

MOROCCAN LAVANDULA L. SPECIES

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Abstract

Morocco is a principal area of diversity within the genus *Lavandula* L., with half of the eight native species endemic. These taxa are generally poorly known, in need of revision and are thus a focus of our wider work on the genus. The subgeneric classification is reviewed, based on preliminary findings, principally from morphological and molecular data. An overview of species diversity and endemism is given which highlights S Arabia & NE Africa, Macaronesia and Morocco as important areas. A provisional checklist of Moroccan species with a key is presented and taxonomic problems at infraspecific ranks highlighted. Several Moroccan species highlight geographical relationships between NW Africa with other parts of the Mediterranean, Macaronesia, Arabia and the Horn of Africa.

Introduction

The genus *Lavandula* (*Lamiaceae*) consists of 30-32 species, distributed from the North Atlantic Islands (Macaronesia), across the Mediterranean Basin, North Africa, the Middle East, tropical NE Africa and India. Widely cultivated since ancient times, the essential oils of a number of species are of economic importance in the perfumery and fragrance industry, aromotherapy and known to have antiseptic and anti-fungal qualities. A number of species and their hybrids are horticulturally desirable.

Although the genus itself may be well known, it is only a small number of the more widely cultivated species, e.g. *L. angustifolia* Miller, *L. latifolia* Medic. (including their hybrids) and *L. stoechas* L., that have been more thoroughly investigated. The greater number of species in the genus remain widely unknown and poorly investigated. The taxonomy of the genus is often confused with many plants misidentified or wrongly named. Indeed, the vast literature, plethora of superfluous names and varied treatments can provide a confusing picture of the genus today. With a renewed and growing interest in *Lavandula* amongst many groups of people worldwide, there is clearly both a demand and need for further systematic investigation.

The last treatment of the whole genus 'A taxonomic study of the genus *Lavandula*' was undertaken almost sixty years ago by CHAYTOR (1937) and still remains the standard reference work. The more important systematic research since includes a revision of the section *Stoechas* (ROZEIRA, 1949) and several floristic accounts such as, SUÁREZ-CERVERA & SEOANE-CAMBA (1986) on the taxa native to the Iberian Peninsula and MILLER (1985) on 'The genus *Lavandula* in Arabia and Tropical North East Africa'. This latter account is a particularly significant work in which five undescribed species are named, requiring a reassessment of distribution and diversity in the genus, a matter discussed later.

The work presently being undertaken at the University of Reading aims to produce a partial revision of the genus, with future work aimed at revising the whole genus

including cultivated taxa. Currently this work has concentrated on the North African species, also including taxa from related areas principally the Iberian Peninsula and Macaronesia. This corresponds taxonomically to the revision of taxa in the sections *Stoechas*, *Pterostoechas* and *Dentata*. Investigation of the generic relationships and subgeneric classification are also in progress.

Subgeneric Classification of the Genus *Lavandula*

It is evident within the genus that natural groupings of related species can be recognised. Baron GINGINS DE LASSARAZ (1826) in his monograph of the genus was the first to formally recognise these groupings as three sections: *Spica*, *Stoechas* and *Pterostoechas*. BENTHAM (1833) recognised a fourth section *Chaetostachys*, from which the section *Subnuda* was split by CHAYTOR (1937). Within the section *Stoechas* one species, *L. dentata*, has long been recognised as divergent by several authors and a new monospecific section, *Dentata* was formally recognised by SUÁREZ-CERVERA (1985) to accommodate it. A recently described species, *Lavandula hasikensis* from Dhofar, (MILLER, 1985) is extremely distinct with no clear affinities within the genus and may represent a new section in its own right. The generic position of *L. atriplicifolia* Bentham, is questionable as it is totally anomalous within its present section *Pterostoechas* and the genus as a whole. It seems likely that its true position lies outside the genus *Lavandula*, possibly within the genus *Sabaudia* Buscalioni & Muschler (CHIOVENDA, 1917).

