# MORPHOLOGICAL AND ANATOMICAL CHARACTERIZATION OF THE GENUS *SEMELE* (*LILIACEAE*) IN THE ISLAND OF MADEIRA

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With 10 figures and 1 table

*ABSTRACT.* The genus *Semele* is endemic to Macaronesia. On Madeira Island it has a wide distribution, growing in the *Laurisilva* and in more xerophytic transition areas of the north coast. The intrageneric taxonomical of *Semele* is almost impossible, because of its wide morphological polymorphism. This study attempts to clarify some aspects of the biology of the *Semele*, and evaluate the importance of the morphological and anatomical criteria used in the taxonomy of genus. Morphological analysis of some vegetative (stems and cladodes) and sexual organs (inflorescence, glomerule (or cymose) and flowers), and the anatomical study of the stem, cladodes and pollen grains of the *Semele* was done. There are two groups of plants (type I and type II) inside the genus, with some important taxonomic differences in the morphology of the climber's termination, the inflorescence structure, floration number. The results suggest that the genus *Semele* in Madeira does not exhibit a monotypic structure.

KEY WORDS: *Liliaceae*; *Semele*; Madeira; Morphology; Anatomy; Botanical types.

## INTRODUCTION

The genus *Semele* is a Macaronesian palaeoendemism (FAVARGER & CONTANDRIOPOULOS, 1961), found on Madeira and the Canary islands. In the Archipelago of Madeira *Semele* is reported on Madeira (HANSEN & SUNDING, 1993), Desertas (COSTA NEVES & al., 1992) and Porto Santo (PICKERING, 1962) islands. The larger distribution is found in the first island. In Madeira, *Semele* is a typical plant from the *Laurisilva* (VIEIRA,

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1992), where it grows in *Clethro-Laurion* phytoassociation. In several places of the north and south coasts of Madeira it is possible to find *Semele* growing in more xerophytic areas, where it forms the shrubby stratus on the *Aeonio-Lytanthion* phytoassociation.

The plants of *Semele* produce long climbing stems which grow from a scaly rhizome. Rhizomes are knotty, with shorts internodes and white modified leaves (bracts). Reduced leaves are present in the rhizome, stem and inflorescence. Stems are branched in secondary leaf like stems (cladodes). Each climbing-stem growth is limited by one vegetative cycle per year, usually during February to April. At the beginning of growth, stems have a pre-determined numbers of secondary stems and cladodes. Cladodes which represent flattened stems are perennial, coriaceous, with a regular system of nervures, and a reduced leaf-bract at the base. Inflorescences develop like glomerules, normally arising on the margins of cladodes. The number of glomerules per cladode are, like the buds, pre-established during growth development. The white-yellowish flowers are bisexual. The number of flowers per glomerule varies and the fruits are a red berry with 1-3 endospermous seeds (DAHLGREN, al. 1985).

One species only was attributed to the genus on Madeira, *S. androgyna* (L.) KUNTH (1850). However, *Semele* is very polymorphic because of its wide distribution in Madeira Island, and the diversity of ecological conditions where the plant grows. Consequently, several intrageneric taxa were described (MENEZES, 1922; COSTA, 1949; COSTA, 1950). At present, the taxonomic differences of these taxa, described by MENEZES and COSTA, have not been accepted by other investigators (VICKERY, 1994; PRESS, 1994). However, the genus shows a large level morphological polymorphism, which can not always be attributed to the environmental conditions. Furthermore, such aspects of its biology as flowering, pollination, morphology and anatomy remain unclear. This study aims to clarify some aspects of the *Semele* biology and evaluate the importance of morphological criteria in the plant taxonomy.

