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Contribution for the Taxonomical Study of *Salix* (*Salicaceae*) in the Portuguese Mediterranean region

Abstract

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Genus *Salix* has not been yet a sufficiently studied taxon in Portugal. The authors aim to clarify some taxonomical issues and add some new information about this genus. Preliminarily, a bibliographical survey concerning the geographical scope of Portugal and Spain only, was made in order to prepare tentative key for the genus. Furthermore, taxonomical assessment was based in samples collected along the Portuguese Mediterranean Region. Fieldwork included recording of morphological and ecological characters that could be only observed *in situ*. For these, voucher specimens were also taken and kept in LISI, for further record of morphometric features. Specimens from Bragança (BRESA), Vila Real (HVR), Porto (PO) and Lisbon (LISI) *herbaria* were also studied. Characters selected for description are mostly those used by Crovello (1969), Paloma Blanco (1986), Vasconcellos (1970), Franco (1971), Díaz González & Llamas (1987), Thiébaud (2000), but also others based in criteria of constancy and believed to yield some taxonomical significance, namely those possessing higher correlations with the former. Thus, a preliminary study of both living and dried material supports the total list of characters. Based solely in morphometric features, a preliminary phenetic classification was approached using a clustering procedure – UPGMA and Bray-Curtis coefficient – by means of the NTSYS-PC™ program.

Introduction

The study of genus *Salix* L. has not been yet sufficiently developed in Portugal. Most authors have considered the category of species or subspecies but not hybrids with enough detail, and there is also some irresolute questions in the description of species. One reason that could explain this situation is that hybrids are very frequent in this genus and there is a great foliar polymorphism (Ferreira de Almeida 1944; Franco 1971; Blanco 1986; Thiébaud 2000). Rechinger (1992) points out that there are no or very reduced sterility barriers even between certain not closely related taxa, and that the fertility of hybrids in many cases is not at all or only slightly reduced. This creates difficulties mainly when studying taxa with overlapping areas.

Objective

The authors aim to clarify some taxonomical issues and add some new information about this genus.

Materials and methods

BIBLIOGRAPHICAL SURVEY

Preliminarily, a bibliographical survey concerning the geographical scope of Portugal and Spain, was made in order to prepare tentative key for the genus.

FIELDWORK

All the studied specimens (202 plants) were collected in the field, except *Salix triandra* L. subsp. *discolor* (Koch) Archangeli, *S. purpurea* L. subsp. *lambertiana* A. Neumann ex Rech. fil. and *S. repens* L. subsp. *repens*, which came from the herbaria of Bragança (BRESA), and Porto (PO). The fieldwork was carried out from February to July of 2001 along the Portuguese Mediterranean Region and included recording of morphological and ecological characters that could be only observed in situ. For these, voucher specimens were also taken and kept in LISI, for further record of morphometric features. Specimens from Vila Real (HVR) and Lisbon (LISI) herbaria were also studied. Ornamental cultivated *Salix*. were excluded from the study.

CHARACTER SET

Characters selected for description are mostly used by Crovello (1969), Vasconcellos (1970), Franco (1971), Blanco (1986), Díaz González & Llamas (1987), Tutin & al. (1993), Thiébaud (2000), but also others based in criteria of constancy (Radford & al. 1974) and believed to yield some taxonomical significance, namely those possessing higher correlations with the former. According to Sneath and Sokal (1973), at least 60 variables are required to obtain good results in morphometrics. However, other authors obtained correct results with 31 and 26 characters (Thiébaud 2000).

This study was based in 62 characters, including continuous (14), ordinal (23) and qualitative binary (19) variables. From this character set, 50 are vegetative and 12 reproductive. Although sexual characters are believed to be more constant (Lawrence 1961), some authors accept the vegetative as good characters in *Salix* (Díaz González & Llamas 1987) and good results have been obtained even with a solely foliar set of characters (Thiébaud 2000). Furthermore, as many species of *Salix* are precocious, more than a half of the samples had only vegetative characters. Therefore, the authors decided to develop in detail the vegetative set. The measure of characters followed criteria used in previous studies (Thiébaud 2000) but other criteria were also established by the authors in order to reduce the subjectivity:

- always measure mature organs;
- for every individual 5 organs were measured, excluding aberrant forms;
- the same person measures the same kind of characters;
- all angles were converted in Stearn (1995) classes.

Table 1. Distribution of taxa.