I. Section LAVANDULA (=SPICA Gingins) 3 sp. (<i>L. angustifolia</i> , <i>L. latifolia</i> , <i>L. lanata</i>) C & SW Europe	IV. Section PTEROSTOECHAS Gingins 14-15 sp (e.g. <i>L. multifida</i> , <i>L. canariensis</i> , <i>L. pinnata</i> , <i>L. pubescens</i> , <i>L. mairei</i> , <i>L. maroccana</i>) Mediterranean, N Africa, Macaronesia & few Arabia
II. Section STOECHAS Gingins 2-3 sp. (<i>L. stoechas</i> & subspecies, <i>L. viridis</i>) Mediterranean & Macaronesia	V. Section SUBNUDA Chaytor 8 sp. (e.g. <i>L. subnuda</i> , <i>L. macra</i> , <i>L. aristibracteata</i>) S Arabia, & Somalia + Socobra
III. Section DENTATA Suarez-Cervera & Seoane-Camba 1 sp. (<i>L. dentata</i>) Mediterranean & Arabia	VI. Section CHAETOSTACHYS Bentham 2 sp. (<i>L. bipinnata</i> , <i>L. gibsonii</i>) C & S India

Unclassified: *L. hasikensis* (distinct species possibly representing a new section);
L. atriplicifolia (generic position questionable)

Table 1. Summary of the Subgeneric Classification

The subgeneric classification is presently being investigated utilising a number of techniques including gross morphology, carpology, karyology, palynology and a molecular study utilising sequencing of the DNA ITS (Inner Transcribed Spacer) region. Preliminary results provide support for the classification summarised in Table 1.

Diversity in *Lavandula*

The sections shows a high degree of correlation with a clearly definable geographical distribution, with the exception of section *Pterostoechas* which is more widespread. For example, section *Lavandula* is restricted to C and SW Europe and section *Subnuda* is found only in S Arabia and Somalia, as illustrated in Table I. When the distribution of the species are mapped out, it is clear that certain areas are more diverse than others.

Geographical area	No. of species	No. of endemics	No. of sections represented
S Arabia & NE Africa	13	9	3-4*
Mediterranean Basin	11	3	4
– western	8	3	4
– eastern	3	0	2
NW Africa	10	5	3
– Morocco	8	4	3
Central Europe	3	0	1
Macaronesia	8	5	2
– Canary Islands	4	4	1
India	2	2	1

Table 2. Summary of species diversity and endemic species. * the fourth section refers to the distinct species *L. hasikensis*.

The richest areas, judged on number of species, endemics and number of sections represented are: S Arabia & NE Africa; NW Africa (particularly Morocco) and Macaronesia (see Table 2). Diversity in the western Mediterranean is also high in contrast to the relatively poor eastern Mediterranean. CHAYTOR (1937) commented on distribution patterns identifying “centres of differentiation”, primarily of closely related species. She cited, “examples of such centres occur in the section *Stoechas* in southern Portugal and in section *Pterostoechas*, where Algeria-Morocco appears as a region of great instability”. These areas are also recognised in this analysis, although the greater importance of S Arabia and NE Africa as probably the main area of diversity

in *Lavandula* has not been appreciated until the work of MILLER (1985). The following comments are made on these patterns of diversity:

1. The S Arabia and NE African area is the richest, both in species and, more importantly endemics. Our studies of gross morphology and a survey of seed anatomy suggest a higher degree of diversification compared with groups of related species from other areas. The endemic species usually have narrow and isolated ranges. We have also found a chromosome count of $2n = 18$ for species from this area, representing the basal number in the genus. This evidence would suggest that this area represents both a major centre of diversity and probably the centre of origin for the genus.

2. The Moroccan-Algerian area is also clearly a centre of diversity with a large number of species (4 of which are endemic) representing 3 of the 6 sections. These taxa are relatively divergent and not as closely allied as suggested by CHAYTOR (1937).

3. Macaronesia numerically represents a centre of diversity on account of its high degree of endemism. Whilst *L. rotundifolia* from the Cape Verde Islands is very distinct, the taxa native to the Canary Islands are related to *L. multifida*. A preliminary analysis of morphological and molecular data shows a distinct clade which include all these taxa. We would contend that speciation on the Canary Islands represents limited adaptive radiation from a single colonisation event on the islands.

