Carduus baeocephalus subsp. microstigma Gaisberg & Wagenitz : a new subspecies from the Canary Islands (Cardueae, Carduinae) : a facultative autogamous descendant of Carduus baeocephalus Webb subsp. baeocephalus

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Carduus baeocephalus subsp. microstigma Gaisberg & Wagenitz, a new subspecies from the Canary Islands (Cardueae, Carduinae) – a facultative autogamous descendant of Carduus baeocephalus Webb subsp. baeocephalus

MARKUS VON GAISBERG
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ABSTRACT

GAISBERG, M. VON & G. WAGENITZ (2002). Carduus baeocephalus subsp. microstigma Gaisberg & Wagenitz, a new subspecies from the Canary Islands (Cardueae, Carduinae) – a facultative autogamous descendant of Carduus baeocephalus Webb subsp. baeocephalus. *Candollea* 57: 271-282. In English, English, French and Spanish abstracts.

Carduus baeocephalus subsp. *microstigma* Gaisberg & Wagenitz is described as new to science. The new subspecies differs from the subsp. *baeocephalus* mainly by characters of the corolla, anthers, style, stigma, pappus, pollen and in its distribution area. In connection with the lower pollen-ovule ratio, the observed differences could be interpreted by a change in the breeding system from facultative xenogamy to facultative autogamy. *Carduus baeocephalus* Webb subsp. *baeocephalus* is endemic to the island of Gran Canaria whereas *C. baeocephalus* subsp. *microstigma* is endemic to Gran Canaria and El Hierro. A key to and a distribution map of the two subspecies are provided.

RÉSUMÉ

GAISBERG, M. VON & G. WAGENITZ (2002). Carduus baeocephalus subsp. microstigma Gaisberg & Wagenitz, une nouvelle sous-espèce des Iles Canaries (Cardueae, Carduinae) – un descendant autogame facultatif de Carduus baeocephalus Webb subsp. baeocephalus. *Candollea* 57: 271-282. En anglais, résumés anglais, français et espagnol.

Carduus baeocephalus subsp. *microstigma* Gaisberg & Wagenitz connaît ici sa première description scientifique. La nouvelle sous-espèce se différencie de subsp. *baeocephalus* principalement par les caractères de la corolle, des anthères, du style, du stigmate, du pappus, du pollen et par son aire de distribution. En liaison avec la production réduite de pollen, les différences observées ont pu être interprétées comme un changement de l'appareil reproducteur en faveur de l'autogamie. *Carduus baeocephalus* Webb subsp. *baeocephalus* est endémique sur l'île de Gran Canaria tandis que *C. baeocephalus* subsp. *microstigma* est endémique sur les îles de Gran Canaria et El Hierro. Une clef et une carte de répartition des deux sous-espèces sont fournies.

RESUMEN

GAISBERG, M. VON & G. WAGENITZ (2002). Carduus baeocephalus subsp. microstigma Gaisberg & Wagenitz, una nueva subespecie de las Islas Canarias (Cardueae, Carduinae) – un descendiente autógamo facultativo de Carduus baeocephalus Webb subsp. baeocephalus. *Candollea* 57: 271-282. En inglés, resúmenes en inglés, francés y español.

Carduus baeocephalus subsp. *microstigma* Gaisberg & Wagenitz se describe como nuevo para la ciencia. La nueva subespecie se distingue de la subsp. *baeocephalus* principalmente por caracteres de la corola, anteras, estilo, estigma, vilano, polen y por su área de distribución. Junto con la reducida producción de polen, se pueden interpretar los caracteres observados como cambio del

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sistema reproductivo a favor de la autogamia. *Carduus baeocephalus* Webb subsp. *baeocephalus* es un endemismo de Gran Canaria, mientras *C. baeocephalus* subsp. *microstigma* es endémica de las islas de Gran Canaria y El Hierro. Se incluye una clave de identificación y el mapa de distribución de dichas subespecies.

KEY-WORDS: Carduus baeocephalus – Autogamy – Pollen-ovule ratio – Endemic species – El Hierro – Gran Canaria.

Introduction

The genus *Carduus* L. s. str. (exclusive *Alfredia* and *Olgaea*) has c. 80–90 species (KAZMI, 1963, 1964; BREMER, 1994) and is distributed from Eurasia to North and northeastern Africa.

On the Canary Islands there are the three endemic species *Carduus clavulatus* Link, *Carduus bourgaei* Kazmi and *Carduus baeocephalus* Webb. In addition one can find the two introduced *Carduus tenuiflorus* Curt. and *Carduus pycnocephalus* L. The first author took interest in *Carduus baeocephalus* during field work on El Hierro due to his observations which deviated from the descriptions and pictures in the literature. During studies on herbarium material in Regensburg, two subpopulations were recognised by considerable morphological differences which were interpreted as two subspecies. This assumption was discussed with the second author who suggested that a difference in the reproductive system may exist between the two taxa.

Material and methods

For the *scanning electron microscopical study* at the University of Regensburg, pollen and style were cool-sputtered with gold-palladium in a Polaron SC 515 SEM Coating System (Fisons Instruments) and examined in a Zeiss Digital Scanning Microscope DSM 950. The pollen, obtained from a dry flower, was acetolysed in a 9:1 mixture of acetic acid anhydride and concentrated sulfuric acid for 12 h at 60°C; thereafter the pollen was sedimented and the acetolysis mixture removed with a pipette, the sediment was washed and resedimented successively in glacial acetic acid, in aqua dest. and in ethanol before being transferred to the double-sided adhesive tape on the sample plate. The style was dissected from a flower boiled in water, then pretreated in a 6:1 mixture of 10% sulfosuccinate and 99.5% acetone, subsequently dehydrated, first in ethanol then in acetone.

