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Anatomical studies on the Sicilian *Helianthemum* (Cistaceae)

Abstract

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The phytodermology on leaf and the stem anatomy were studied in *Helianthemum croceum* (Desf.) Pers., *H. canum* subsp. *nebrodense* (Heldr.) Arcang. and *H. cinereum* (Cav.) Pers.. In particular, the characters taken into account concern presence of trichomes, heterogeneity of chlorenchyma, presence of glandular hairs, epidermal foliar parameters by scanning electron and light microscopy, leaf architecture as well as stem and flower bud structure.

Introduction

In Sicily the genus *Helianthemum* Miller consists of *Helianthemum croceum* (Desf.) Pers., *H. nummularium* (L.) Miller, *H. apenninum* (L.) Miller, *H. sessiliflorum* (Desf.) Pers., *H. ledifolium* (L.) Miller, *H. salicifolium* (L.) Miller, *H. aegyptianum* (L.) Miller, *H. canum* subsp. *nebrodense* (Heldr.) Arcang., *H. cinereum* (Cav.) Pers. (Pignatti 1982); three of these species, i.e. *H. croceum*, *H. canum* subsp. *nebrodense* and *H. cinereum*, are all subshrubby chasmophytes occurring in the meadows and on the slopes of the northern mountainous ranges between Peloritani and the Madonie mountains, above 500 m a.s.l.

Helianthemum croceum has twisted and woody stems with white-tomentose, ascending branches; basal leaves are almost round, while the upper ones are elliptic-lanceolate, slightly revolute on the margin and white-tomentose on the lower blade.

Helianthemum canum subsp. *nebrodense* has woody, twisted basal stems, tightly entangled; the leaves are small and white-tomentose with hairs tightly interwoven.

Helianthemum cinereum has woody basal stems which are more or less grey-tomentose and often reddish in the upper part; petiolate leaves with ovate-elliptic blade rounded at the base, sub-glabrous on the upper surface and white-tomentose on the lower one.

In this paper the leaf morphology is analysed and compared in *Helianthemum croceum* (Desf.) Pers., *Helianthemum canum* subsp. *nebrodense* (Heldr.) Arcang. and *Helianthemum cinereum* (Cav.) Pers. with the aim to find anatomical features possibly suitable in the taxonomical delimitation of the genus *Helianthemum*, whose uncertain characters are well known. (Pignatti 1982).

Materials and methods

The observed materials were collected at the typical localities where the species occur. After some preliminary staining-fresh observations with relative discolouration, the materials were fixed in F.A. and later dehydrated, coloured with safranin or light green and dipped in paraffin. The 10-15 μm thin sections were obtained using a revolving type microtome and were later mounted on Canada balsam. The observations consist in determining both the number and the size of the epidermic cells, the number and the position of the stomata, the presence of hairs, the thickness and the number of strata forming the epiphyllous and the hypophyllus as well as the thickness of the leaf, of the mesophyll, of the palisade and of the spongy parenchyma. In order to highlight the fine pattern of veinlets in the leaves, the Fuchs method (1963) was applied. The terminology employed for the pattern of veins is that of Hickey (1973), whereas the anatomical terms are those employed by Easù (1965). The samples were later brought to critical point, metal sprayed and observed at the S.E.M.

Result

Leaf micromorphology of the three *Helianthemum* species was obtained by means of epidermal replications of the only upper surface, the lower one, in fact, being markedly tomentose, was studied at the S.E.M.

In *H. croceum*, (Fig. 1a, 1b) cells are present in large number (2922 by mm^2) while *H.*

Table 1. Epidermal foliar parameters (upper blade) of Sicilian *Helianthemum*: data and plots.