4. The Portuguese (expanded here to include southern Spain) centre of diversity mentioned by CHAYTOR (1937), is the most diverse in taxa at the infraspecific level, but almost solely in the *L. stoechas* group. The most recent account (SUÁREZ-CERVERA & SEOANE-CAMBA, 1989) recognises six subspecies in *L. stoechas*. They also raised *L. pedunculata* to the rank of species, this taxa having previously being lowered in rank to a subspecies of *L. stoechas* (ROZEIRA, 1949). All taxa in this group are clearly closely related suggesting a more recent radiation of diversity.

Checklist of Moroccan *Lavandula* Species

The key and checklist of species presented here are based on morphological studies, extensive fieldwork and the account of Chaytor (1937).

- | | |
|---|---------------------|
| 1. Leaves linear in outline, entire or dentate; flowers 2-6 (-8) in axil
of each bract | 2 |
| Leaves pinnate or bipinnate, a single flower in axil of each bract | 3 |
| 2. Leaves dentate | <i>L. dentata</i> |
| Leaves entire | <i>L. stoechas</i> |
| 3. Bracts longer than and concealing calyx | <i>L. mairei</i> |
| Bracts as long or shorter than calyx | 4 |
| 4. Stems with long grey villous indumentum | <i>L. multifida</i> |
| Stems glabrous or with short hooked hairs | 5 |
| 5. Spikes 3-4 cm | <i>L. maroccana</i> |
| Spikes 5-8 +cm | 6 |

6. Calyx bilabiate, teeth heteromorphous7
 Calyx not bilabiate, teeth subhomomorphous *L. coronopifolia*
7. Bracts \pm as long as calyx (at least 2/3 calyx length) *L. tenuisecta*
 Bracts 1/2 to 1/3 calyx length *L. brevidens*

Lavandula L., *Sp. Pl.* 572 (1753) [*Gen. Pl.* ed. 5: 631 (1754)].

Section **Dentata** Suarez-Cervera & Seoane-Camba, *Anales Jardin Bot. Madrid* 42(2): 402 (1986).

1. **L. dentata** L., *Sp. Pl.* 572 (1753).

1. Leaves \pm glabrous or slightly pubescent var. *dentata*
 Leaves densely grey pubescent var. *candicans*

var. **dentata**

L. dentata var. *typica* Maire in Jahandiez & Maire, *Cat. Pl. Maroc* 3: 622 (1834) [ined.].

L. dentata forma *albiflora* Maire in Jahandiez & Maire, *Cat. Pl. Maroc* 3: 622 1834 [ined.].

L. dentata forma *multibracteolata* Sennen, *Pl. Esp.*, no. 7675.

NW Africa, S Spain, Balearic Islands, Ethiopia, Saudi Arabia & Yemen Arab Republic. In Morocco widespread especially in the north, reaching the Anti-Atlas.

var. **candicans** Battandier in Battandier & Trabut, *Fl. Algérie* 666 (1890)

Algeria & Morocco. In Morocco limited principally to the northern Mediterranean coast and Atlantic coast North of Agadir.

Section **Stoechas** Gingins, *Hist. Nat. Lavandes* 128 (1826).

2. **L. stoechas** L., *Sp. Pl.* 573 (1753).

1. Peduncles sessile or not longer than flower spike subsp. *stoechas*
 Peduncles 3-10cm, longer than flower spike subsp. *atlantica*

subsp. **stoechas**

L. stoechas f. *brevibracteolata* Sennen, *Pl. Esp.* no. 7678.

Mediterranean Region. Widespread in Morocco, especially in the north on acid soils.

subsp. **atlantica** Braun-Blanquet, *Bull. Soc. Hist. Natu.* 13 (2): 191 (1922).

L. pedunculata (Miller) Cav. var. *atlantica* (Braun-Blanquet) Maire, *Bull. Soc. Hist. Nat. Afr. Nord* 13: 19 (1922).

L. atlantica (Braun-Blanquet) Braun-Blanquet & Maire, *Bull. Soc. Hist. Nat. Afr. Nord* 14: 77 (1923).

Endemic. Limited to mountainous areas in Rif, Middle, High & Anti-Atlas.

Section **Pterostoechas** Gingins, *Hist. Nat. Lavandes*: 128 (1826).

3. **L. multifida** L., *Sp. Pl.* 572 (1753).