<i>Taxon</i>	Number of individuals	%
<i>S. atrocineria</i> Brot.	53	29
<i>S. x secalliana</i> Pau & Vicioso (<i>S. atrocineria</i> Brot. x <i>S. salviifolia</i> Brot.)	25	14
<i>S. x pseudosalviifolia</i> (<i>S. elaeagnos</i> Scop. subsp. <i>angustifolia</i> (Cariot) Rech. fil. x <i>S. salviifolia</i> Brot.)	23	13
<i>S. alba</i> L.	15	8
<i>S. x multidentata</i> T. E. Díaz & F. Llamas (<i>S. atrocineria</i> Brot. x <i>S. triandra</i> subsp. <i>discolor</i> (Koch) Arcangeli)	15	8
<i>S. x erythroclados</i> Simonkai (<i>S. alba</i> L. x <i>S. triandra</i> subsp. <i>discolor</i> (Koch) Arcangeli)	13	7
<i>S. x rubens</i> Schrank (<i>S. alba</i> L. x <i>S. fragilis</i> L.)	11	6
<i>S. neutricha</i> Görz	7	4
<i>S. salviifolia</i> Brot.	7	4
<i>S. quercifolia</i> Sennen (<i>S. atrocineria</i> Brot. x <i>S. caprea</i> L.)	4	2
<i>S. fragilis</i> L.	3	2
<i>S. purpurea</i> subsp. <i>lambertiana</i> (Sm.) A. Neumann ex Rech. Fil.	2	1
<i>S. repens</i> L. subsp. <i>repens</i>	2	1
<i>S. repens</i> L. subsp. <i>arenaria</i> (L.) Hiitonen	2	1
<i>S. triandra</i> subsp. <i>discolor</i> (Koch) Arcangeli	1	0,5
TOTAL	183	100

IDENTIFICATION OF SPECIMENS

All the individuals were identified according to Díaz González & Llamas (1987) key except taxa absent in the area of that work (*S. repens* L. subsp. *repens* and *S. repens* L. subsp. *arenaria* (L.) Hiitonen) for which *Flora Europaea* was consulted.

DATA PROCESSING

Based only in morphometric features, a preliminary phenetic classification was approached using a clustering procedure – UPGMA and Bray-Curtis coefficient - by means of the NTSYS-PC™ program. The individuals with more than 30% or 40% of missing values were eliminated of the analysis. From the initial character set, characters, which provide little information were also eliminated of the analysis resulting 35 vegetative characters and 11 reproductive characters.

Results and discussion

RESULTS OF THE IDENTIFICATION

The distribution of taxa used in data processing (183) after the elimination of individuals with more of the 30% of missing values can be observed in Table 1.

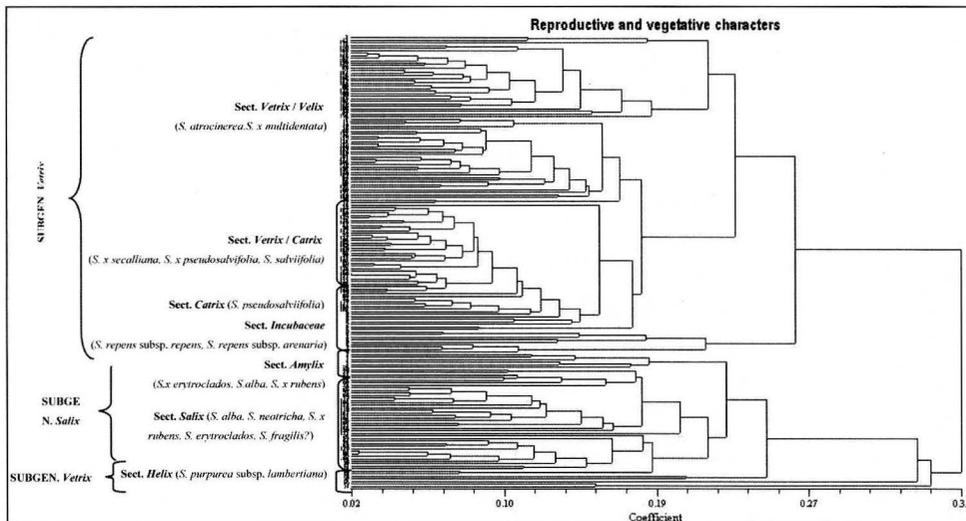


Fig. 1. Reproductive and vegetative characters.

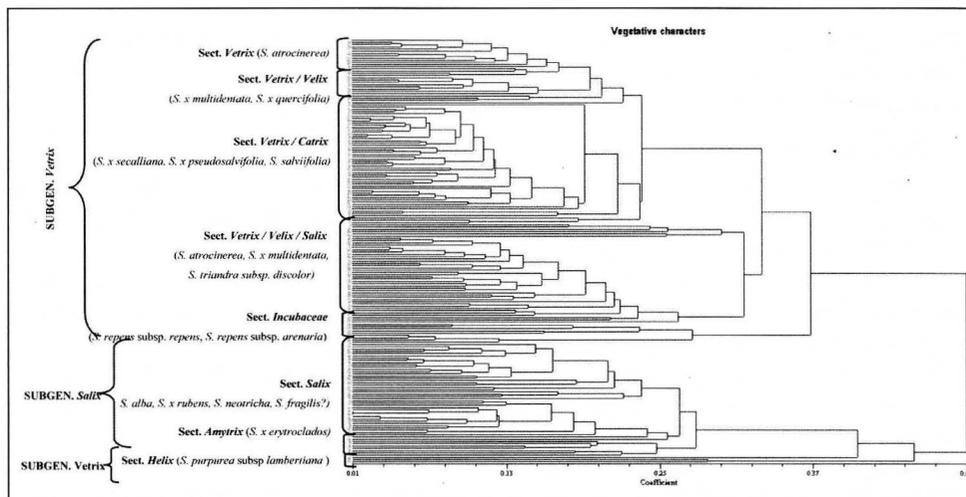


Fig. 2. Vegetative characters.

