long in *S. aethiopsis*. In *S. sclarea* the thread protruding from the tube was short and often split, with the majority inside the tube; in *S. disermas* it was long and single and in both species the threads were coiled around large lumps of protoplasmic cell content. In *S. disermas* often the entire thread escaped the tube and was coiled around large dark brown solid cell content, and sometimes appeared as terminal caps as in the unrelated *S. plebeia* R. Br. (Hedge 1970). In *S. aethiopsis* very little single thread material was visible outside and inside the sheath including little cell content, very similar to *S. nubicola* Sweet (Hedge 1970).

Provenance of material examined. – *Salvia aethiopsis*: Turkey, Konya, Dudley D.35900 (E); *S. disermas*: S Africa, Cape, Lavranos 15196 (E); *S. sclarea*: Turkey, Ankara, Davis 13126 (E); *S. spinosa*: Turkey, Mardin, Davis & Hedge, D. 28632 (E); *S. tingitana*: ex “Seedhunt”, Freedom, California.

Taxonomy

Salvia tingitana Etl., Comment. Bot.-Med. Salvia: xxxv. 1777. – Lectotype (designated by Rosúa 1988): “*Sclarea tingitana foetidiss. flore dilute caeruleo variegato. Sa fleur est d’un bleu fort pâle, toute la plante put fort*” specimen no. 1081 in the Tournefort herbarium in Paris (P-TRF, microfiche no. 53) – Fig. 3.

= *Salvia foetida* Lam., Tabl. Encycl. 1: 69. 1791. – Lectotype (designated by Sales & Hedge 2000): “*S. foetida* gen. n° 295 / *Salvia foetida* j.” (P-LA, microfiche no. 522)

– *Salvia disermas* auct. non L., Sp. Pl. ed. 2, 1: 36. 1762

– *Salvia sclarea* sensu Rosúa in Taxon 37: 188. 1988, p.p. non L., Sp. Pl., Sp. Pl.: 27. 1753.

Strongly aromatic, woody-based, multi-stemmed perennial shrub to 100 cm tall and ± as wide; stems erect, rigid, with sparse, ± patent multicellular hairs intermixed with much denser, shorter eglandular and glandular hairs. *Basal leaves* with short petioles ± ovate to oblong, to 7 cm long, subcordate, obtuse, crenate to undulate, distinctly rugose, with frequent, tapering, eglandular hairs intermixed with sessile glands; *cauline leaves* few, smaller, sessile. *Inflorescence* a broad, branched panicle; verticillasters 6-10, approximating above, 3-6-flowered; *bracts* (floral leaves) broadly ovate, 1-2 × 0.7-1.5 cm, with an acuminate apex. *Calyx* green, broad, ± triangular-campanulate, 15-20 mm, not noticeably accrescent in fruit, strongly ridged, with diverging lips with spinulose apices, with long, eglandular multicellular hairs intermixed with short, sessile glands. *Corolla* white with a cream-yellow lower lip, (20-)25-30 mm (in cultivation either white throughout or with a pale lavender hood and pale yellow lip); tube ± exerted, c. 10 mm straight or gradually widening towards throat, esquamulate; upper lip ± falcate. *Nutlets* 3 × 2.2 mm, prominently mucilaginous on wetting.

lc. – Fig. 2, 4A-C & 5; Collenette (1999: 461 as *Salvia* sp. nov. aff. *S. dominica*); Chaudhary & Hedge (2001: 378, t. 28).