N Africa, S Spain, Italy, Sicily. Widespread in Morocco, south into the Anti-Atlas. Often associated with disturbed or degraded habitats.

4. **L. mairei** Humbert, *Bull. Soc. Hist. Nat. Afr. Nord* 18: 157-159 (1927).

1. Plants with a grey pubescent indumentum; SE High Atlas var. *mairei*
- Plant not covered by a grey pubescent indumentum;
- Anti-Atlas var. *intermedia*

var. **mairei**

Endemic. SE High Atlas.

var. **intermedia** Maire, *Bull. Soc. Hist. Nat. Afr. Nord*, 24: 223 (1933).

Endemic. Anti Atlas.

A further variety *antiatlantica* has also been recognised, a plant of generally larger proportions but its relationship is presently uncertain.

5. **L. maroccana** Murbeck *Bot. Notiser*: 269 (1922).

L. abrotanoides var. *attenuata* Ball, *J. Bot. (London)*: 175 (1875).

L. tenuisecta (Cosson) Ball, (pro parte) *J. Linn. Soc., London* 16(96-97): 608 (1878).

Endemic. High Atlas

6. **L. brevidens** (Humbert) Maire, *Bull. Soc. Hist. Nat. Afr. Nord* 20: 33 (1929).

L. coronifolia subsp. *brevidens* Humbert, *Bull. Soc. Hist. Nat. Afr. Nord* 18:155 (1927).

Endemic. Morocco. Middle Atlas, Grand Atlas & Anti Atlas. Chaytor (1937) recognised three varieties. The differences appear to be small and have not been maintained in this treatment.

7. **L. tenuisecta** Cossom ex Ball Journ. Linn. Soc. Bot. 16: 609 (1878)

Endemic. High Atlas.

8. **L. coronopifolia** Poiret in Lamarck & Poiret, *Encycl. Méth., Bot.* 3: 308 (1813).
L. stricta Delile *Fl. Aegypt. Illusr.* 238 (1813).

North Africa (Morocco, Egypt), Arabia (Yemen Arab Republic, Jordan, Saudi Arabia), Iran, NW tropical Africa (Sudan, Ethiopia, Mauritania), Cape Verde Islands. In Morocco restricted to the southern Anti-Atlas. Several varieties are recognised including var. *humbertii* endemic to Morocco and var. *subtropica* endemic to Cape Verde Islands.

Taxonomic Problems

The species delimitations made by CHAYTOR (1937) have proved to be sound, but we have found considerable taxonomic problems at the infraspecific level.

Phenotypic variation in L. dentata - this is a common species with two varieties native in Morocco, the widespread var. *dentata* and var. *candicans*, readily distinguished by its grey pubescent leaves, often associated with coastal environments. During fieldwork in autumn 1993, collections were made from a population which appeared to be var. *dentata*. A further visit to the site the following spring and examination of the same plants showed them to have gained the characteristic grey pubescence of var. *candicans*! Similar observations were made with cultivated material, many taxa collected as var. *candicans* losing pubescence during the winter but regaining it again in the summer. We have never observed plants that were clearly var. *dentata*, gaining or losing pubescence. This illustrates that a large phenotypic factor is involved, probably related to stress physiology, but also that var. *candicans* is genetically distinct. This has led us to hypothesise that populations of var. *candicans* have probably evolved many times in response to environmental stress, related to coastal habitats. This is further supported by the wide variation in the density of pubescence encountered between different populations. This may raise philosophical questions in recognising this variety but at least for practical purposes it seems both appropriate and useful to continue recognising this taxon.