	<i>H. croceum</i>	<i>H. canum</i>	<i>H. cinereum</i>
N. cells $\times \text{mm}^2$	2922.4	2973	2888
N. stomata $\times \text{mm}^2$	274	570	468
Length cells (μm)	57.5	50.7	50
Width cells (μm)	30.5	30	37
Length stomata (μm)	32.5	37.5	35
Width stomata (μm)	22.5	26.5	25

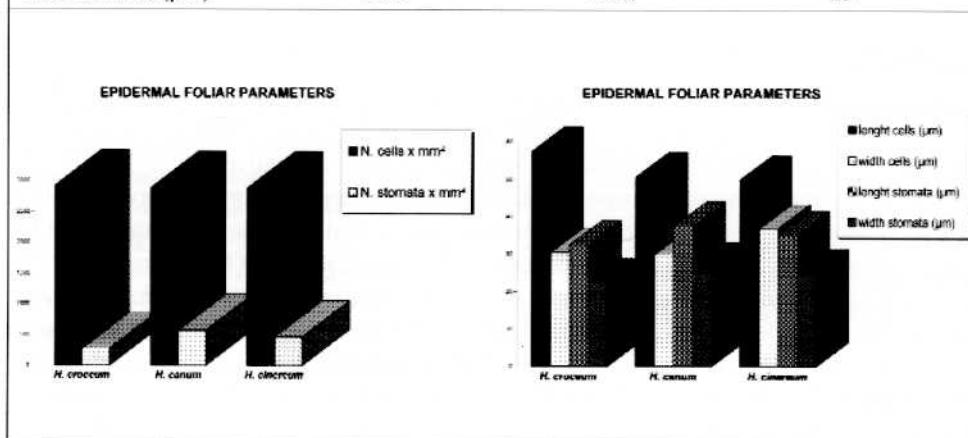


Table 2. Foliar tissues thickness (μm) of Sicilian *Helianthemum*: data and plot.

	<i>H. croceum</i>	<i>H. canum</i>	<i>H. cinereum</i>
Upper epidermis	39.5	24	33.5
Palisade	117	108	126
Spongy	123	147.5	170
Lower epidermis	22.5	19.9	33
Middle vein	419	328	276.5
Total thickness	301	299.5	362

The chart displays the following data for each species:

Species	Upper epidermis (μm)	Palisade (μm)	Spongy (μm)	Lower epidermis (μm)	Middle vein (μm)	Total thickness (μm)
<i>H. croceum</i>	39.5	117	123	22.5	419	301
<i>H. canum</i>	24	108	147.5	19.9	328	299.5
<i>H. cinereum</i>	33.5	126	170	33	276.5	362

canum and *H. cinereum* show slightly lower values (2888 by mm^2). The number of stomata is extremely variable: they are in a relatively low number in *H. croceum* (274 by mm^2) while higher values are present in *H. cinereum* (468 by mm^2) and *H. canum* (570 by mm^2); length and width of the epidermal cells are totally comparable in the three species, as well as length and width of the stomata (Table 1). Observed at S.E.M., *H. croceum* shows anomocytical stomata on both leaf surfaces (usually four epidermal cells surround each stoma), isodiametrical epidermal cells with more or less undulate walls, presence of sub-epidermal mucilage, hairs in small number (15 by mm^2) on the upper surface, with deeply-rooted foot into the epidermal thickness and the body made up of 2 to 4, smooth and on average $470\mu\text{m}$ -long branching (Fig. 1c, 1d, 1e, 1f). The hair amount considerably increases towards the rounded leaf margin. The lower surface is instead markedly tomentose and whitish, with stellate hairs and a large number of branches (Fig. 1g-1h); such hairs are tightly interlaced; observed at the S.E.M., through the thick tomentum the stomata appear broader than in the lower surface.