Specimens seen (or microfiches examined). – *Naturally-occurring plants*: SAUDI ARABIA: Hema Fiqra [24°25'N, 38°50'E], 60 km west of Madinah, in the juniper zone, 1676 m, 22.4.1989, Collenette 7142 (E); *ibid.*, 1.4.1995, Collenette 9320 (RIY, n.v., see Chaudhary & Hedge 2001: 416). — *Cultivated plants and those of uncertain provenance*: “*Sclarea tingitana foetidiss. flore dilute caeruleo variegato*”, Tournefort herbarium no. 1081 (P-TFR); “*Sclarea tingitana foetidissima, spec. in agro Tunetano, ex herb Commerson, 1764, S. tingitana Ettl. foetida Lam*”, no. 5214 (P-JU); “*S. tingitana, ex hort. r. Paris 1765*” (P-JU); “*S. foetidissima hirsute fl variegato*”, “*Tunetana*” [Tunis] (P-JU); “*S. foetida* [Hort. Paris symbol], fructidor [the 12th month of the Revolution calendar]” (E); “*Salvia foetida* Desf., Atl. – *tingitana* Willd., Sp.; *foetida* alger., Com. Mai” (E); “*S. foetida* gen. n° 295 / *Salvia foetida* j.” (P-LA); Chelsea Garden, 26.5.1819, herb. Smith no. 63.59 (LINN); “*Salvia graveolens* Abyss. H[U.]” [handwriting Linnaeus] “*tingitana 60*” [handwriting Smith], herb. Linnaeus no. 42.59 (LINN); “*Salvia aegyptiaca frutescens, foetidissima, hirsute, florea albo*” [handwriting Thouin], “*foetidissima*” [handwriting L. fil.], “*tingitana 60*” [handwriting Smith], herb. Linnaeus no. 42.60 (LINN); “*Herb. Cabr.*” [Antonio Cabrera] (FI-W 148512); “*Salvia foetida* ‘hort. Aven. [hortus botanicus Avignon]’, 1831, *Requien* (K); “*hort. Monsp[eliensis]*”, 1831, *Delile* [?] (K); “*Algérie, Alger, cultivé, orig. mal connue*”, 5.1935, *R. Maire* (MPU); “*Chaouia, cultivé a Ain Sebra[?], n’est connue qu’ez culture par les indigens NW du Maroc, S Espagne et Oranie*”, 19.4.1939, *J. Gattefosse* (MPU); “*Ain Sebra (cultivé), herbar Maire*” (MPU); grown at “Seedhunt”, Freedom, California by Ginny Hunt, RBG Edinburgh acc. no. E00228478 (E); grown at Logan Botanic Garden, Scotland, from the same Californian source, accession no. 20061235 [material used for cytological investigation].



Fig. 5. Inflorescence of a cultivated plant of *Salvia tingitana*. – Courtesy of C. Froissart.

Conclusions

Although we have brought together a fairly comprehensive account of the history and taxonomy of *Salvia tingitana*, some basic questions remain unanswered or are still a matter of conjecture. The epithet implies a N African provenance but no certain wild origin gatherings from there are known; the only known ones being recent collections from Saudi Arabia. Because it is a strongly aromatic plant it may have been used and cultivated, as a medicinal plant, in the area of the Arabian peninsula many centuries ago and, during the time when the Arab Empire expanded north and westwards towards the Mediterranean, *S. tingitana* may have had a similar extension. Egypt, Syria, Aleppo, Tunis, Tanger are some of the place names that are mentioned in the early history of the species. The earliest certain record of it is Tournefort's specimen of late 1690s in the Paris herbarium (P), but the provenance of this is unknown. If we are correct in equating the plant that Alpino grew at Padua in the 1600s with *S. tingitana*, that takes its history much further back. *Aloe vera* (L.) Burm. fil., *Iris albicans* Lange, *Punica granatum* L. (pomegranate) and *Ceratonia siliqua* L. (carob, Ramón-Laca & Mabberley 2004) are some examples of species that today are widespread in the Mediterranean region as cultivated/naturalised plants but apparently have their progenitors in the Arabia/Socotra area. Maybe *S. tingitana* should be an addition to the list. Hav-

ing the unusual chromosome number of $2n = 42$ is further evidence that it is a distinct species and separate from *S. sclarea* and other species that have been considered as related or confused with it. The investigation of the mucilage produced by nutlets proved interesting and informative, but in the absence of a broader-based study, its significance in understanding taxonomic relationships in the genus should not be over-emphasised.

Within the genus, *Salvia tingitana* is not alone in being of obscure origin. Two other more recently described species which originate in the New World also lack known wild provenance. *S. divinorum* (Epling & Játiva 1962) occurs in a very limited area of S Mexico, where for long it has been cultivated by the Mazatec Indians of Oaxaca for its psychotropic, especially hallucinatory, properties. Another species is *S. buchananii* Hedge having appreciable horticultural attributes; this was described from plants cultivated in Britain from seed originating from a Mexico City garden (Hedge 1963); its wild provenance is unknown though surely it is from the New World.