Subdivision of *Carduus baeocephalus* and discussion of the characters

The individuals of *Carduus baeocephalus* observed on El Hierro differed considerably from the illustrations in the literature and the herbarium material seen before. The main differences apparent at first glance were the smaller capitula with flowers scarcely exceeding the involucre (Fig. 1).

This deviate morphology could be mistakenly interpreted as a different stage of development of the same taxon or traced back to a second flower period as described for the genus by DEVESA & TALAVERA (1981). Since the examined specimens of the two taxa were collected during the same period of the year, the latter can be excluded. Additionally, the two different forms of the capitula could not be observed on the same plant during three years of field work on El Hierro. Comparing the habit of the new subsp. *microstigma* (Fig. 2) with that of subsp. *baeocephalus* (BRAMWELL & BRAMWELL, 1990: 315; SCHÖNFELDER & SCHÖNFELDER, 1997: 245), it is remarkable that even the smaller individuals of the typical subspecies develop the wider capitula form with flowers strongly exceeding the involucre. The difference in the anther-corolla length ratio (Table 1) is also inexplicable by various developmental stages of the same taxon. As shown by THIELE (1988), the anther, during the production of the *Compositae* flower, gains full size well before the corolla. In contrast to this, subsp. *microstigma*, with its

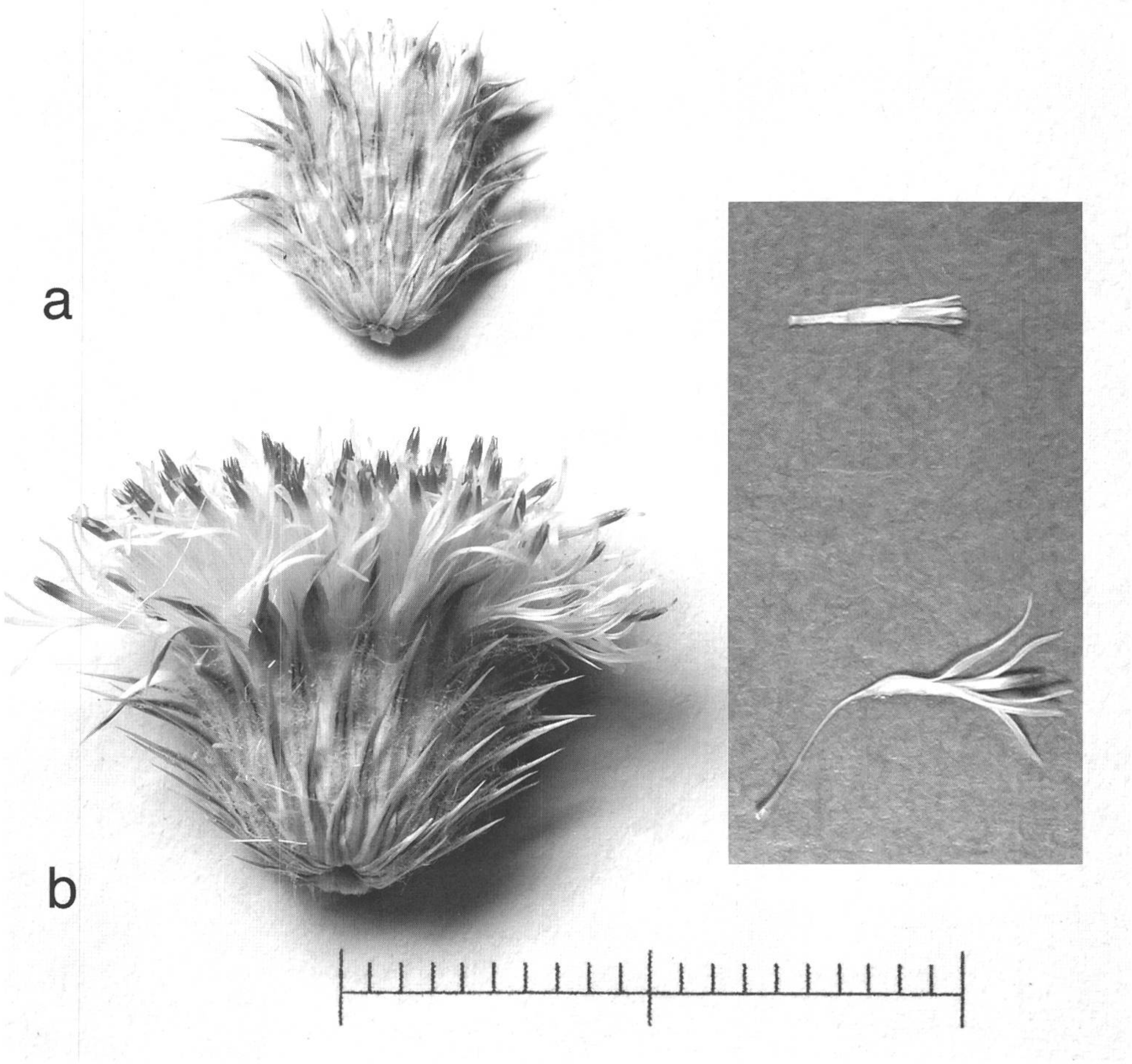


Fig. 1. – Capitula and flowers of the two subspecies of *Carduus baeocephalus* Webb – **a:** subsp. *microstigma* [from *A. Marrero,* LPA 018929]; **b:** subsp. *baeocephalus* [from *P. Schönfelder 94/39,* herb. Schönfelder]. – Scale: 2 cm. Photograph: Wolfram Schmidt, Regensburg.

smaller corolla, has comparatively little anthers. The same is true for the stylus-stigma length ratio: subsp. *microstigma* with its shorter style has in comparison to subsp. *baeocephalus* relatively short style-branches (Table 1, Fig. 6–7). In the course of the development of the *Compositae* style, the style-branches stop growing first, which is why a young and short style has relatively long style-branches, especially before the anthesis.

