MORPHOLOGY AND HISTOCHEMISTRY OF TRICHOMES OF *TEUCRIUM ABUTILOIDES* L'HERIT. (LAMIACEAE) AN ENDEMIC SPECIES OF MADEIRA

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With 16 figures

ABSTRACT. The micromorphology of trichomes present on different organs of Teucrium abutiloides L'HERIT. (Lamiaceae) is described. This rare endemic plant species of Madeira has a large leaf surface covered by a dense indumentum of non-glandular trichomes and three types of glandular ones (Types I, II and III). The glandular trichomes were very abundant on young leaves, but their number decreased progressively as the leaves developed. On the surfaces of the corolla, calyx and anthers type I trichomes were absent. Particular attention was paid to the type III trichomes of which the histochemical characterization is described.

KEY WORDS. Lamiaceae, Glandular Hairs, Endemic, Madeira

INTRODUCTION

The flora of Macaronesia possesses six endemic genera in the Lamiaceae, some of which are very rare, and four of these grow exclusively in the Madeira archipelago (VIEIRA,1992). The micromorphology of the indumentum has shown to be essential for taxonomical and ecological studies in this family. From an ecological point of view, the glandular trichomes have been considered to play an important role in the defence against predation (LOURO et al., 1962) due to the accumulation of several deterrent compounds. (SIMMONDS et al., 1989). Their taxonomical value was also pointed out recently by several authors (MOH REJDALI, 1991; BINI MALECI & SERVETTAZ, 1991; KAROUSOU, BOSABALIDIS & KOKKINI, 1992; WERKER, 1993).

T. abutiloides (=*T. umbrosum* BUCH) (Lamiaceae) is an endemic species of Madeira.

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Its reported life zone ranges from 300 m to 800 m (HENRIQUE & VALENTE,1992). Nowadays *T. abutiloides* is a rare species that grows mostly in laurel woods.

The leaves of all *Teucrium* species are covered with glandular trichomes whose morphology and distribution have been used as taxonomic markers within this genus (BINI MALECI & SERVETTAZ, 1991).

In this study we report on the micromorphology and histochemistry of the trichomes present on different organs of *T. abutiloides*.

MATERIAL AND METHODS

Vegetative and reproductive organs of *T. abutiloides* were collected from plants growing in the Botanical Garden of Madeira. A voucher specimen has been deposited in the Herbarium of the Botanical Garden of Madeira (MADJ:02515).

Scanning electron microscopy: Specimens from different plant parts were fixed, for 2 h at 4°C, in a 3% glutaraldehyde solution in 0.1 M sodium cacodylate buffer, pH 7,2, and after rinsing post-fixed in a 2% osmium tetroxide aqueous solution, for 2h at room temperature. After dehydration, in a graded ethanol series, the material was dried by the critical point drying method using a Polaron E 3500. The dried specimens were sputter coated with gold, in a Polaron E 5350, and then observed using a Jeol JSM T220 scanning electron microscope at 10 Kv.

Histochemistry: The histochemical tests were carried out using fresh plant material. Total lipids were detected using Sudan IV (JENSEN, 1962) and Nile Blue A (CAIN,1947), and terpenoids were stained using the Nadi reagent (DAVID & CARDE,1964). Appropriate controls were carried out as suggested by the respective authors. The autofluorescence of secreted material was studied using a Leitz epifluorescence microscope.

RESULTS AND DISCUSSION

The different organs of *T. abutiloides* showed an indumentum composed of glandular and non-glandular trichomes. The latter consisted of an uniseriated filament with a pointed apical cell (Fig. 4). In what concerns the glandular trichomes, it was possible to recognize three types: Type I, consisting of a basal epidermal cell, a very short stalk cell and a multicellular head with four glandular cells (Fig. 1); Type II, consisting of a basal epidermal cell, a stalk cell and two glandular head cells (Fig. 3); Type III, consisting of a basal epidermal cell, a long multicellular stalk (5-7 cells) and a rounded glandular head cell (Fig. 2).

The different types of glandular trichomes found in the indumentum of *T. abutiloides* are similar to those reported in the literature concerning the Lamiaceae (WERKER, RAVID & PUTIEVSKY,1985; FAHN, 1988) and very close to those reported for Italian *Teucrium* species

(BINI MALECI & SERVETTAZ, 1991). It is noteworthy, however, that the glandular trichomes of *T. abutiloides* are dissimilar to those of *T. scorodonia*, a species that grows wild in Portugal, where type III trichomes are absent (ANTUNES & SEVINATE- PINTO, 1991).

The density of the glandular trichomes on the leaves of *T. abutiloides* depends on the developmental stage of the leaf; they are very abundant on young leaves, but their number decreases progressively as the leaves develop. It should be emphasized that the old leaves of the plants, growing in the field, are normally attacked by predators; this is in contrast with the young leaves. Both observations support the hypothesis of the participation of glandular trichomes in defence mechanisms against predators.

Comparative studies have shown that *T. abutiloides* has a larger leaf surface than other endemic *Teucrium* species of Madeira (SEVINATE-PINTO & ANTUNES, unpublished results). However, this species also shows a larger number of type III glandular trichomes. In view of this, particular attention was paid to this type of trichomes.

The fluorescence of the glandular head cell content (Figs. 14, 15 and 16) as well as the histochemical results (Figs. 11, 12 and 13) revealed the lipophilic nature of the secreted material. These results agree with the previous results of the chemical analysis of the volatile components produced by this species (BARROSO *et al.*, 1993).