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Unpublished Sources

Blaikie, T. 1777: A catalogue of the plants in the Botanicall gardens at Paris. – The Library, Royal Botanic Garden Edinburgh; hand-written.

References

- Afzal-Rafii, Z. 1981: Reports. [In: Chromosome number reports LXX]. – *Taxon* **30**: 73-74.
- Allioni, C. 1774: Auctarium ad synopsis methodicam stirpium horti regii taurinensis. – *Mélanges Philos. Math. Soc. Roy. Turin* **5**: 53-96.
- Alpino, P. 1627: De plantis exoticis libri duo, editit A. Alpini auctoris fil. – Venetiis.
- 1640: De plantis Aegypti liber, ed. 2, emend. cum observationibus et notis Joannis Veslingii et Alpini. – Patavii.
- Alziar, G. 1993: Catalogue synonymique des *Salvia* du monde VI. – *Bioscosme Mésogéen* **10(3-4)**: 60.
- Arduino, P. 1759: Horti publici patavini custodis animadversionum botanicarum specimen. – Padua.
- Atzei, A. D. & Picci, V. 1982: *Salvia desoleana* Atzei & Picci, specie nuova dell'isoladi Sardegna. – *Webbia* **36**: 71-78.
- Ball, J. 1877-78: Spicilegium florum maroccanarum. – *Bot. J. Linn. Soc.* **16**: 218-772.
- Bentham, G. 1832-36: Labiatarum genera et species. – London.
- 1848: *Labiatae*. – Pp. 27-603 in: Candolle, A. P. de (ed.), *Prodromus systematis naturalis* **12**. – Paris.
- Blaikie, T. [ed. Birrell, F.] 1931: Diary of a Scotch gardener at the French court at the end of the 18th century. – London.
- Bolkhovskikh, Z., Grif, V., Matvejeva, T. & Zakharyeva, O. 1969: Khromosomnye chisla tsvetkovykh rastenii [Chromosome numbers of flowering plants]. – Leningrad.
- Bonnet, E. & Barratte, G. 1896: Catalogue raisonné des plantes vasculaires de la Tunisie. – Paris.
- Candolle, A.-P. de 1813: *Catalogus plantarum horti botanici monspeliensis*. – Monspeli.
- Chaudhary, S. & Hedge, I. 2001: *Labiatae*. – Pp. 309-418 in: Chaudhary, S. (ed.), *Flora of the Kingdom of Saudi Arabia* **2(2)**. – Riyadh.