The main method of fertilization in the genus is the pollination by insects, attracted by the capitula, showing all features of entomophilous flowers. This facilitates allogamy. As described by DEVESA & TALAVERA (1981), the capability of autogamy and geitonogamy is also widespread in the genus *Carduus*. The percentage of its participation in reproduction varies from species to species. Analogue to other *Compositae* the capitula show centripetal development as observed in *C. tenuiflorus* and *C. pycnocephalus* by OLIVIERI & al. (1983). The flowering

Fig. 2. – *Carduus baeocephalus* subsp. *microstigma* Gaisberg & Wagenitz in its natural habitat on El Hierro.

Table 1. – Morphological differences between the subspecies of *Carduus baeocephalus*. Measurements of flower characters in mm; pollen characters measured in µm; head diameter measured in the middle of the capitula length; the corolla lobe length was measured at the 4 short lobes; stylus length measured in the pistillate stage of the flowers; stigma length equals length of the style-branches; total number of individuals/capitula/flowers measured for the flower characters: subsp. *microstigma*: 16/27/68; subsp. *baeocephalus*: 5/13/55; cultivated material: 2/6/28; total number of individuals/flowers/pollen measured for the pollen characters: subsp. *microstigma*: 6/10/20; subsp. *baeocephalus*: 3/4/10; cultivated material: 2/3/8.

	subsp. *microstigma*		subsp. *baeocephalus*		Cultivated material (subsp. *baeocephalus*)	
	Mean	*Min. and Max.*	*Mean*	*Min. and Max.*	*Mean*	*Min. and Max.*
Capitulum diameter	5.8	4.2–8.0	9.3	7.8–10.2	8.5	6.1–10.0
Corolla length	4.9	2.5–6.3	8.5	5.8–11.5	7.4	6.9–8.5
Corolla lobe length	1.6	0.8–2.5	3.9	2.6–4.5	3.4	2.9–4.1
C. lobe-c. length ratio	0.33	0.28–0.42	0.43	0.37–0.48	0.45	0.42–0.48
Pappus length	4.7	3.0–5.9	7.8	5.1–9.2	8.0	7.1–8.9
Stylus length	4.5	2.4–6.1	8.4	5.5–11.2	6.7	6.4–7.9
Stigma length	0.46	0.21–0.66	1.32	0.91–1.57	1.23	1.13–1.31
Stylus-stigma length ratio	10.9	8.4–16.5	6.5	5.2–7.3	5.6	5.4–6.3
Anther length (incl. app.)	2.2	1.3–3.1	4.5	2.9–5.2	4.2	4.0–4.5
Anther (incl. app.)-corolla length ratio	0.45	0.37–0.54	0.54	0.45–0.63	0.57	0.51–0.63
Pollen diameter (equatorial) incl. spines	36.4	35.4–37.7	39.9	38.8–40.9	35.0	34.8–35.2
Pollen diameter (equatorial) without spines	26.1	24.4–27.3	31.8	30.8–32.9	28.2	27.9–28.6
Height of the pollen-spines	5.2	5.0–5.6	4.0	3.2–4.6	3.2	3.1–3.5
Height of the pollen-spines-pollen diameter (equatorial) without spines ratio	0.20	0.19–0.23	0.13	0.10–0.14	0.12	0.11–0.12
Pollen-ovule ratio	c. 190	c. 50–280	c. 850	c. 700–1200	c. 800	c. 700–1000
Height of the plant	0.1–0.5 m		0.2–1.3 m		0.4–0.6 m	

sequence starts with the outer florets entering the staminate stage which is followed by the pistillate stage. In the case of the species examined by Olivieri & al., the pistillate stage of the outer florets coincides with the anthesis of the inner florets. Thus in the majority of the cases, the outer florets have a higher probability of being selfed by pollen of the same capitulum, while the inner florets have a higher probability of outcrossing. Since the achenes produced by the inner flowers are mainly responsible for the long-distance dispersal of *C. tenuiflorus* and *C. pycnocephalus* (BENDALL, 1973), OLIVIERI & al. (1983) draw the conclusion that being outbred is an advantage for these annual colonizers to establish new populations in perhaps different sites.

On the other hand a tendency to autogamy has been observed in various families for quite some time (e.g. CHAMBERS, 1963; ORNDUFF, 1963; GRAU, 1983). Self-compatibility increases the probability that a single transported achene could lead to the establishment of a population in a new region. This accounts for an overrepresentation of self-compatible angiosperms on oceanic islands.

There are several examples that a change of the breeding system could lead to the reduction in size of various flower-parts and therefore reduce the energetic cost per flower. This can result in relatively inconspicuous capitula of the *Compositae*, whose flowers hardly exceed the involucre (e.g. CHAMBERS, 1963; ORNDUFF, 1963; CRUDEN, 1977).

