EX SITU MORPHOLOGICAL ASSESSMENT OF WILD LAVANDULA POPULATIONS IN PORTUGAL

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The genus *Lavandula* L. (Lamiaceae family) belongs to the subfamily Nepetoideae. The tribe Lavanduleae (Endl.) Boiss contain just the single genus *Lavandula*. The *Lavandula* species occur in Portugal, either spontaneously or grown for their ornamental and aromatic value. These species are also used in traditional medicine in the form of infusions, for internal and external uses. The wild populations of this genus are represented by five species and several subspecies in the Portuguese flora. This genus has revealed a complex taxonomy with some taxa known under different scientific names, although under the same common name. In Portugal has been significant research on these species, with significant results, in ethnobotany, essential oils, biological activities and in vitro research. The present assessment aimed to present the Banco Português de Germoplasma Vegetal contribution to the ex situ conservation of *Lavandula* species genetic resources: ex situ evaluation of *Lavandula stoechas* and *L. pedunculata* wild genetic resources, the need to plan new collecting missions and, the prospects for the use of genetic variability preserved in this collection. The main results of the morphological assessment showed that *L. stoechas* presents greater morphological diversity.

Keywords: *Ex situ* conservation, resources genetics, morphological descriptors

1. Introduction:

The genus *Lavandula* L. (Lamiaceae family) belongs to the subfamily Nepetoideae. The tribe Lavanduleae (Endl.) Boiss contains only a single genus Lavandula. *Lavandula* name derives from the Latin "lavare" which means to wash. It consists of 39 species with a wide geographical distribution: from the Macaronesian region, throughout the Mediterranean coast, North Africa, Arabian Peninsula and from South Asia to India. The taxonomy of this genus has undergone several taxonomic changes due to their morphological variability and capacity for hybridization. These are two approaches for plant description and classification also applied to the *Lavandula* Genus where polymorphisms and

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chemiotypes are known.

In Portugal mainland and islands as well as in many other countries, the various *Lavandula* species are used for aromatic purposes and also as medical and cosmetics. The lavender scent is very popular in pillows, bath care, home and pet products and provides a unique taste to many beverages, sweets, jellies, jams, marmalades, honey and condiments. It is very popular in traditional medicine and religious ceremonies, as well as for melliferous and ornamental purposes. Also, recent studies showed that the essential oils have an important antifungal activity.

The Flora Iberica (Morales 2010), is the most recent publication describing the *Lavandulas* of the Iberian Peninsula, says 8 species: *L. angustifolia* (subsp. *pyrenaica*), *L. latifolia*, *L. lanata*, *L. stoechas* (subsp. *stoechas* and *luisieri*), *L. pedunculata*, *L. viridis*, *L. dentata* and *L. multifida*.

In Portugal the taxonomy of the genus *Lavandula* has undergone several taxonomic changes due to their morphological variability and capacity for hybridization.

Besides the effect of the high polymorphism resulting of the hybridization in nature, other phenomena are added. Various scientific names identify the same vernacular name, more commonly, rosemary, lavender or lavender. Depending on region of the country and under the common name rosemary, include various species of the genus *Lavandula*, namely *L. pedunculata* (Mill.) Cav. (rosemary, butterfly lavender, Portuguese long-stalked lavender), *L. stoechas* L. (rosemary, topped lavende, lavander) and *L. luisieri* (Rozeira) Rivas-Martínez (rosemary, butterfly lavender, Portuguese short-stalked lavender) in Portugal Continental, *L. dentata* L. and *L. viridis* L'Hér. (rosemary) in Madeira and *L. viridis* L'Hér. (rosemary, lavender-green) in the Azores. In the Azores, rosemary can be still a common name assigned to a species belonging to a botanical family different (Ericaceae), *Vaccinium cylindraceum* JE Sm., Also known as “uva-da-serra” or blueberry bush. (Cristina Figueiredo 2014).