- Clebsch, B. 2003: The new book of salvias. – Portland & Cambridge.
- Collenette, S. 1999: Wildflowers of Saudi Arabia. – Riyadh.
- Compton, J. A. 1992: *Salvia*. – Pp. 176-188 in: Huxley, A. & Griffiths, M. (ed.), The new Royal Horticultural Society dictionary of gardening **4**. – London & Baringstoke.
- 2000: *Salvia*. – Pp. 180-192 in: Cullen, J. & al. (ed.), The European garden flora **6**. – Cambridge.
- Delestaing, N. 1954: Contribution à l'étude cytologique du genre *Salvia*. – Rev. Cytol. Biol. Vég. **15**: 195-236.
- Desfontaines, R. L. 1798: Flora atlantica, sive historia plantarum, quae in Atlante, agro Tunetano et Algeriensi crescunt **1**. – Parisiis.
- 1804: Tableau de l'école de botanique, du Museum d'Histoire Naturelle. – Paris.
- 1815: Tableau de l'école de botanique du Jardin du Roi. – Paris.
- Diana Corrias, S. 1983: Numeri cromosomici per la flora italiana 948-955. – Inform. Bot. Italia **15**: 44-48.
- Don, G. 1838: A general history of dichlamydeous plants (general system of gardening and botany). – London.
- Donn, J. 1796: Hortus cantabrigiensis: or a catalogue of plants indigenous and foreign cultivated in the Walkerian Botanic Garden, Cambridge. – Cambridge.
- 1819: Hortus cantabrigiensis, ed. 9. – London.
- 1826: Hortus cantabrigiensis, ed. 11. – London.
- & Don, P. N. (ed.) 1845: Hortus cantabrigiensis, ed. 13. – London.
- Dumont de Courset, G. L. M. 1802-05: Le botaniste cultivateur: ou description, culture et usages de la plus grande partie des plantes – rangées suivant la méthode de Jussieu.
- Epling, C. & Játiva, C. D. 1962: A new species of *Salvia* from Mexico. – Bot. Mus. Leaflet. **20**: 75-76.
- Etlinger, A. E. 1777: Commentatio botanico-medica de *Salvia*. – Erlangae.
- Forbes, J. 1833: Hortus woburnensis: a descriptive catalogue of ... plants cultivated at Woburn Abbey. – London.
- Fox, D. P. 1969: Some characteristics of the cold hydrolysis technique for staining plant tissues by the Feulgen reaction. – J. Histochem. Cytochem. **17**: 226.
- Galland, N. 1988: Recherche sur l'origine de la flore orophile du Maroc étude caryologique et cytogéographique. – Trav. Inst. Sci. Univ. Mohammad V. Sér. Bot. (Rabat) **35**: 1-168.
- Goldblatt, P. 1981, 1984, 1985, 1988: Index to plant chromosome numbers 1975-1978, 1979-1981, 1982-1983, 1984-1985. – Monogr. Syst. Bot. Missouri Bot. Gard. **5, 8, 13, 23**.
- & Johnson, D. E. 1990, 1991, 1994, 1996, 1998, 2000, 2003: Index to plant chromosome numbers 1986-1987, 1988-1989, 1990-1991, 1992-1993, 1994-1995, 1996-1997, 1998-2000. – Monogr. Syst. Bot. Missouri Bot. Gard. **30, 40, 51, 58, 69, 81, 94**.
- Greuter, W., Burdet, H. M., Chaloner, W. G., Demoulin, V., Grolle, R., Hawksworth, D. L., Nicolson, D. H., Silva, P. C., Stafleu, F. A. & Voss, E. G. (ed. & compilers) 1988: International Code of Botanical Nomenclature. Adopted by the Fourteenth International Botanical Congress Berlin, July-August 1987. – Regnum Veg. **118**.
- Hedberg, I. & Hedberg, O. 1977: Chromosome numbers of afroalpine and afroalpine angiosperms. – Bot. Not. **130**: 1-24.
- Hedge, I. C. 1963: *Salvia buchananii*. – Bot. Mag. **174**: t. 430.
- 1970: Observations on the mucilage of *Salvia* fruits. – Notes Roy. Bot. Gard. Edinburgh **30**: 79-95.
- 1974: A revision of *Salvia* in Africa. – Notes Roy. Bot. Gard. Edinburgh **33**: 1-121.
- Henriques, J. A. 1890: Explorações botánicas em Portugal por Tournefort. – Bol. Soc. Brot. **8**: 191-261.
- 1898: Explorações botánicas em Hespanha por Tournefort. – Bol. Soc. Brot. **15**: 109-174.
- Holmgren, P. K. & Holmgren, N. H. 1998- (continuously updated): Index herbariorum. – Published on the internet at <http://sweetgum.nybg.org/ih/>