The morphological differences between the two subspecies are summarized in Table 1. At a closer glance they can be viewed as the expression of different reproduction strategies of two distinct taxa. Characters of the stigma (Fig. 6, 7), stylus, anthers as well as the pollen are therefore suitable for the classification of the two subspecies.

Since the number of flowers per capitulum could only be counted in few capitula and the well known variability of this character, the different values of c. 30 for subsp. *microstigma*, c. 65 for subsp. *baeocephalus* and 42–55 for the cultivated plants from the subsp. *baeocephalus* are not listed in Table 1. Because of the greater size of subsp. *baeocephalus* the wider leaf shape and the stronger ramification were also not sufficiently examined, since only the upper parts of the plant were usually collected.

Some of the characters listed in Table 1, like the diameter of the capitula, the length of the corolla, the corolla lobes and the pappus have been shown as relatively variable within some species of the genus. In contrast other characters like the corolla lobe-corolla length ratio or pollen characters are considered fairly constant (FULLER, 1969; DEVESA & TALAVERA, 1981; PEREIRA COUTINHO, 1996).

Only two plants of subsp. *baeocephalus* could be cultivated from one specimen (*P. Schönfelder 94/39*), whereas achenes of subsp. *microstigma* did not germinate. Those plants revealed only a slight variability in nearly all the characters listed above (Table 1). There are striking differences in the pollen diameters, not only between the two subspecies but also between the cultivated plants from subsp. *baeocephalus* and their mother plant with nearly the same anther length. On the other hand the height of the pollen spines and the pollen spines-pollen diameter ratio show less variability and are therefore proper characters to differentiate between the two subspecies (Fig. 3–5).

The lower production of pollen in subsp. *microstigma* (Table 1) is mainly caused by the considerably shorter pollen sacs. In most cases this results in the change of the apical appendage-anther length ratio up to 0.6 in subsp. *microstigma*, which is a very high value in the *Compositae* during the anthesis (THIELE, 1988). As shown by CRUDEN (1977) the pollen-ovule ratio is an indicator of breeding systems in flowering plants. He divides the breeding systems into five classes: obligate xenogamy, facultative xenogamy, facultative autogamy, obligate autogamy and cleistogamy. The evolutionary shift from class to class is accompanied by a significant decrease in the mean pollen-ovule ratio. Obligate xenogamy and obligate autogamy or cleistogamy represent the extremes of a spectrum in which the successful breeding system displays a balance between them. Which breeding system is the most successful is also related to the pollinator activity and the site conditions in which the plants are living. A comparison of the pollen-ovule ratio with the successional stage of vegetation showed that the values increase significantly from disturbed areas to late successional stage or potential vegetation (CRUDEN, 1977). The lower pollen-ovule ratio of the new subsp. *microstigma* (Table 1) corresponds, according to CRUDEN (1977), to a change from facultative xenogamy to facultative autogamy.

As mentioned above, autogamy increases the probability that a single transported achene could establish a population in a new region. Additionally, if one considers the decrease of pollinator activity through the strong trade winds on the northeastern coasts of the Canary Islands and the destruction of natural habitats in these areas, it may be reasonable to assume that these factors may have played a role in the evolution of the new subspecies.

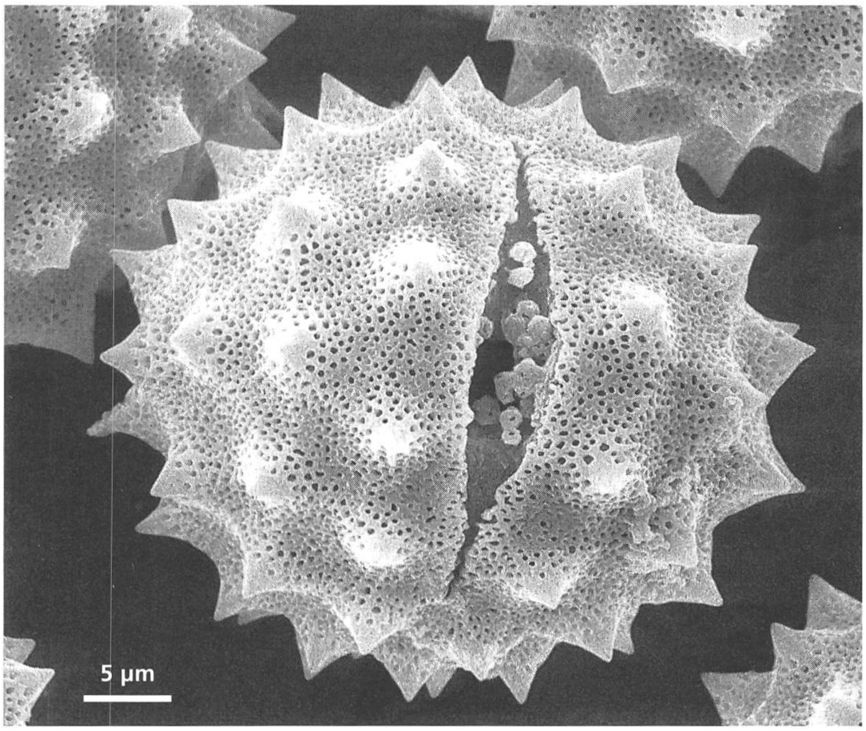


Fig. 3. – Equatorial view of a pollen grain of *Carduus baeocephalus* Webb subsp. *baeocephalus* [from *P. Schönfelder 94/39,* herb. Schönfelder].