H. canum subsp. *nebrodense*: amphistomatic leaf, with epidermal structure very similar to *H. croceum* (Fig. 2a, 2b, 2c); anomocytical stomata on both leaf surfaces (Table 1), hairs on the upper surface (16 by mm^2), slightly lignified at the base and cellulosic at the apex

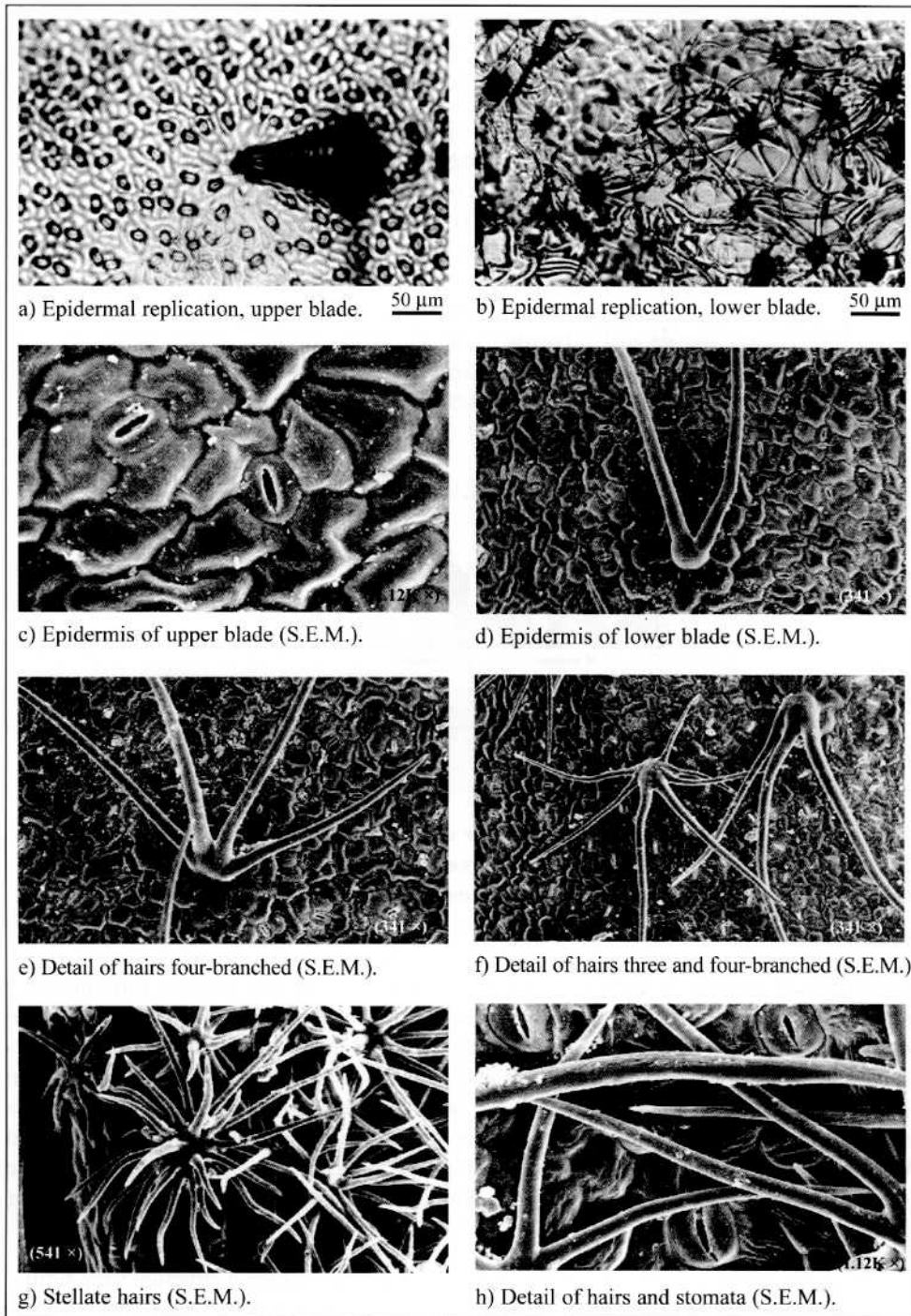


Fig. 1. *Helianthemum croceum*: leaf micromorphology.

as shown by the Schultze solution treatment. Hairs on the upper surface are either two- or four-branched as well as closer and longer than in *H. croceum* (Fig. 2d). The leaf lower surface is markedly tomentose with stellate hairs with a greater number of thinner and longer branches (Fig. 2e) than in *H. croceum*.