In Portugal, there are significant research on these species, with significant results, in areas of knowledge, like ethnobotany, essential oils, biological activities and *in vitro* research (Barata et al. 2010, 2011). While genetic resources morphologically studied, there are not many examples to *Lavandula* species: Zuzarte 2013, Zuzarte et al. 2009, Feijão et al. 2011, Teixeira et al. 2013 (micromorphology) and Delgado 2010, Prazeres 2014 with morphometric studies. In France other studies have been conducted to the Genus *Lavandula* in which various fields of knowledge are integrated (Benabdelkader 2012, Guitton 2010).

The Food and Agriculture Organization of the United Nations (FAO) in its Second Report on the State of the World’s Plant Genetic Resources for Food and Agriculture, on what global germplasm holdings is concerned, show that a total of 160,050 accessions of medicinal, aromatic, spice and stimulant crops are maintained in gene banks worldwide, while botanical gardens, globally, have about 1,800 medicinal plant taxa represented in their collections (Barata et al. 2016). Morphological characterization and evaluation data of *ex situ* collection of 19, 500 accessions has been carried out in 3, 446 accessions.

The conservation of medicinal and aromatic plants (MAP) is a global and important goal for the sustainability of plant genetic resources in the world (Barata et al. 2016). In 2002, a global Plant Conservation Strategy was launched that set a long term task, no species of wild flora should be endangered and at least 30% of all based plant based products should derived from sources that are sustainable managed. Recognizing the importance of the MAP conservation, the Steering Committee of the European Cooperative Programme for Plant Genetic Resources (ECPGR), during its eighth meeting, in October 2001, agreed on the establishment of the Medicinal and Aromatic Plants Working Group (MAPWG). In last decade international standards (International Standard on Sustainable Wild Collection of MAPs ISSC-MAP, Guidelines for Good Agricultural (and Collection) Practice of MAPs GA(C)P, FairWild Standard and Certification) of the sustainable exploitation and management of MAP natural resources have become an required from both environment protection and socio-economic points of view.

In 2009 the Portuguese Genebank (BPGV) started the collecting missions and *ex situ* conservation of *Lavandula* species. Between 2009 and 2010, a joint multi crop collecting mission, that included Medicinal and Aromatic Plants (MAPs), with BPGV and two other National Institutions, took place in Alentejo Region, Portugal, During these collecting missions, 54 samples of *Lavandula* species were collected. Between 2011 and 2014, the collecting missions continued for Medicinal and Aromatic Plants (MAPs), and they took place in the northeast region of Portugal and 35 accessions of *L. pedunculata* were collected. The selection for sampling locations, considered not only the distance between sites, but also the altitude. This approach has the advantage of ensuring differences between sampling sites, which are likely to be relevant to future users. The collection and classification of species were done by Filomena Rocha and Carlos Gaspar (Lopes et al. 2015, Rocha et al. 2013). It was followed the Flora Iberica (Morales 2010).

The BPGV *Lavandula* collection includes a total of 91 wild accessions. *L. pedunculata* (Mill.) Cav. is the largest species represented (62 accessions) followed by *L. stoechas* L. (26 accessions), *L. viridis* L'Her. (2 accessions), and *Lavandula* spp. (1 accession). The *L. pedunculata* gene pool was collected between 100 and 1000 m of altitude and the *L. stoechas* gene pool original from altitudes between 47 and 600m. However both gene pools were more frequent at altitudes between 100 and 300 m. The geographical area prospected and collected indicated that the presence and frequency of species follows the geographical distribution proposed in Upson and Andrews, 2004 (Benabdelkader 2012, Guitton 2010).

The main objective is to present the main achievements of the Portuguese Genebank concerning the morphological outcomes for wild genetic resources of aromatic plants, endemic to the southern region of the Iberian Peninsula and a part of the *Stoechas* section of the Lamiaceae family, *L. stoechas* and *L. pedunculata* conserved in *ex situ* conditions.

2. Materials and methods:

The 30 accessions from BPGV collection were morphologically characterized between 2011 and 2014 (17 accessions of *L. stoechas* gene pool and 13 of *L. pedunculata* gene pool (Table 1, http://bpgv.iniav.pt/gringlobal/)) followed the guidelines of the International Biodiversity, considering descriptors utilized by Delgado et al. 2010, adapting descriptors used by UPOV (The International Union for the Protection of New Varieties of Plants) and others that were created considering the taxonomy of the genus *Lavandula* L. (Maria Lis-Balchin 2002, Upson and Andrews 2004).