## METHODS

The distribution and localisation of the *Semele* populations on Madeira were studied. Morphological analyses of stems, cladodes, glomerule, flowers, stomas and pollen grains were done on all populations. Only the lower parts of the main stems were studied because they are less influenced by environmental factors. Voucher specimens were deposited in MADU collection. Anatomical studies of the plants organs were made with a stereoscope microscope, model Wild Heerbrugg M3. Histologycal preparations of the stems and cladodes were made, with the technique of Mirande in green carmine (DOP & GATIÉ, 1965). The histological preparations were observed with a light microscope, model Leitz Biomed, with a micrograduate ocular and objective. The pollen of *Semele* was prepared by acetolysis (ERDTMAN, 1969), and gold metalisation, in a Fine Coat Ion Sputter, model Jeol JCF-1100.

The pollen samples were seanned in a Jeol microscope, model JSM-5400 and photographed in Ilford FP4 Plus 125 film. Each measurement was made at least 25 times and the respective means (M) and standard deviations (SD), calculated.

## RESULTS AND DISCUSSION

The locations of *Semele* populations observed, during this study are shown in fig. 1. Two distinct groups of plants, distinguishable by the structure of the vegetative and sexual organs, were found and referred to in the text as botanical type I and II.

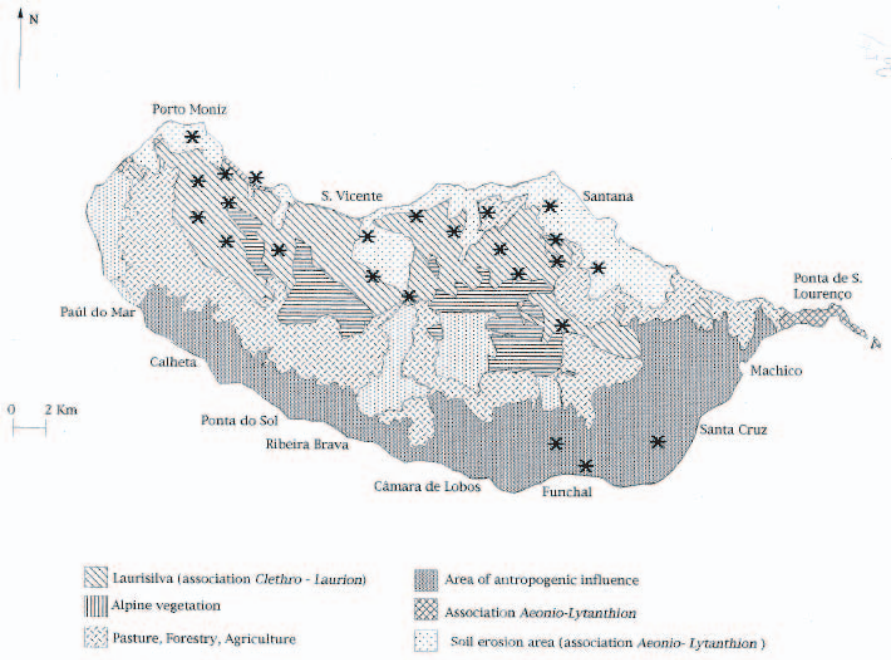



Fig. 1 - Map of Madeira Island showing where the *Semele* populations were observed. (*)

The *Semele* type I plants have long stems, 10-15 m (fig. 2), which climb by means of twirling clockwise, whereas the type II plants have flattened stems 1-3 m long (fig. 3). The secondary stems of *Semele* are very variable, and their length, for example, depends on their position on the main stem of the plant. This morphological characteristic is more or less stable in the lower part of the main stem. The length of the secondary stems are in type I 22,0 - 139,0 cm and in type II - 18 - 44,0 cm. The large variation in the secondary stem length may be with the attributed environmental conditions in which the plant is growing. Cladodes are also distinct. In type I the cladodes vary between falciform and oblong-lanceolate or round and heart shaped, and, in type II between oblong-lanceolate and filiforme shaped. Cladodes from the type I are 1,5 - 8,5 x 5,0 - 25,0 cm, and in type II - 2,0 - 3,0 x 7,6 - 9,8 cm.