H. cinereum: subglabrous epidermis with scanty branched hairs (5 by mm^2), usually either two- or three-branched, shorter (294 μm) than the above examined ones (Fig. 3a,

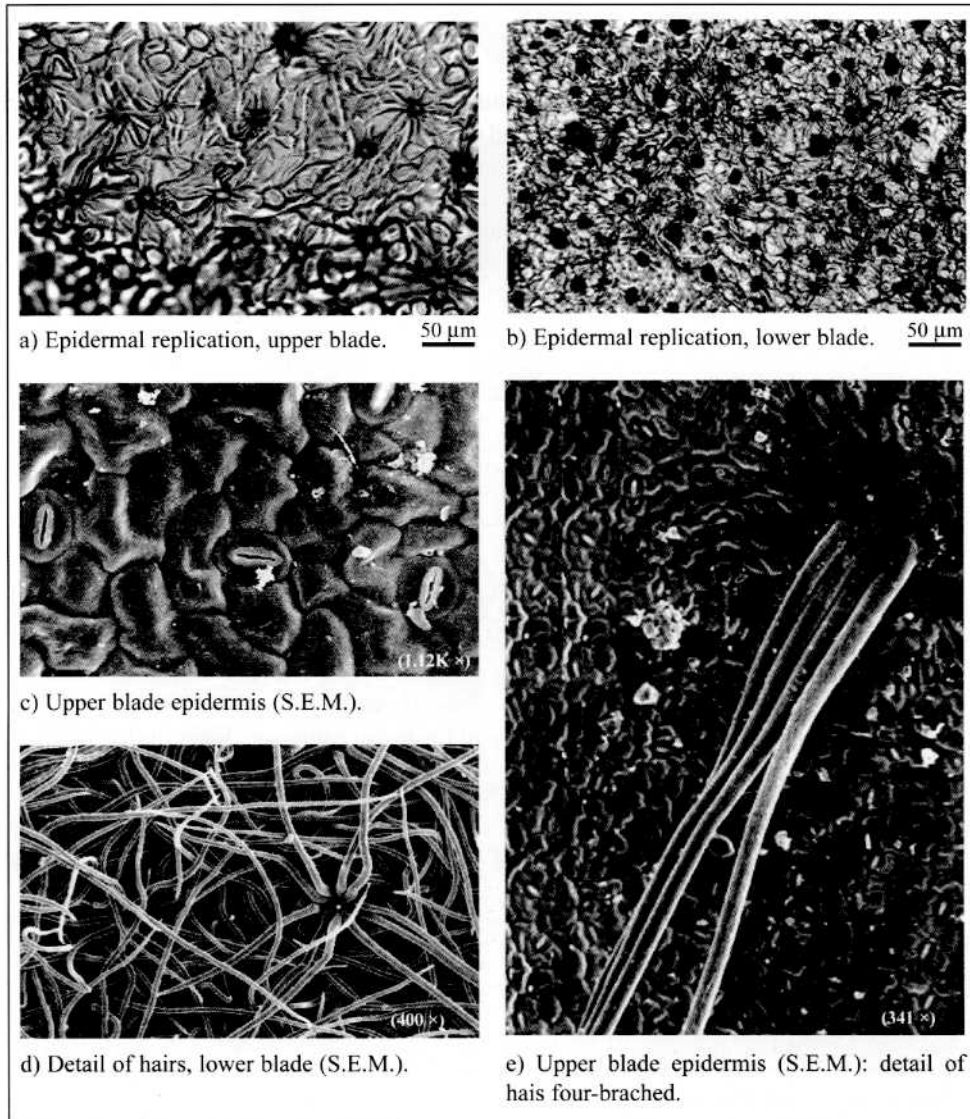


Fig. 2. *Helianthemum canum* subsp. *nebrodense*: leaf micromorphology.