Table 1. Identification of the accessions characterized from BPGV seed MAP collection

Nº accession	Species	District	Region
BPGV11290	*Lavandula pedunculata* (Mill.) Cav.	Bragança	Northeast
BPGV11308		Bragança	Northeast
BPGV09845		Évora	South
BPGV10391		Évora	South
BPGV09838		Évora	South
BPGV10372		Portalegre	South
BPGV10379		Portalegre	South
BPGV10412		Portalegre	South
BPGV10369		Portalegre	South
BPGV10378		Portalegre	South
BPGV10418		Portalegre	South
BPGV10387		Portalegre	South
BPGV10400		Portalegre	South
BPGV09857	*Lavandula stoechas* L.	Beja	South
BPGV09858		Beja	South
BPGV09850		Beja	South
BPGV09852		Beja	South
BPGV09854		Beja	South
BPGV09862		Beja	South
BPGV09864		Beja	South
BPGV09866		Beja	South
BPGV09902		Beja	South
BPGV09839		Évora	South
BPGV09848		Évora	South
BPGV09841		Évora	South
BPGV09837		Évora	South
BPGV09870		Setúbal	South
BPGV09867		Setúbal	South
BPGV09868		Setúbal	South
BPGV09911		Setúbal	South

A total of 47 traits were observed in 20 plants by accession during two cycles of life (Table 2). There have been no fertilizer or phytochemicals applications and drip irrigation held 1 to 2 times per week.

Table 2. Morphological characteristics evaluated in *ex situ*

Observations before flower stem development
Plant
1. Growth habit (1-upright, 3-bushy, 5-globular, 7-spreading or prostrated)
2. Intensity green color of foliage (3-light, 5-medium, dark-7)

3. Plant height (cm)
4. Intensity of gray tinge of foliage (1 absent or very weak, 3-weak, 5 – medium, 7-strong; 9 very strong)
5. Density at full flowering (3-open, 5-medium 7-dense)
6. Attitude of outer flowering stems in full bloom (3-erect; 5-semi erect; 7-spreading)
Observations on main flowering stem at the time of full flowering
Leaf
7. Intensity of incisions of margin (3-absent; 5- weakly expressed; 7 strongly expressed)
8. Type margin (1-whole; 3 weakly indented; 5 strongly cut, 7-crenada toothed; 9-penatifendida; 11-sub-penatifendida; 15-revolute ondulate)
9. Limbo form (1-Straight, 3-straight oblong, 5-lanceolate, oblong-7, 9-oblong-lanceolate, 11-oblong-oblonceolada; 12-ovata lanceolate; 13- linear oblanceolate)
10. Leaf shape at the apex (3-obtuse; 5-cuspidate; 7-incised; 9-acuminate; 11- agude; 15-retuso)
11. Hairiness (1- glabra; 3-pulverulent; 5-tomentosa; 7-villous pubescent)
Floral Stem
12. Length with spike (cm)
13. Thickness of 1/3 medium without spike (1-very thin, 3-thin, 5-medium; 7-thick, 9-very thick)
14. Section peduncle (1-foursquare, 3-round)
15. Intensity of green color (1-very light; 3-light, 5-medium, 7-dark; 9 very dark)
16. Rigidity of basal part of the floral stem (3-weak; 5-medium; 7 strong)
17. The presence of lateral branching above the foliage (1-absent; 9-present)
18. Intensity of pubescence (3-weak; 5-medium; 7 strong)
19. Number of lateral branches above the foliage (3- few, 5-medium, 7-many)
20. Length of longest lateral branch above foliage (including spike) (cm or 3-short, 5-medium; 7-long)
Spike
21. Length of spike peduncle (cm)
22. Maximum width (cm or 1-very narrow, 3-narrow, 5-medium, 7-broad, 9-very broad)
23. Total length, including the 1st whorl (cm)
24. Length from the 2nd whorl (cm)
25. No. of whorls excluding 1st whorl (number or 3-few, 5-medium; 7-many)
26. Distance between whorls, excluding 1st whorl (1-very short, 3-short, 5-medium; 7-long, 9 very long)
27. Shape (1-narrow conical, 3-conical, 5-truncated conical, 7-cylindrical, 9-sub-cylindrical, 11-ovoid, 13-fusiform; 15 narrow trullate)
28. No flowers (3-few, 5-medium, 7-many)
29. No. of flowers on apical whorl (number)
Bracts
30. Width of fertile bracts (cm or 3-narrow, 5-medium; 7-broad)
31. Form of lower fertile bracts (1-Linear ;3-lanceolate-linear;5-cuneiform;7-obovate;9-obovate-rhomboid;11-rhomboid-ovate;13-obovate-orbicular;15-ovate-orbicular;17-ovadamucronada;19-cordata-reniform;21-cordata-mucronata;23-obtriangular;25-sub-orbicular;27-sub-rectangular;29-cordata)
32. Main color of fertile bracts (1-white, 3-green, 5-green-yellowish, 7- green-greyish; 9-violet, 11-red purple, 13-Brown, 15-purple)
33. Infertile bracts Presence (1-absent; 9-present)
34. Length of infertile bracts (cm or 3-short, 5-medium; 7-long)
35. Shape of infertile bracts (1-linear; 3-eliptica; 5-oblonga; 7-lanceolada; 9-sub-orbicular; 11-ovate; 13-obovate; 15-oboval-orbicular; 17-espatulade)
36. Main colour of infertile bracts (1-white, 3-green, 5-green, 7-yellow, 9-purple, 11- pink, 13- light pink, 15-violet)
37. Curling degree of margin of bract infertile (3-weak; 5-medium; 7 strong)
38. Petiole length of infertile bracts (cm)
39. No. of infertile bracts
Bracteoles
40. Degree of presence (1-sometimes present; 3-always present)
41. Bracteole length (mm or 3-short, 5-medium; 7-long)
Flower
42. Calyx color (1-greenish, 3-purplish, 5-violet; 7-greyish)
43. Hairiness of the calyx (3-weak; 5-medium; 7 strong)
44. Pubescence of the calyx (1-tomentose, 3-puverulento; 5-villous; 7-flaky-villous; 9-hirsuta)
45. Corolla color (1-white; 3-pink, 5-purple; 7-dark purple; 9-violet, 11-whitish-violet; 13 light-blue, 15 blue,