In both cases the cladodes have parallel nervures, with a very variable number of nervures per cladode. Both types can be distinguished through the glomerule structure and flower numbers (fig. 4 a, b, c). The type I can develop glomerules in every cladode of the secondary stems. Glomerules arise from the margins of cladodes, or exceptionally, in na abaxial position (fig. 4 c & 5). The number of glomerules vary between 2 to 12 / cladode. In the type II, 1, 2 or 4 only develop on the apical cladodes of the secondary stems or on the tips of the main stem. The glomerules have an abaxial disposition or less frequently arise from the margins of cladodes (fig. 4 b & 6 a, b). The number of flowers per glomerule vary in type I between 2 and 6, but as the pedicels remain in the cladodes after anthesis, this number can increase up to 12. The number of flowers per glomerule in type II plants can be 5, 7 or 12, but increase up to 40 or 60 in old cladodes. Neverthless the glomerules of both plant groups can be distinguished by their structure (fig. 5 &. 6 a, b). In the inflorescence of type II plants, bracts are developed at the base of pedicels and pedicel remain after anthesis. Furthermore, the anthesis activity continues over several years and consequently the glomerules become subglobose. Type I plants do not show such inflorescence structure and the glomerules show anthesis activity only during 1 to 3 years, and bract development at the base of pedicels is less evident. Both types have bisexual flowers, but frequently only one male or female organs were developed (fig. 4 a, b). The red spherical berry is similar in both types, 10,0 - 15,0 mm of diameter, with 1-3 endospermous seeds.

Fig. 2 - An aspect of *Semele* type I plant, showing climbing stems.

Fig. 3 - A partial aspect of *Semele* type II plant, showing flattened stems.

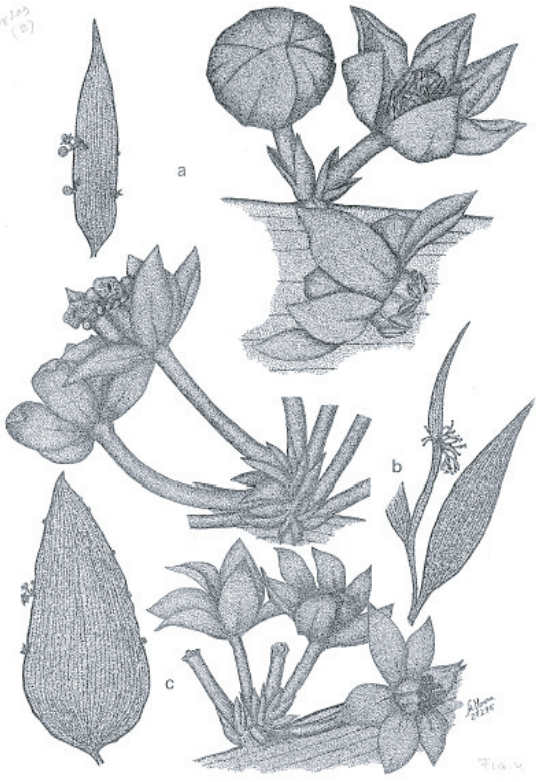



Fig. 4 - An aspect of the *Semele* floration: a) botanical type I. Cladodes (x 1/2) with glomerule arising from margins. Male flowers (x 6).; b) botanical type II. Cladodes (x 1/2) with abaxial floration. Female flowers (x 6); c) botanical type I. Cladodes (x 1/2), with glomerule arising from margins. Flowers hermaphrodites. Specimens from the MADU collection, M.Â.A. PINHEIRO DE CARVALHO & I.C. VALE LUCAS.