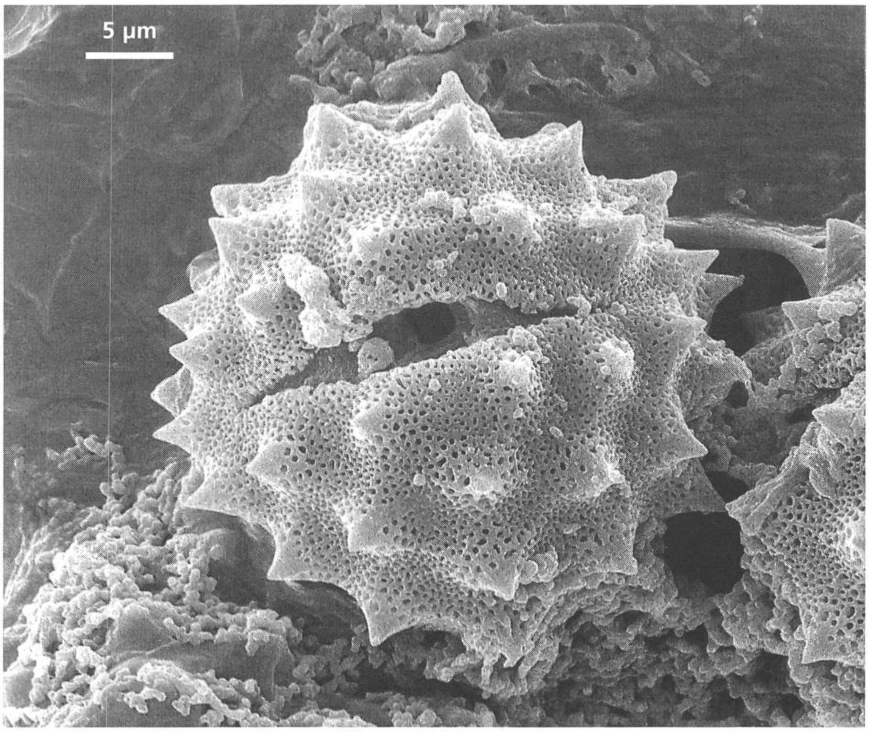


Fig. 4. – Equatorial view of a pollen grain of a cultivated plant of *Carduus baeocephalus* Webb subsp. *baeocephalus.*

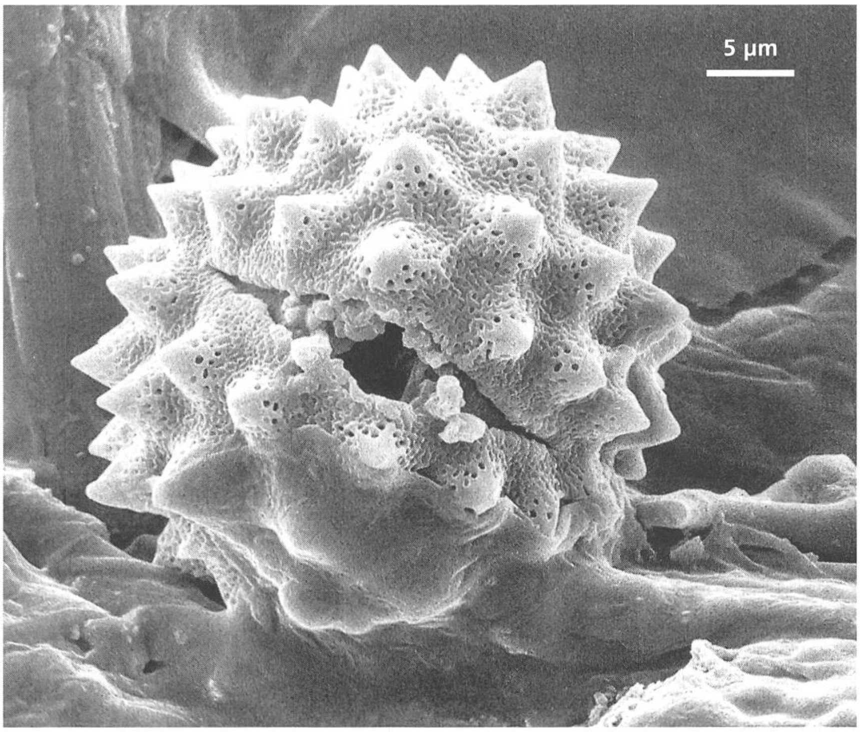


Fig. 5. – Equatorial view of a pollen grain of *Carduus baeocephalus* subsp. *microstigma* Gaisberg & Wagenitz [from *J. R. Acebes & al.*, TFC 23.270].

Key to the subspecies of *Carduus baeocephalus*

1. Flowers considerably exceeding the involucre (Fig. 1b); corolla lobe length 2.6–4.5 mm; stigma length 0.9–1.6 mm (Fig. 6); stylus-stigma length ratio 5.2–7.3; styles 5.5–11.2 mm; corolla length 5.8–11.5 mm; anthers incl. appendages 2.9–5.2 mm long; plant 0.2–1.3 m. Gran Canaria only . . . .*C. baeocephalus* subsp. ***baeocephalus***

1a. Flowers not or scarcely exceeding the involucre (Fig. 1a); corolla lobe length 0.8–2.5 mm; stigma length 0.2–0.7 mm (Fig. 7); stylus-stigma length ratio 8.4–16.5; styles 2.4–6.1 mm; corolla length 2.5–6.3; anther incl. appendages 1.3–3.1 mm long; plant 0.1–0.5 m; Gran Canaria, El Hierro . . . .*C. baeocephalus* subsp. ***microstigma***

Carduus baeocephalus Webb in Webb & Berthel., Hist. Nat. Iles Canaries 2(2): 373–374, tab. 112. 1846.