The distribution of taxa shows a large percentage of hybrids (50%) and *Salix atrocinerea* Brot. is the most frequent species.

Salix x pseudosalvifolia, described by Díaz González & Llamas (1987), was identified in 23 individuals. Although one of the parental species is absent in Portugal (*S. elaeagnos* Scop. subsp. *angustifolia* (Cariot) Rech. fil.), the character of discoloured leaves that Díaz González & Llamas (1987) use to separate this taxon from *S. salvifolia* Brot., leads us to think that our specimens are actually that hybrid.

Some authors consider that *Salix fragilis* L. is not present in Portugal (Rechinger 1992) nor in the South of the Iberian Peninsula (Díaz González & Llamas 1987) replaced by *S.*

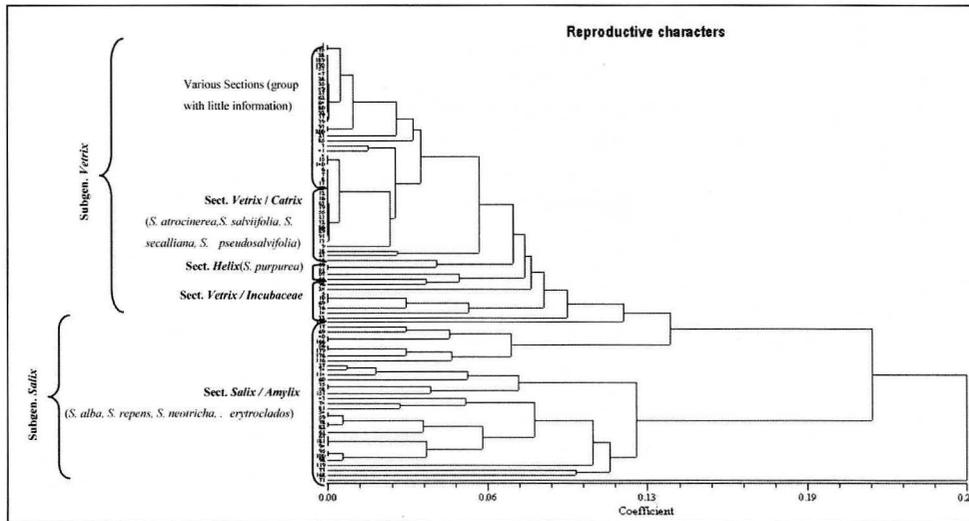


Fig. 3. Reproductive characters.

neotricha Görz. However, 3 of our specimens present glabrous leaves, conspicuous and often branched glands in the base of the petiole, and the peduncle of the capsule sessile or shorter than nectaries, which fits with *Salix fragilis* description and not with *S. neotricha* (Díaz González & Llamas 1987).

DATA PROCESSING

The program was run for three groups of characters: vegetative, reproductive and both together, as showed in the dendrograms 1 (vegetative and reproductive characters), 2 (vegetative characters) and 3 (reproductive characters) (Figs 1, 2, 3).

After the identification of every individual, the groups created were compared with the system of Skvortsov (1968) and Díaz González & Llamas (1987) for the classification of the Genus at the taxonomical categories of Subgenus and Section.

The three dendrograms show a fair coincidence with the taxonomic model at the level of SUBGENUS, and even SECTION in dendrograms 1 and 2 (Figs 1, 2), except for *Salix purpurea* subsp. *lambertiana*, far from the subgenus *Vetrix* in the graphics.

Dendrograms 1 and 2 (Figs 1, 2) are, in general, more consistent with the taxonomic model. In dendrogram 3 (Fig. 3), the lack of information for some characters creates an artificial group at the extreme of the dendrogram, and the various individuals of *Salix repens* s.l. occurs in different points of the graphics.

When studying a lowest level of assembly the best correspondence with the taxonomical model was found in the dendrogram 1 (Fig. 1) (all characters) for subgenus *Vetrix*, and dendrogram 2 (Fig. 2) (vegetative characters) for subgenus *Salix*. This suggests that only vegetative characters are insufficient to identify certainly subgenus *Vetrix*. This character set shows better results in subgenus *Salix*, where the amount of pubescence, presence and size of glands are fundamental to separate *S. alba*, *S. neotricha*, *S. fragilis*, *S. × rubens* and *S. × erythroclados*. For species like *S. atrocinerea*, *S. salviifolia* and their hybrids the great foliar polymorphism creates difficulties on grouping only with vegetative characters. The occurrence of dislocated taxa is related with the impossibility of giving different

weights to the variables with the program NT-SYS, which organises the dendrogram using variables without consider their taxonomic value.

Furthermore, some specimens present intermediate characters between hybrids and their parental species, suggesting a continuity of features between individuals that calls into question the barriers between taxa.

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