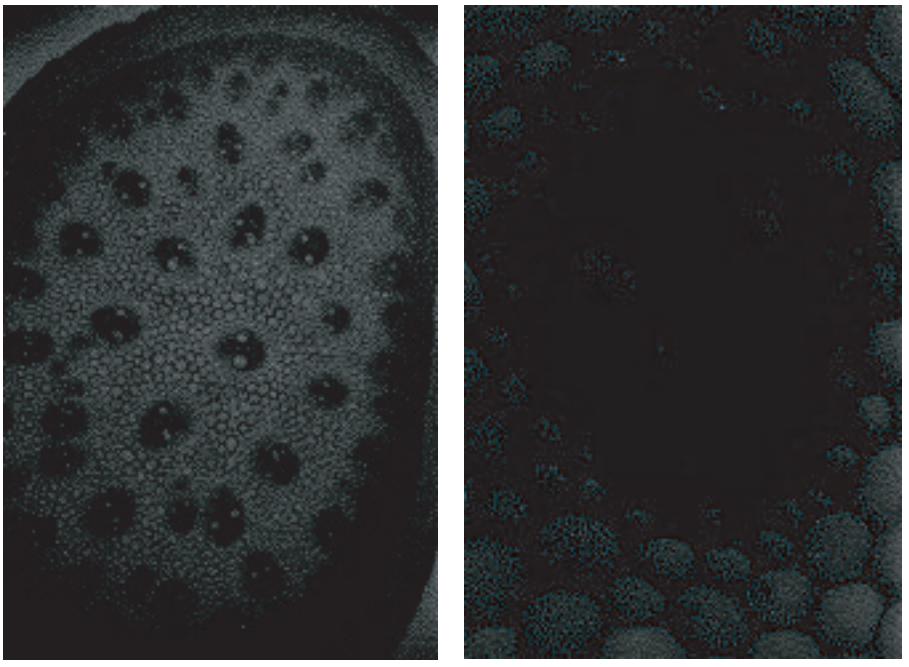
Fig. 5 - An aspect of glomerule structure and flowers in *Semele* type I plants. Photos of I.C. VALE LUCAS & M.Â.A. PINHEIRO DE CARVALHO.

a

b

Fig. 6 - An aspects of glomerule structure (a) and flowers (b) in *Semele* type II plants. Photos of I.C. VALE LUCAS & M.Â.A. PINHEIRO DE CARVALHO.

An anatomical study of stems and cladodes in the type I and II plants did not reveal significant variation. The anatomy of the stems is typical of the monocotyledons, with double dispersed sheaves, atactostele (fig. 7 a). The sheaves are fibro-vasculars, which characteristic of *Liliopsida*, where the metaxyleme shows two great trachea and the protoxyleme absent and substituted by a channel (fig 7 b). The anatomy of the cladodes have the same structure of the stems, except their symmetry is bilateral (fig. 8). Cladode epidermis is strongly cutinised. The glomerules in both types are served by a deflected stele, separated from the bases of the cladodes. Some parenchymentous cells of the stems, cladodes and anthers have oxalato cristals or raphides. The macled cristals are rhombics and located within the cell. The raphides compounded by aciculate cristals, 22,5 - 32,5 x 50,0 -130,0 µm. The stomas, with 37 - 38 µm height and 33,2 µm width, are paracytics (fig. 9), which is very rare in *Liliaceae* (TAKHTJAN, 1991). Stomas have a cellular organisation like those of *Helleborus*, with ostium wall thick and without pre-stomatical and reduced sub-stomatical chambers. The *Semele* pollen grains are similar to other monocotyledons. The monosulcate pollens, with mean values of 32 x 24,8 µm for the polar (P) and equatorial (E) axles sizes, with a P/E relationship of 1,2 - 1,3 and a prolate-spherical shape (fig. 10 a). The sporodermis is uniform and thin. The exine is without ornamentation, granular texture and microperforate (fig. 10 b).



a b

Fig. 7 - Microphotograph showing aspects of stem anatomy of *Semele*. a) Histological section of secondary stem showing the atactostele disposition of sheaves (x 200). b) Histological section of fibro-vasculars sheaves. The central part of sheave shows the trachea (metaxyleme) and the protoxyleme replaced by a channel.(x 2000). Photos obtained by light microscope, model Leitz Biomed. I.C. VALE LUCAS & M.Â.A. PINHEIRO DE CARVALHO.