17 dark-blue, 19 blue-purple)
46. Length corolla (mm or 3-short, 5-medium; 7-wide)
47. Time of flowering beginning (nº days since 1st January)

Statistical analysis of data was made as described in Lopes et al. 2010: morphological *Lavandula* sp. data (Tables 4 and 5) were submitted to one-way analysis of variance using MSTAT (MSTAT-C version 2.1, Michigan State University, USA) (Russell 1994). The one-way analysis of variance allowed the selection of the descriptors that differentiated the populations and these were then selected for cluster analysis. Only the morphological characters that differentiated the accessions and were not redundant, were used in the cluster analysis using Numerical Taxonomy Multivariate Analysis System (NTSYS-pc software, version 2.2, Exeter Software, Setauket, New York) (Rohlf 2000). Classification of accessions using morphological data was performed by means of un-weighted pair-group method using arithmetic average (UPGMA) algorithm based on Euclidean distances. Prior to squared Euclidean distance calculation, the data were standardized to have a mean of zero and a variance of one.

3. **Results and discussion**

3.1. Results

Fifteen of forty-seven descriptors were the most important to differentiate accessions, mainly those concerning the inflorescence. Seven of spike characteristics were more relevant for morphological variability analysis (descriptors code 21, 23, 30, 34, 38, 39, 47, table 3, Figure1).