Infraspecific taxa in the widespread species L. coronopifolia - this species has the widest distribution of any *Lavandula* occurring in the Cape Verde Islands in the West and extending across North Africa and into the Middle East. A closely related species *L. sublepidota* Rechinger fil has been described from Iran, but we are unclear if this is a distinct species or falls within the variation of *L. coronopifolia*. Two varieties are generally recognised, var. *humbertii* from Morocco and var. *subtropica* from the Cape

Verde Islands. These varieties are described as differing principally in indumentum type and minor spike, leaf and calyx characters (CHAYTOR, 1937). However, examination of material from across the range of this species indicates a degree of heterogeneity. Identifying discrete and definable variation in this species has proved problematic. This is highlighted by var. *subtropica*, described from the Cape Verde Islands and often cited as occurring throughout the range of the species. If this taxa was restricted to the Cape Verde Islands there would be little problem in recognising the variety, but this variation across its range raises questions as to if this may just reflect natural variation in the species. Our approach to this problem will be to confirm if collections of var. *subtropica* from the African mainland are indeed the same as the Cape Verde populations, in the more dense indumentum distinguishing this variety. The Moroccan var. *humbertii* will also be investigated in a similar fashion, although specimens have proved difficult to distinguish on morphological grounds.

Defining infraspecific taxa in the endemic species L. mairei & L. brevidens - Lavandula mairei is confined to the Anti-Atlas mountains with three varieties recognised by CHAYTOR (1937): var. *mairei*, var. *intermedia* and var. *antiatlantica*. Only two of these varieties have been retained in the course of this present investigation: var. *mairei* distinguished by its grey pubescence and found in the High Atlas; var. *intermedia* a larger plant, non pubescent, occurring in the Anti-Atlas. The third variety var. *antiatlantica* is problematic, principally distinguished by its greater size, 1.25 metres compared to the other varieties which do not reach over 50cm. Herbarium specimens have proved difficult to distinguish and despite visiting recorded localities, we could find no distinct plants matching the description. We suggest that this taxa may just represent a phenotypically large variant.

Lavandula brevidens is endemic to the eastern Middle Atlas and Anti-Atlas, with three varieties recognised var. *ziziana*, var. *moulouyana* and var. *mesatlantica*. Although recorded from different areas, we are unable to satisfactorily identify these taxa on the rather small differences distinguishing them. This appears to reflect the approach of Dr R. Maire who named these varieties in 1929, tending to take a narrow approach to circumscription of variation in contrast to the broader criteria generally employed today.

Biogeographic Links in NW Africa - Examples from *Lavandula*

A number of Moroccan species show distribution patterns that provide support for floristic links between NW Africa and other areas of the Mediterranean, Macaronesia and Arabia. Within Morocco *Lavandula* species can generally be assigned to either of the two floristic regions within Morocco, the Mediterranean and Saharo Sindian (QUÉZEL, 1978), each illustrating various links.

Mediterranean Links - the Mediterranean region is confined to the north of Morocco. *L. stoechas* subsp. *stoechas* is a typical species of these regions and almost circum Mediterranean in its distribution. Other species show more specific links within this area. The well known Moroccan-Spanish link is well illustrated by *L. dentata* and *L. multifida*, both species being confined to the S & SE provinces of Spain. *Lavandula multifida* also supports the Sicilian connection (DAVIS & HEDGE, 1971) through Tunisia

to Southern Italy being native in all these areas. *Lavandula dentata* may also follow this pattern, but it is uncertain if it is truly native in Sicily and Italy.

Macaronesian Links - a connection is suggested between the Mediterranean floristic region and the Canary Islands by *L. multifida*. Our preliminary morphological and molecular studies suggest that these Canarian endemics, *L. canariensis* Miller (also treated as *L. multifida* var. *canariensis* Miller (Kuntze) and *L. multifida* subsp. *canariensis* (Miller) Pitard & Proust, *L. pinnata* L. fil., *L. buchii* Webb & Berth. and *L. minutolli* Bolle, form a distinct clade with *L. multifida* within the section *Pterostoechas*. This suggests that the Canarian endemics are related to and probably derived from *L. multifida*.

S W. Asian Links - several species which are members of the Saharo-Sindian floristic region extend from Morocco (or even Macaronesia) east across North Africa to Arabia and the Horn of Africa. The genus *Lavandula* even illustrates links further east into India. *Lavandula dentata* has a disjunct distribution being native to the western Mediterranean (N W Africa, S Spain, Balearic Islands) and Southern Arabia and Somalia. *Lavandula coronopifolia* is native to the Cape Verde Islands (Macaronesia), Morocco, Algeria, across much of North Africa to Arabia and Iran in the east. These examples clearly support the links between these widely separated areas suggested by DAVIS & HEDGE (1971) and FICI (1991).

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