3b). The scaly cuticle and the stomata are strongly cutinized and slightly protruding respect to the epidermal surface. On the lower surface, the hairs are both stellate and two- or three-branched, accordingly they can be defined as hair complex, following Watson and Dallwitz (1992). The leaf is amphistomatic with anomocytical stomata.

In the transverse section, *H. croceum*, *canum* e *cinereum* leaves are dorsiventral with cystoliths in the mesophyll, broad midrib, protruding towards the lower surface, minor leaf veins with phloem transfer cells. Values concerning the epidermal, palisade and spongy thickness are listed in Table 2. Margins are rounded and slightly revolute.

Leaf architecture

H. croceum: lower leaves ovate with obtuse basal part and pointed, somewhat obtuse apex (Fig. 7a, 7b). Strong midrib with lignified sheath where four pairs of secondary veinlets, forming an acute angle with slightly waved trend, depart. Camptodrome veining developing broad and almost regular inter-ribbing panels. Third-, fourth- and fifth-rank veins are present and scarcely characterized with a randomly netted arrangement. Small and irregular areoles with branches one- or two-branched with the ending tracheids scarcely lignified. The narrow and elongate upper leaves have the midrib scarcely lignified with parenchymatic sheath. Secondary veining (six pairs) is thinned and the third-rank one barely distinguishable.

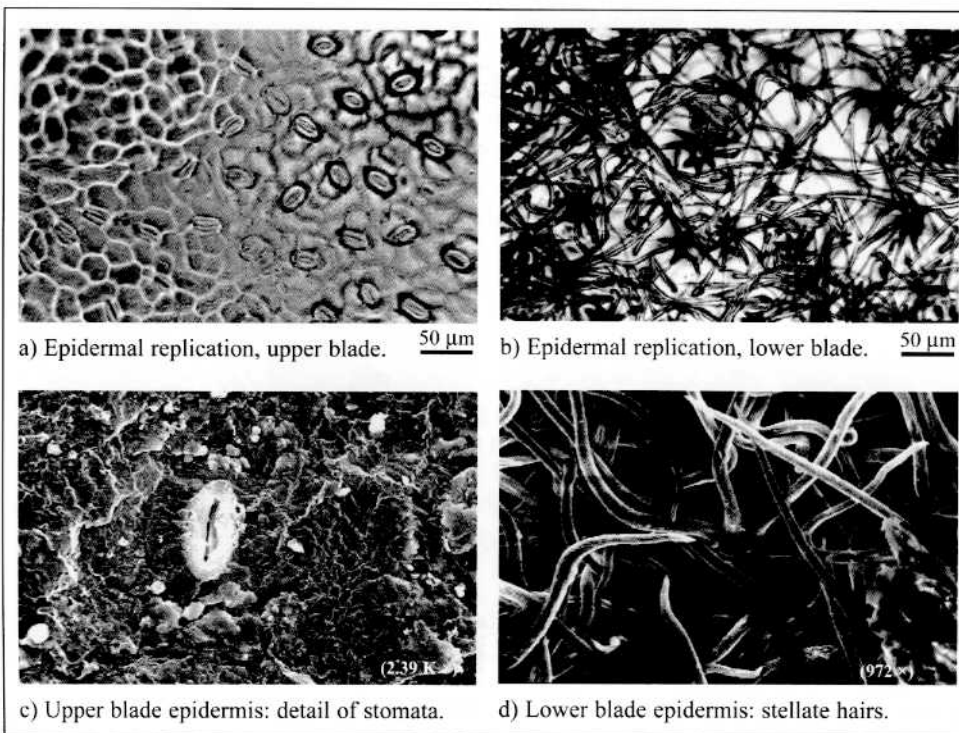


Fig. 3. *Helianthemum cinereum*: leaf micromorphology.