Holotype: Canary Islands, **Gran Canaria,** Cuesta de Silva, *Despréaux* (FI!).

Annual herb. *Stem* 0.1–1.3 m, diameter 0.2–0.8 cm, erect, furrowed-striated, branched (individuals up to 0.3 m often unbranched), with a spiny wing 0.2–0.5–(1.0) cm wide, in the lower parts nearly glabrous, upwards arachnoid-hairy. *Leaves* alternate, the lower nearly petiolate, the upper sessile, downwards ovate-lanceolate, upwards linear-lanceolate, 1.5–11 × 0.2–3 cm, regularly sinuate, margin doubly toothed with spines up to 0.4 cm, glabrous above, more or less sparsely arachnoid-hairy beneath. *Capitula* homogameous, with 30–65 flowers, erect, 0.4–1.0 cm wide, sessile or with short peduncle. *Involucre* ovate to campanulate; involucral bracts in 5–7 series, often from green at the base to dirty-violet with a yellowish margin near the tip, arachnoid-hairy and finely serrate in the upper part, slightly keeled; the outermost bracts c. 0.2–0.3 cm, ovate-lanceolate, with spines up to 1.2 mm; the bracts of the following series

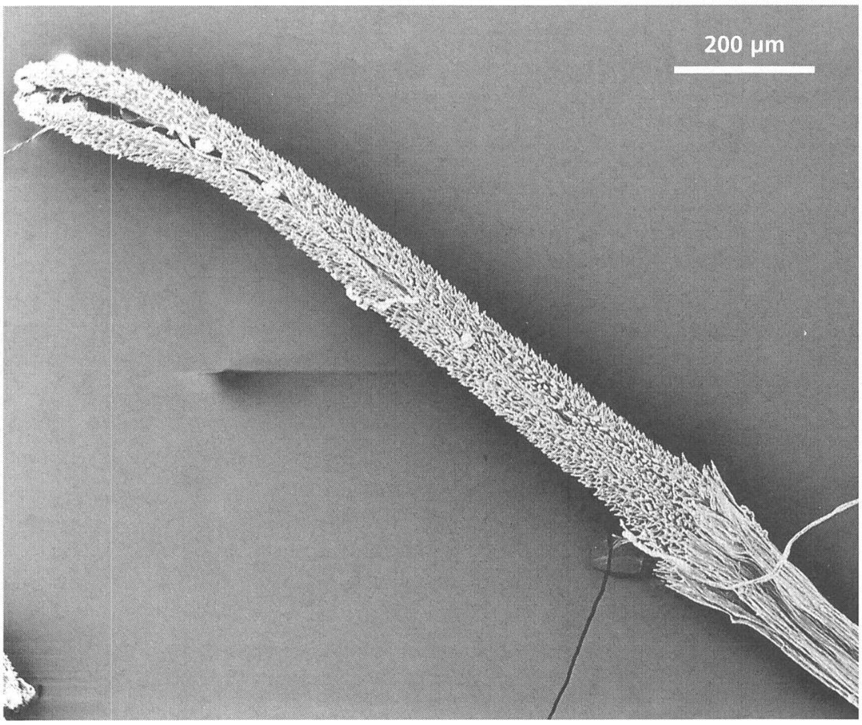


Fig. 6. – Style-branches of *Carduus baeocephalus* Webb subsp. *baeocephalus* [from *P. Schönfelder 94/39,* herb. Schönfelder].