The secreted material is accumulated in the subcuticular space and released by the cuticle rupture. The circular depression, frequently observed on the head cell cuticle (Figs. 5 and 6) can be interpreted as a line of fragility related to this process. After the cuticle rupture, the head glandular cell assumes a cup shape. Similar results have been described for *Salvia officinalis* (WERKER *et al.*, 1985).

Although the indumentum of the reproductive organs also showed a predominance of type III trichomes, it should be stressed that on corolla, calyx and anther, no type I trichomes could be observed (Figs. 7, 8, 9 and 10).

Similar investigations on other endemic *Teucrium* species are in progress in order to evaluate the usefulness of the indumentum features in the characterization of the different species.

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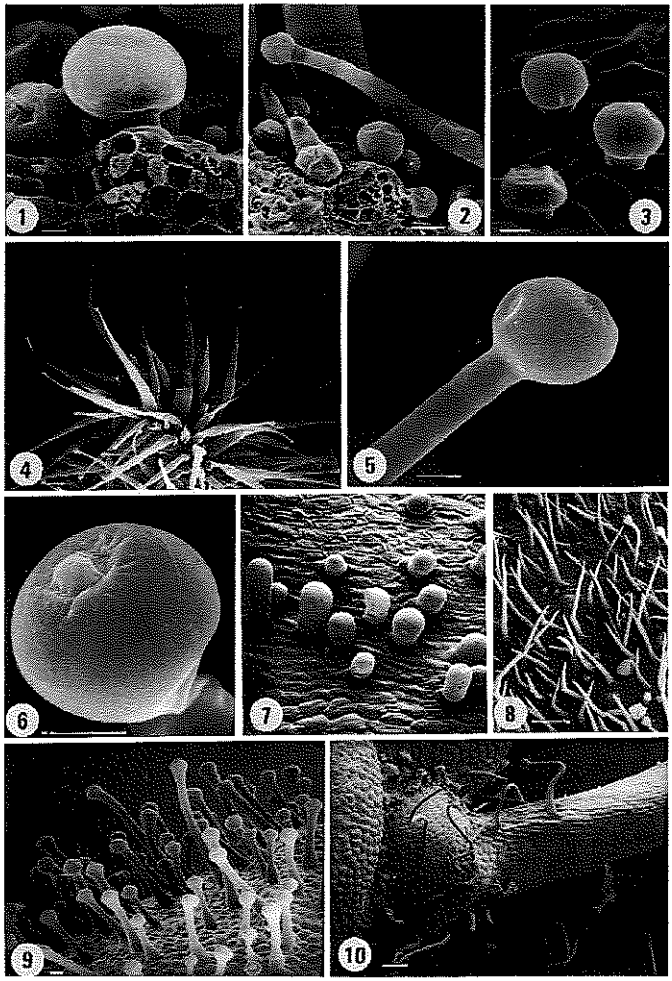
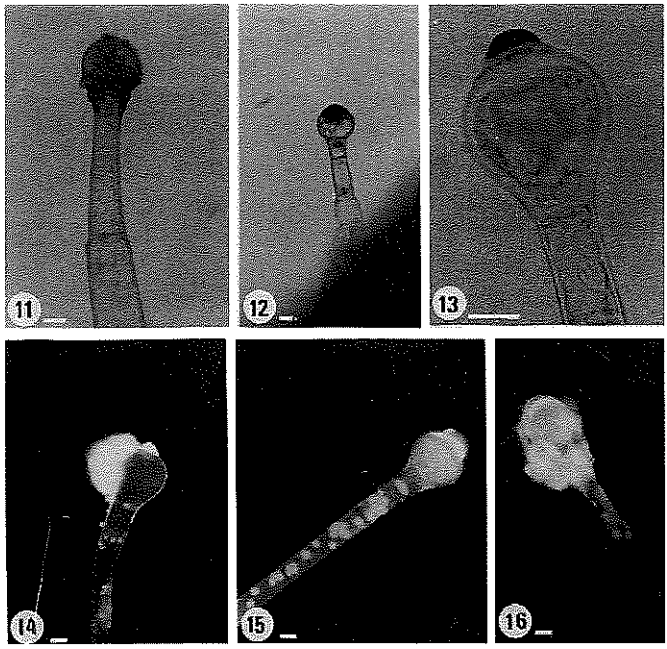


Figures 1-10 - *Teucrium abutiloides* SEM micrographs: Fig. 1- Type I trichome. Fig. 2- Type III trichome showing the multicellular stalk and a rounded glandular head cell. Fig. 3- Type II trichomes showing the stalk cell and two glandular head cells. Fig. 4- Part of the leaf surface showing glandular and non-glandular trichomes. Figs. 5 and 6- Details of type III trichomes. Note the circular depression on the glandular head cell. Fig. 7- Trichomes of the inner surface of the corolla. Fig. 8- Trichomes of the outer surface of the calyx. The non-glandular trichomes are the most abundant ones. Fig. 9- Trichomes of the outer surface of the corolla. Fig. 10- Trichomes on the base of the anther filament. Scale bar = 10 μm (Figs. 1, 3, 5, 6); Scale bar = 20 μm (Figs. 2, 7, 9); Scale bar = 100 μm (Figs. 4, 8, 10).



Figures 11-16 - Histochemical characterization of type III trichomes; Fig. 11- Sudan IV stains the lipids of the secreted material in the head cell. Fig. 12 - Nile blue stains the lipid content of the subcuticular space. Fig. 13- Nadi stains the secreted material accumulated in subcuticular space. Fig. 14- The secreted material shows light yellow fluorescence under UV light (340-380 nm) and gold yellow fluorescence under blue light (460-490 nm) (Figs. 15 and 16). Scale bar = 10 μm.