Table 3. Morphological variability between *L. stoechas* e *L. pedunculata* to seven descriptors

Main descriptors	*L. stoechas*	*L. pedunculata*
Peduncle Length	6.70 – 3.52 cm	>9 cm
Size of skipe	> 3,0 cm in both species	
Nº of infertile bracts	4 – 7.71	4 – 6.3
	more variability to *stoechas* gene pool	
Length of infertile bracts	1.4 – 2.65 cm	1,81 – 2.46 cm
	more variability to *stoechas* gene pool	
Petiole of infertile bracts	usually absent	present
Width of fertile bracts	0.82 – 1.08 cm	0.63 – 0.90 cm
Time flowering beginning	96 – 150 days	
	more variable to *stoechas* gene pool	

The group of populations classified as *L. stoechas* (*Sensu Lato*) was characterized in *ex situ* conditions by spike shape truncated conical and the metric morphological descriptors were more heterogeneous between accessions. The intensity of incisions of the leaf margin weakly expressed or strongly expressed and the size of leaves was heterogeneous. The shape of the fertile bracts was frequently the biotype cordata and cordata-reniform (descriptors 29 and 19). The pubescence of the

Figure 1. Morphological variability observed to spike descriptors to *Lavandula* sp.accessions (*Senso Lato*)

calyx was tomentose or puverulento. The infertile bracts, as the limb form, was described as lanceolate or oblanceolada and presented the margin with weak degree of curling (Table 4).

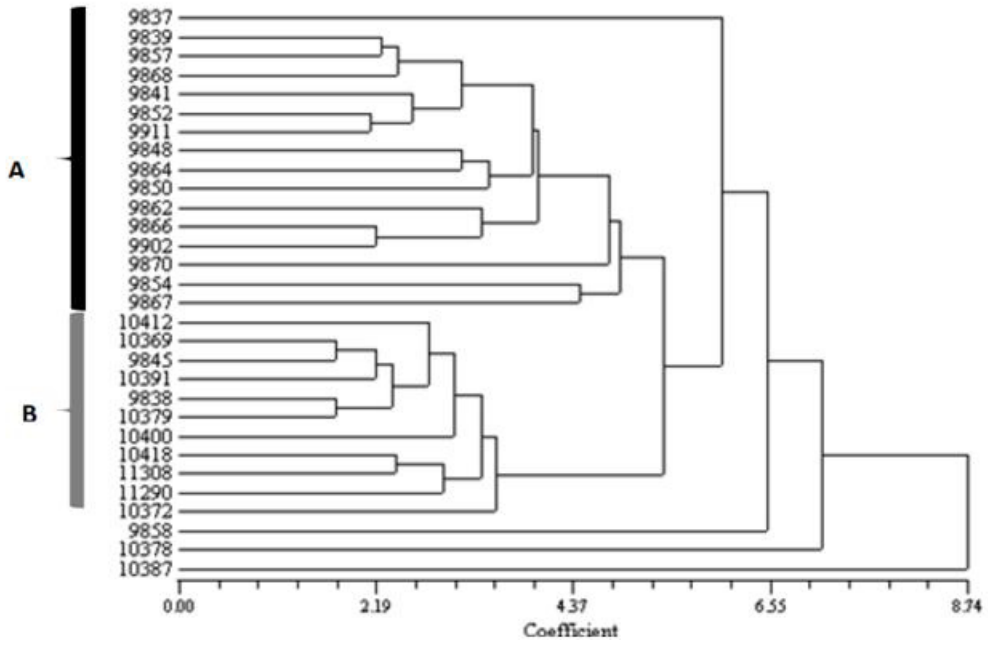
With regard to the *L. pedunculata* group (*Sensu Lato*) of populations, in *ex situ* characterization, presented the spike shape cylindrical and the limb form linear or oblong lanceolate or ovate lanceolate and fertile bracts shape was mostly orbicular, but it was also recorded the bio forms cordata, ovata and obovata-orbicular; all biotypes with the expression "mucronata" very frequent in records. The intensity of incisions of leaf margin was absent to *L. pedunculata* accessions and the size of leaves was regular. The pubescence of the calyx was hirsute and villous. The infertile bracts observed is described as elliptic whose margin presents a greater degree of curl.

Comparing both gene pools characterized, the *L. pedunculata* was characterized by the greater length of peduncle spike being observing the relationship of peduncle is equal to 4 x the length of the spike, while in *L. stoechas* is 1-2 x. Also, it presented in relation to *L. stoechas*: less number of whorls, fewer flowers in the apical whorl and less number of bracts infertile. It was earlier and it has smaller number of flowers (Table 5). Both gene pools presented the calyx with the posterior lip modified into an appendage.