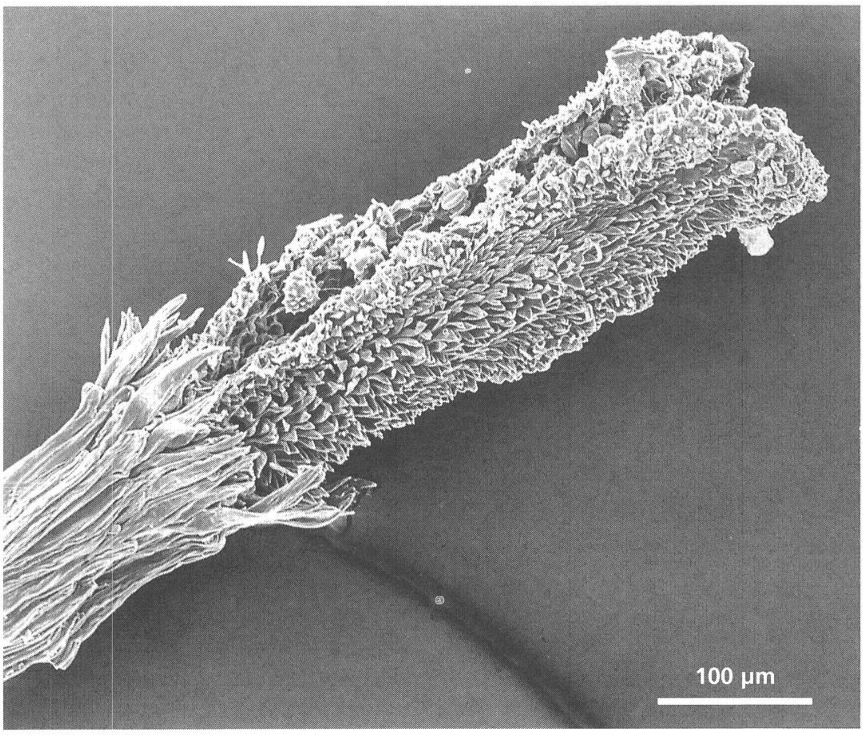


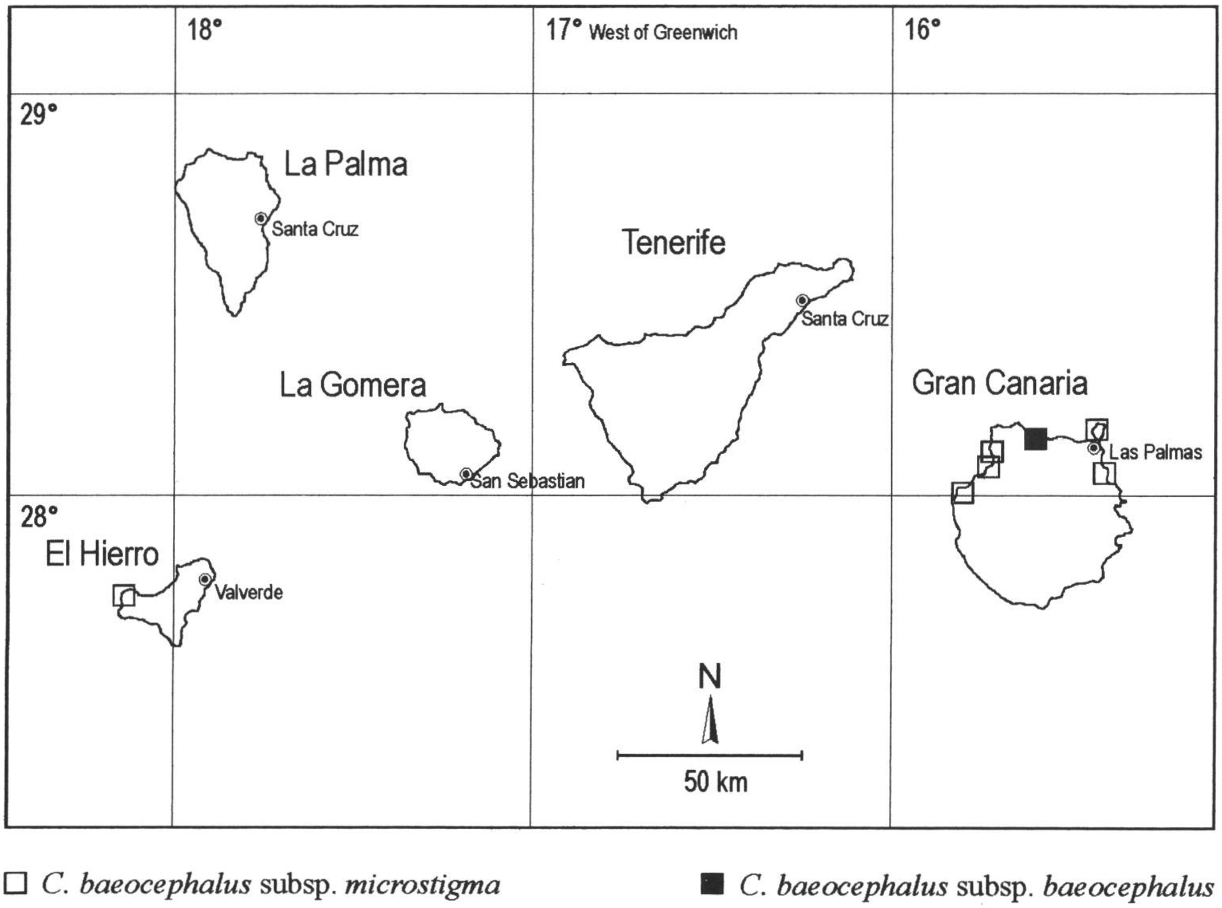
Fig. 7. – Style-branches of *Carduus baeocephalus* subsp. *microstigma* Gaisberg & Wagenitz [from *A. Marrero,* LPA 018929].

0.5–0.9 cm, lanceolate, with spines up to 1.6 mm; the innermost bracts less hairy, in the lower part with a transparent margin, 0.8–1.1 cm, lanceolate, with spines up to 0.9 mm. *Receptaculum* plain, alveolate; scales brownish, c. 1 mm long. *Flowers* hermaphrodite, sweet smelling. *Corolla* white, glabrous, 2.5–11.5 mm, tube narrow, corolla lobes 0.8–4.5 mm, obtuse, with usually one lobe longer than the others. *Anthers* white, incl. appendages 1.3–5.2 mm, apical appendages often purple, 0.3–1.2 mm, steril, acute, basal appendages white, 0.15–0.5 mm, steril, lacerate, filaments upwards pubescent. *Styles* smooth, 2.4–11.2 mm, with a collar of greater collecting hairs below the truncate, scarcely divergent style-branches. *Stigma* in length equal to the style-branches 0.21–1.57 mm long, papillose. *Achenes* 1.8–2.3 × 0.9–1.1 mm, glabrous, ovate, compressed, brown and dark spotted. *Pappus* pluriseriate, of c. 80–90, white, barbellate, dorsiventrally flattened, 3.0–9.2 mm long bristles, mostly clavate at the end, inner bristles longer than the outer. *Pollen* c. 35–41 µm in equatorial diameter, tricolporate, echinate with microperforate tectum continuous between the spines. Flowering February to May.