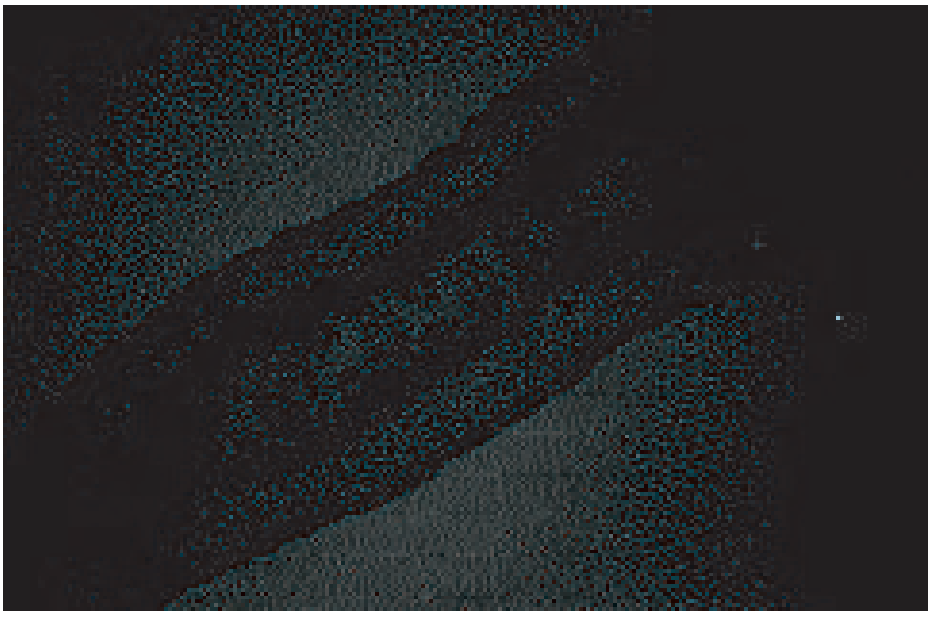


Fig. 8 - Microphotograph of anatomical section of *Semele* cladodes, with flattened sheaves obtained by light microscope, model Leitz Biomed (x 200). Photo of I.C. VALE LUCAS & M.Â.A. PINHEIRO DE CARVALHO.