- Hooker, W. J. 1855: *Salvia asperata*. – Bot. Mag.: t. 4884.
- Kliphuis, E. & Y. I. Barkoudah 1977: Chromosome numbers in some Syrian angiosperms. – Acta Bot. Neerl. **6**: 239-249.
- Lamarck, J. B. A. P. de 1791: Tableau encyclopédique et méthodique **1**. – Paris
— 1805: Encyclopédie méthodique botanique **6**. – Paris
- Levan, A., K. Fredga & Sandberg, A. A. 1964: Nomenclature for centromere position on chromosomes. – *Hereditas*, **52**: 201-220.
- Loudon, J. W. [“Mrs”] (ed.) 1880: Loudon’s encyclopaedia of plants. New Impression. – London.
- McNeill, J., Barrie, F. R., Burdet, H. M., Demoulin, V., Hawksworth, D. L., Marhold, K., Nicolson, D. H., Prado, J., Silva, P. C., Skog, J. E., Wiersema, J. H. & Turland, N. J. (Ed. & Compilers) 2006: International Code of Botanical Nomenclature (Vienna Code, 2006) adopted by the Seventeenth International Botanical Congress Vienna, Austria, July 2005. – Regnum Veg. **146**.
- Miller, P. [ed. Martyn, T.] 1797, re-issued 1807: The gardener’s and botanist’s dictionary, ed. 9. – London.
- Morison, R. 1699: Plantarum historiae universalis oxoniensis **3**. – Oxonii.
- Murray, J. A. 1778: Systema vegetabilium, ed. 6, **1**. – Paris.
- Patudin, A. V., Yurtsev, V. N. & Pakaln, D. A. 1975: Chisla khromosom i nekotorykh vidov roda *Salvia* L. (*Lamiaceae*) [Chromosome numbers in some species of *Salvia* L. (*Lamiaceae*)]. – Bot. Zhurn. SSSR **60**: 529-534.
- Persoon, C. H. 1805: Synopsis plantarum **1**. – Paris.
- Queirós, M. 1983: Notas cariológicas em *Labiatae* portuguesas. – Bol. Soc. Brot., ser. 2, **56**: 71-77.
- Ramón-Laca, L. & Mabberley, D. J. 2004: The ecological status of the carob-tree in the Mediterranean. – Bot. J. Linn. Soc. **144**: 431-436. [[CrossRef](#)]
- Reese, G. 1957: Über die Polyploidiespektren in nordsaharischen Wüstenpflanzen. – Flora **144**: 598-634.
- Rivinus, D. A. Q. 1690: Ordo plantarum quae sunt flore irregulari monopetala. – Lipsiae.
- Rosúa, J. L. 1988: Sobre la lectotypification de *Salvia tingitana*. – Taxon **37**: 186-188. [[CrossRef](#)]
- Roth, A. W. 1787: Botanische Abhandlungen und Beobachtungen. – Nürnberg.
- Sales, F. & Hedge, I. 2000: The enigma of *Salvia tingitana* Etl. – Edinburgh J. Bot. **57**: 463-466. [[CrossRef](#)]
- Savage, S. 1945: A catalogue of the Linnaean herbarium. – London.
- Sutton, J. 1999: The gardener’s guide to growing salvias. – Portland & New Abbot.
- Sweet, R. 1818: Hortus suburbanus londinensis. – London.
- Tinéo, A. V. 1827: Catalogus plantarum horti regii panormitani ad annum 1827. – Panormi.
- Tournefort, J. P. de 1700: Institutiones rei herbariae. Editio Altera. – Parisiis.
- Vahl, M. H. 1804-05: Enumeratio plantarum **1**. – Hauniae & Lipsiae.
- Valdés, B., Rejdali, M., Achal El Kadmiri, A., Jury, S. L. & Montserrat, J. M. (ed.) 2002: Catalogue des plantes vasculaires du nord du Maroc **1-2**. – Madrid.
— , Talavera, S. & Fernández-Galiano, E. (ed) 1987: Flora vascular de Andalucía occidental **2**. – Barcelona.
- Walker, J. B. & Sytsma, K. J. 2006 [online, print publ. 2007]: Staminal evolution in the genus *Salvia* (*Lamiaceae*): molecular phylogenetic evidence for multiple origins of the staminal lever. – Ann. Bot. **100**: 375-391. [[CrossRef](#)]
— , Sytsma, K. J., Treutlein, J. & Wink, M. 2004: *Salvia* (*Lamiaceae*) is not monophyletic: implications for the systematics, radiation and ecological specializations of *Salvia* and tribe *Mentheae*. – Amer. J. Bot. **91**: 1115-1125. [[CrossRef](#)]
- Walpers, W. G. 1844-45: Repertorium botanices systematicae **3**. – Lipsiae.
- Webb, P. B. 1838: Iter hispaniense or a synopsis of plants collected in the southern provinces of Spain and in Portugal. – Paris & London.

- Willdenow, C. L. 1797: *Species plantarum*, ed. 4, **1**. – Berolini.
— 1809: *Enumeratio plantarum horti regii botanici berolinensis*. – Berolini.
Williams, F. N. 1890: Plants described by Arduino. – *J. Bot.* **28**: 293-294.
Yakovleva, S. V. 1933: Kariologicheskiye issledovaniya nekotorykh vidov *Salvia* [Caryological investigations on some salvias]. – *Trudy. Prikl. Bot. Genet. Selesk.*, ser. 2, **5**: 207-213.
Yeo, C. 1995: *Salvias* **1**. – Devon.

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