Carduus baeocephalus subsp. ***baeocephalus*** — Fig. 1b

Distribution. – *Carduus baeocephalus* subsp. *baeocephalus* is endemic to the island of Gran Canaria, where it grows only in a small region on the north coast of the island near San Felipe at Cuesta de Silva and in Bco. del Calabozo situated above (Map 1).

The holotype from FI can definitely be assigned to the typical subspecies. However one must take into consideration that the leading shoot of the plant was evidently already damaged



Map 1. – Distribution of the subspecies of *Carduus baeocephalus* Webb.

before its collection. On the remaining part of the leading shoot (c. 17 cm long), the plant generated lateral shoots with smaller, less developed flowers. Although the corolla length (5.8–6.9 mm) of these flowers is relatively short compared to those of well-developed plants, they could clearly be assigned to the typical subspecies because of their corolla lobe length (2.6–2.8 mm), corolla lobe-corolla length ratio (0.46), stigma length (0.91–0.92 mm) and the stylus-stigma length ratio (6.1).

Additional specimens seen. – **Gran Canaria:** Cuesta de Silva, 180 m, 13.IV.1994, *P. Schönfelder 94/39* (herb. Schönfelder); Autovía del Norte, Cuesta de Silva, 29.II.2000, *A. Marrero & B. Navarro* (LPA 018930); Cuesta de Silva, 23.V.1933, *Erik Asplund 1374* (O); Bco. del Calabozo, 300–400 m, 8.IV.1971, *L. Borgen 800* (O).

Carduus baeocephalus subsp. ***microstigma*** Gaisberg & Wagenitz, **subsp. nova** (Fig. 1a, 2, Map 1)

Holotype: Canary Islands, El Hierro, La Dehesa UTM 28RAR9072, 320 m, 30.III.1999, *M. v. Gaisberg* (B; iso-: GOET, TFC).

Differt a subsp. baoecephalo floribus involucri non vel vix superantibus, corollis distincte minoribus, lobis corollae 0.8-2.5 mm longis, stigmatibus 0.2-0.7 mm longis.

Distribution and ecology. – *Carduus baeocephalus* subsp. *microstigma* is endemic to the islands of Gran Canaria and El Hierro. On Gran Canaria it grows on the North coast at Pto. de la Aldea, Andén Verde, La Isleta, Playa del Risco, Playa de San Nicolas, Playa de Jinamar, East of Mazagan, Agaete, Tinoca, Confital and San Cristóbal in places with a certain humidity (KUNKEL, 1977, Map 1). On El Hierro its distribution is confined to the northwest of the island (Map 1), where it grows at La Dehesa together with *Chenopodium murale*, *Parietaria debilis*, *Urtica membranacea*, *Urtica urens*, *Sisymbrium erysimoides* and other plants, in eutrophic sites of the *Rubio fruticosae-Juniperetum canariensis* Santos in Rivas-Martínez & al. (1993) and its substitute community *Micromerio hyssopifoliae-Cistetum monspeliensis* Santos in Pérez de Paz & al. (1990). Above the Punta de la Dehesa it also appears in humid and nutrient-rich sites of the *Euphorbio regis-jubae-Schizogynetum sericeae* Pérez de Paz & al. (1990).

Additional specimens seen. – **El Hierro:** below Mña. Escobar UTM 28RAR9073, 430 m, 19.III.1999, *M. v. Gaisberg* (herb. Gaisberg); below Mña. de los Guirres UTM 28RAR9074, 90 m, 17.IV.1997, *M. v. Gaisberg* (herb. Gaisberg); Tosca Amarilla, 21.III.1977, *S. Martínez González & E. Barquín Díez* (TFC 34.553); Sabinar, 22.III.78, *P. L. Pérez de Paz* (TFC 8158); Lomo Negro, sobre la Hoya del Verodal, 10.IV.1979, *W. Wildpret de la Torre & al.* (TFC 8123); in rupestribus infra oppidum Sabinosa, ad mare, V.1902, *O. Burchard 322* (M); in rupestribus infra oppidum Sabinosa, ad mare, V.1902, *O. Burchard 322* (O); between Punta de la Dehesa and Sabinosa, 2.IV.1978, *P. Sunding 3941* (O); Sabinosa, ad mare, Las Arenas Blancas, 2.V.1855, *H. de la Perraudière* (GOET).

Gran Canaria: Pto. de la Aldea, 18.IV.1976, *J. R. Acebes & al.* (TFC 23.270); acantilados al final de la pista del Pto. de la Aldea hacía los Herreros, 222 m, 18.IV.1976, *J. R. Acebes & al.* (TFC 23.262); Andén Verde, 19.IV.1988, *A. Marrero* (LPA 016372); La Isleta, cantiles de Las Coloradas, 1.IV.1997, *A. Marrero* (LPA 018929); Playa del Risco, 20 m, 20.I.1966, *J. Lid* (O); Playa de San Nicolas, 10 m, 16.IV.1960, *J. Lid* (O); Playa de Jinamar, 15 m, 18.II.1960, *J. Lid* (O); east of Mazagan, 20 m, 20.II.1960, *J. Lid* (O); Roque Nieves near Agaete, 70 m, 15.IV.1960, *J. Lid* (O).

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