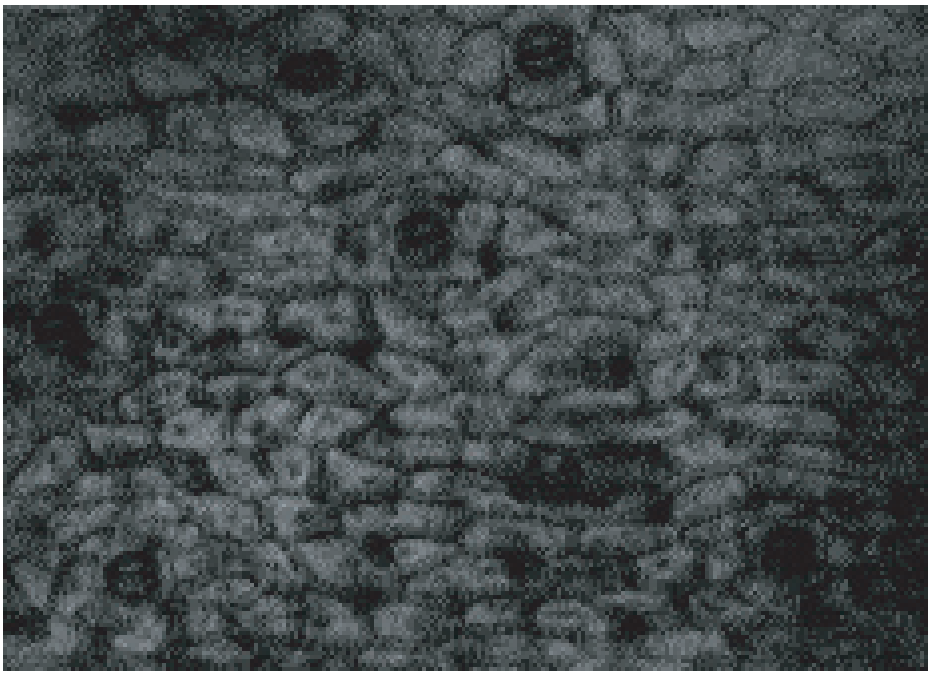


Fig. 9 - Microphotograph showing an aspect of *Semele* epidermis in inferior cladodes page obtained by light microscope, model Leitz Biomed (x 1000). Photo of I.C. VALE LUCAS & M.Â.A. PINHEIRO DE CARVALHO.