Main morphological results obtained for the significant morphological descriptors, related to the inflorescence (13 traits), plant height and the flowering date (Tables 2, 3, 4, Figure 2) allowed the clustering of accessions into 6 clusters (4 of them were accessions individualized). The *L. stoechas* accession 09837, presented floral stem without pubescence and it was the more early accession among the samples species and the 09858 accession was the biotype with high plant height and higher number of flowers on apical whorl. The accessions classified as *L. pedunculata* 10378 and 10387 were separated by different relationship between length of spike and of peduncle spike and the fertile bracts shape not expressed as orbicular and, the pubescence of the calyx was tomentose. The *L. pedunculata* accession BPGV10400 was the single sample that presented short bracteoles.

The classification by phenogram shows the *stoechas* "gene pool" (cluster 2 between 09839 and 09867) has higher genetic variability than *pedunculata* "gene pool" (cluster 3 between 10412 and 10372) from Alentejo region. In general, for the same species, the accessions didn´t cluster by origin (table. 1, Figure 2). However the clustering of accessions shows that there is genetic relationship between gene pools.

Figure 2. Phenogram of thirty accessions of the genus *Lavandula* for 15 morphological traits (Euclidian distance, coefficient of cophonetic =0.89): A *L. stoechas*; B *L. pedunculata*



Discussion

Upson and Andrews (2004) consider the subgenus *Lavandula* the sections: *Lavandula*, *Dentatae* Suárez-Cerv. & Seoane-Camba e *Stoechas* Ging. and include at this the species: *L. stoechas* L. subsp. *stoechas*; *L. stoechas* L. subsp. *luisieri* (Rozeira) Rozeira, *L. pedunculata* (Miller) Cav. subsp. *pedunculata*; *L. pedunculata* (Miller) Cav. subsp. *cariensis* (Boiss.) Upson & S. Andrews, *L. pedunculata* (Miller) Cav. subsp. *atlantica* (Braun-Blanq.) Romo; *L. pedunculata* (Miller) Cav. subsp. *lusitanica* (Chaytor) Franco; *L. pedunculata* (Miller) Cav. subsp. *sampaiana* (Rozeira) Franco e *L. viridis* L'Hér. and six hybrides.

In Flora Ibérica, Morales (2010) to Iberian Peninsula, referes 8 species: *L. angustifolia* (subsp. *pyrenaica*), *L. latifolia*, *L. lanata*, *L. stoechas* (subsp. *stoechas* and *luisieri*), *L. pedunculata*, *L. viridis*, *L. dentata*, and *L. multifida*. In Flora European, Guinea (in Tutin et al. 1972) divides *L. stoechas* species in 6 subspecies different: *stoechas*, *cariensis*, *pedunculata*, *lusitanica*, *luisieri* and *sampaiana*. Rivas-Martinez et al. 1979, 1990, proposes eleven new combinations nomenclatural for the Iberian taxa, including the species *L. sampaiana* (Rozeira) (Basinómio *L. stoechas* subsp. *sampaiana*) and the species *L. sampaiana* subsp. *lusitanica* (Chaytor) (Basinómio *L. pedunculata* var *lusitanica*).

No reported studies on this Genus in Portugal identify the species as *L. stoechas* subsp *stoechas*. *L. stoechas* subsp *luisieri* is the species identified in Portugal. Amaral Franco (1971) considers three subspecies of *L. pedunculata*: subsp. *pedunculata* in northwest Portugal, subsp. *sampaiana* in north and central Portugal and subsp. *lusitanica* in central and south Portugal. Later, the Portuguese botanic indicates in the "Nova Flora de Portugal" five species being *L. stoechas* and its infra specifics categories distributed by two distinct species: *L. luisieri* and *L. pedunculata* (subsp. *pedunculata*, subsp. *sampaiana* and subsp. *lusitanica*).

Prazeres (2014) detects three distinct taxa: *Lavandula sampaioana* (Rozeira) Rivas Mart, *Lavandula pedunculata* (Mill.) Cav. subsp. *lusitanica* (Chaytor) Franco and *Lavandula stoechas* subsp. *luisieri* (Rozeira) Rozeira.