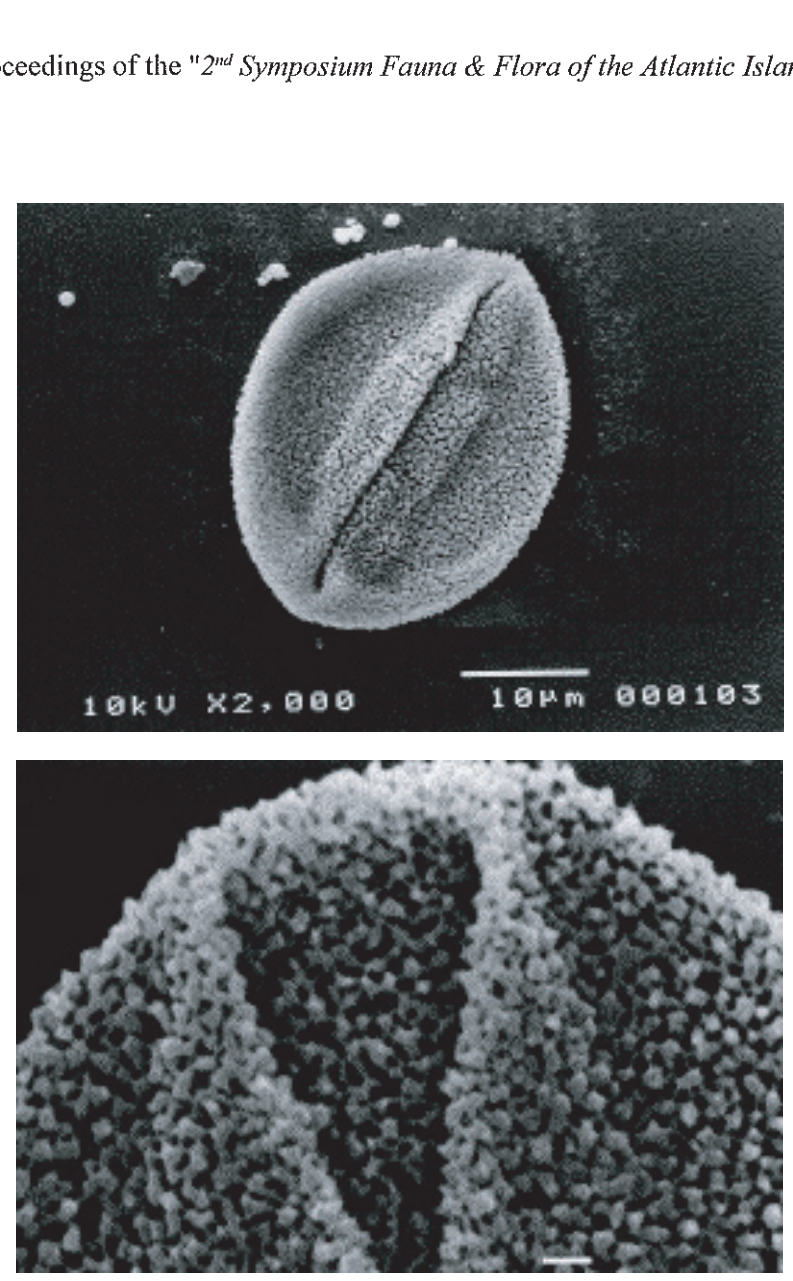



Fig. 10 - Microphotograph showing aspects of *Semele* pollen grain morphology. a) An aspect of prolate-spherical pollen grain showing the monosulcate aperture and regular reticulated sporodermis (x 2000). b) An aspect of sporodermis showing the granular texture and microperforations of the tectum (x 7500). Photos obtained by scanning microscope Jeol, model JSM-5400. M.Â.A. PINHEIRO DE CARVALHO & ANTÓNIO DIAS.

The present study suggests the existence on Madeira Island of two ecological groups and two botanical types within the genus *Semele*. One ecological group occurs in the *Clethro-Laurion* alliance and the other one in the *Aeonio-Lytanthion* alliance. Such ecological distribution seems to have no affect in major morphological and anatomical characteristics of the *Semele* plants, except in large variations of the primary and secondary stem sizes which could be attributed to the growing conditions. Besides, that the *Semele* botanical types, described

in this study, were independent of the ecological growing conditions. Since type II is exclusively found in the *Clethro-Laurion* alliance, but the type I occurred in both alliances.

The taxonomic level of botanical types within the genus *Semele* remains unclear. Nevertheless, observed differences in plant morphology, for example, are enough to clearly show that the genus is not monotypic (Table 1). The most significant characteristics in separating the *Semele* types seem to be the stem length, inflorescence structure and the flowers numbers. Nevertheless, a wide morphological polymorphism inside the both botanical types requires a more detailed analysis with the application of others criteria. This study will be continued.

**TABLE 1** - Major morphological and anatomical characteristics of both botanical types of *Semele* detected in Madeira island. The table shows morphological differences observed between the *Semele* type I and type II plants.

| Characteristics | Botanical type I | Botanical type II |
|---|---|---|
| Main Stem | Climbing - 10 - 15 m | Flattened - 1- 3 m |
| Secondary stems length | 22 - 139 cm | 18 - 44 cm |
| Cladodes size | 1.5 - 8.5 x 5.0 - 25.0 cm | 2.0-3.0 x 7.6 - 9.8 cm |
| Inflorescence structure | Not subglobose | Subglobose |
| Glomerules | Develop on every cladodes of secondary stems arising from margins or rarely abaxial 2 - 12 per cladode | Develop on apical cladodes of secondary stems or on main stem termination, abaxial or less frequently arising from margins of cladodes 1,2 or 4 per cladode |
| Flowers number | 2 - 6 per glomerule, can increase up to 12 on old cladodes flowers bisexual frequently with one reduced sex | 5, 7 or 12 per glomerule, can increase up to 40 - 60 on old cladodes flowers bisexual or unisexual |
| Fruits | red spherical berry, with 1 - 3 endospermous seeds | red spherical berry, with 1 - 3 endospermous seeds |
| Stems anatomy (style) | Atactostele | Atactostele |
| Stomas | Paracytics, *Helleborus* cellular organization | Paracytics, *Helleborus* cellular organization |
| Pollen grain | monosulcate, whit prolate-spherical shape | monosulcate, whit prolate-spherical shape |
| Secondary metabolite production | macled cristals or rafids of oxalate | macled cristals or rafids of oxalate |
| Habitats | *Clethro-Laurion* and *Aeonio-Leptauthion* alliances | *Clethro-Laurion* alliance |

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