Previously, Delgado (2010a, b) reveals the presence of *L. luisieri*. In their study the metric descriptors as the height of the flower stem and peduncle length was greater in *ex situ* characterization and, the descriptors more relevant were similar to our outcomes: the inflorescence descriptors.

The morphological outcomes, achieved for *Lavandula* wild genetic resources *ex situ* conserved, show the *L. pedunculata* gene pool morphologically similar to the species *L. pedunculata* (Mill.) Cav. subsp. *lusitanica* (Chaytor) described by Upson and Andrews (2004) and Benabdelkader (2012). Although Morales does not consider the subspecies *lusitanica*, the results for length of peduncle spike are those described by the author, the length of peduncle spike higher and more than 2x the length spike. To the *L. stoechas* gene pool in *ex situ* conservation and, considering the geographic distribution presented by Upson and Andrews (2004) and supported by Guitton (2010), the morphological results lead to the

classification as *L. stoechas* L. subsp. *luisieri* Rozeira, like that recorded by Delgado (2010 a, b) and Prazeres (2014).

It is confirmed the polymorphism of this Genus, being the gene pool of *L. stoechas* from South of Portugal more polymorphic concerning metric descriptors. *L. stoechas* share a common ancestor with *L. pedunculata*, with a maternal lineage common, but its geographical distribution is large (S. Moja et al. 2015) and the natural hybridization more probable. In Portugal the geographical distribution of *L. stoechas* subsp. *luiseri* Rozeira is larger than *L. pedunculata* (Mill.) Cav. subsp. *lusitanica* (Chaytor) (Upson and Andrews 2004, Benabdelkader 2012) and the natural crossings increase the morphological polymorphism. The variability between populations is significant and the clusters are not related to the origin of population. The results concerning *L. stoechas* subsp. *luiseri* suggest it must be treated as a distinct species like it is presented in research of S. Moja (2015) and S. Arantes et al. (2016).

Look to classification and description of Upson and Andrews (2004), reporting the geographical distribution of the *Lavandula* species proposed by those authors, to which is added the classification of Franco (1984), the results obtained in *ex situ* characterization from BPGV collection measured by results of Prazeres (2014) e Delgado (2010), allows to adjust the taxonomy of the *Lavandula* Genus collection, *ex situ* conserved in Portugal.

4. Conclusions:

The geographic distribution proposed by Upson and Andrews (2004)., supports the importance of The South of Portugal as one of the natural areas for *in situ Lavandula* spp. Conservation.

The *ex situ* collection characterized considered two species, *L. pedunculata* (Mill.) Cav. subsp. *lusitanica* (Chaytor) and *L. stoechas* L. subsp. *luisieri* Rozeira.

The taxonomic classification of the species supported in Flora Iberica (Morales, 2010) is improved and gets closer to the one considered by Franco (1984) to Portugal. This approximation should be re-evaluated with future biochemical evaluation, confirming or not the differences between these gene pools described in Portugal for these two species.

In order to achieve a better knowledge about the wild *Lavandula* genetic resources, chemical composition and micromorphology of the Portuguese taxa is important, as a tool to assist in the difficult differentiation of subspecies and varieties, within this Genus, due to his high polymorphism.

It is important to pursue the *Lavandula* collection characterization, as well as the collecting missions, promoting a larger biodiversity preservation and genetic resources evaluation for the sustainable use.. Complementary studies such as essential oils and glandular structures analysis are an advantage for a better knowledge of the *Lavandula ex situ* BPGV collection.

Competing interests

The authors declare that they have no competing interests.

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Table 4. Average values of the main characteristics to *L. stoechas* L.

		L. stoechas gene pool																
	Descriptor code	*9837*	*9839*	*9841*	*9848*	*9850*	*9852*	*9854*	*9857*	*9858*	*9862*	*9864*	*9866*	*9867*	*9868*	*9870*	*9902*	*9911*
Floral Stem	12	34.3	42.5	36.0	38.6	38.0	33.3	50.2	44.6	51.7	40.1	49.8	36.8	35.7	41.7	38.7	33.2	34.8
Spike characteristics	21	6.2	4.7	5.4	4.4	4.8	4.7	4.8	5.0	5.3	4.6	4.3	4.6	5.6	5.8	3.5	6.7	5.4
	18	0.0	6.3	5.0	7.0	7.0	5.0	3.0	5.0	7.0	3.0	7.0	3.0	3.2	5.0	7.0	3.0	5.0
	22	1.0	1.1	1.2	1.1	1.0	1.1	1.2	1.1	1.3	1.2	1.2	1.2	1.2	1.0	1.0	1.0	1.0
	23	5.9	3.9	4.1	4.4	3.4	2.5	3.3	2.8	4.0	4.3	3.8	3.7	4.6	3.1	3.3	3.5	3.0
	25	4.0	5.3	6.2	6.8	5.9	4.2	5.3	5.4	7.5	7.6	6.2	5.7	8.0	5.8	5.4	6.3	6.3
	28	5.0	4.3	3.8	3.9	3.0	3.6	3.3	3.8	3.5	3.4	3.8	5.0	3.5	4.3	4.4	3.0	4.3
	29	11.5	13.4	10.8	14.6	11.6	14.9	11.3	9.8	18.5	10.8	9.4	9.3	11.9	8.8	10.4	8.0	16.3
	30	0.9	1.0	1.0	1.0	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.0	1.0	0.8	1.0	1.0	0.8
	39	7.0	5.4	4.8	4.5	6.6	6.3	4.3	5.2	4.0	6.3	6.1	7.3	6.1	5.2	7.7	5.7	6.0
	34	1.6	1.8	2.0	2.7	2.4	1.8	2.3	1.6	1.6	2.6	2.6	2.3	2.1	2.1	1.4	2.3	1.9
	38	0.2	0.0	0.1	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.1
	35	19.0	5.0	7.0	7.0	19.0	3.0	5.0	3.0	19.0	19.0	7.0	5.0	3.0	7.0	19.0	5.0	5.0
	37	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Time of flowering beginning	47	96.0	142.5	114.9	110.8	114.4	116.1	150.3	117.4	140.6	101.8	119.2	107.1	123.5	127.0	124.1	101.0	118.0

Table 5. Average values of the main characteristics to *L. pedunculata* (Mill.) Cav.

		L. pedunculata gene pool												
	Descriptor code	**10412**	**10387**	**10418**	**10378**	**10369**	**9838**	**11290**	**11308**	**10379**	**10372**	**9845**	**10391**	**10400**
Floral Stem	12	40.4	34.7	40.9	40.3	35.9	40.9	30.1	35.6	41.9	30.7	35.2	40.4	39.1
Spike characteristics	21	10.2	4.2	15.5	11.4	15.5	15.9	11.9	13.1	16.2	9.0	15.3	16.2	15.0
	18	5.7	5.0	5.5	6.0	5.0	6.2	5.0	6.1	5.0	6.6	5.5	6.3	6.6
	22	1.2	1.1	1.2	1.1	1.0	1.3	1.0	1.0	1.4	1.1	1.1	1.0	1.3
	23	2.6	2.7	3.2	2.7	2.8	3.5	2.1	2.5	3.8	3.6	3.0	3.5	3.2
	25	4.1	4.0	3.8	3.7	3.5	4.4	3.2	3.0	4.4	4.6	4.7	4.9	5.1
	28	5.0	4.8	5.0	4.1	4.4	4.7	4.5	5.0	5.0	4.8	5.2	5.4	4.2
	29	6.1	4.9	4.9	2.6	3.4	4.4	3.3	6.5	4.8	4.2	5.9	5.5	10.9
	30	0.6	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.8	0.9	0.7	0.8
	39	5.6	5.7	4.0	4.2	5.2	4.7	4.0	3.3	5.8	5.3	5.5	5.2	6.3
	34	1.9	2.3	2.5	2.4	2.3	2.4	2.2	2.2	2.3	1.8	2.3	2.4	2.3
	38	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
	35	3.0	7.0	3.0	3.0	7.0	3.0	1.0	3.0	3.0	7.0	3.0	3.0	1.0
	37	4.4	6.0	4.5	3.8	4.8	5.4	3.8	5.0	5.4	4.8	5.0	4.6	3.5
Time of flowering beginning	47	108.0	146.6	131.2	113.8	100.9	103.4	104.8	123.0	103.4	99.0	108.4	108.2	98.6

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