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MICROMORPHOLOGY OF THE SEEDS IN BEGONIA SECTION SOLANANTHERA A.DC.

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SUMMARY

The micromorphological characters of seeds of *Begonia solananthera*, *B. integerrima* and *B. procumbens* provide additional arguments for the delimitation of *Begonia* Sect. Solananthera. The seeds clearly deviate from those of most sections of *Begonia* . The scobiform seeds have air-filled testa cells with bulging outer cell walls on their micropylar part, and depending on the species, also on their chalazal and central parts. These characters are interpreted as adaptations to wind dispersal and compared with trends in some other epiphytic Begonias.

1. INTRODUCTION

The small section Solananthera was established by A. De Candolle in 1859. He included two newly described species *Begonia solananthera* and *B. populnea* (later shown to be a synonym of *B. integerrima* Sprengel 1825). Since then several species have been placed in this section, which now counts about 11 species names, several of them described from horticultural material. According to the latest revision by IRMSCHER (1955) that number should be reduced to 4, mainly due to the reduction of several species to *B. procumbens* Vellozo. BARKLEY & GOLDING (1974) reduced the number to 3 by sinking *B. limmingheiana* Morr. into *B. procumbens*. *B. limmingheiana* was described from cultivated specimens by Morren in 1866; it was distinguished from *B. procumbens* by Irmscher mainly on the basis of differences in leaf shape.

The section is well-defined by the presence of porate anthers. This most striking character of the section reminded De Candolle of *Solanum* and provided the sectional name. BRADE (1944) was the first who drew the attention to the aberrant seed shape and suggested this as an additional sectional character. SEITNER (1972) depicted the seed of *B. solananthera* and the ruptured seed coat after germination.

The section is restricted to Brazil and has mainly been recorded from the South-Eastern States Rio Grande, Santa Catarina, Parana, São Paulo and Rio de Janeiro.

The species are epiphytic subshrubs, climbing with the aid of adventitious roots on tree boles in the mountain forests. The horticulturists classify species of this section in the "trailing-scandent" group of Begonias (THOMPSON & THOMPSON 1981).

It has appeared that the micromorphological characters of *Begonia* seeds are of taxonomic value and may be of help in the delimination of sections and spe-

cies. Moreover, in a number of cases relations between the seed morphology and type of seed dispersal can be demonstrated (BOUMAN & DE LANGE 1982, 1983). Within this scope the seeds of the section Solananthera are described here.

2. MATERIAL AND METHODS

Specimens examined:

Begonia integerrima Sprengel, Est. Rio de Janeiro, Barreira, E. Pereira 606 (RB),

Begonia integerrima var. *cardioides* Irmscher, Est. São Paulo, Trepadeira, Oswaldo Handro 698 (P),

Begonia procumbens Vellozo, Est. São Paulo, Ipiranga, H. Luederwaldt s.n. (SP); Est. Santa Catarina, Res. Fl. Pilões, A. P. Duarte 3377 (RB),

Begonia solananthera A.DC, cultivated at WAG, Dept. of Horticulture.

The seeds were sputter-coated with gold-palladium for 3 min and observed in a Cambridge Stereoscan Mk 2a or in an ISI DS-130.

3. RESULTS

3.1. *Begonia solananthera* A.DC. (fig. 1A–D)

Seeds narrowly elliptic to narrowly obovate in outline, mostly straight, the chalazal part sometimes curved and rendering the seeds J- of C-shaped. Variation in length from 660 to 940 × 10^{-6} m, in width from 120 to 185 × 10^{-6} m; mean 755 × 145 × 10^{-6} m. Ratio length: width 5.2. Collar cells varying in length from 180 to 320 × 10^{-6} m; mean 250 × 10^{-6} m. Ratio collar: seed length 1:3.0.

Collar cells strongly elongated, the anticlinal walls between the cells almost straight, near their chalazal ends finely S-undulated. Outer periclinal walls convex, not collapsing in the mature seeds. Testa cells elongated, in line with the collar cells and becoming shorter near the chalazal end. Outer walls convex, the anticlinal walls finely undulated, becoming straighter towards the chalaza.

Operculum funnel-like with sunken hilum, obtuse, mostly two cells high, the cells bordering the collar longer and forming a ring. The border-line is distinct. Outer periclinal walls flat, cuticular sculpture as in the other testa cells.

Micromorphology. Anticlinal boundaries straight. Cuticular pattern on the anticlinals perpendicular to the walls. The elongated testa cells with parallel, lengthwise running striae, sometimes slightly curved. The smaller chalazal cells with more irregularly oriented, shorter striae. Testa cells sometimes with irregularly distributed located patches discernable by their flattened and denser striae.

3.2. *Begonia procumbens* Vellozo (fig. 1E, F, fig. 2A, B)

Seeds narrowly elliptic to narrowly obovate in outline, mostly J-shaped, some C-shaped or straight. Variation in length from 935 to 1175 × 10^{-6} m, in width 155 to 180 × 10^{-6} m; mean 1060 × 170 × 10^{-6} m. Ratio length: width is 6.2. Collar cells varying in length from 125 to 450 × 10^{-6} m; mean 255 × 10^{-6} m. Ratio collar: seed length 1:4.2.

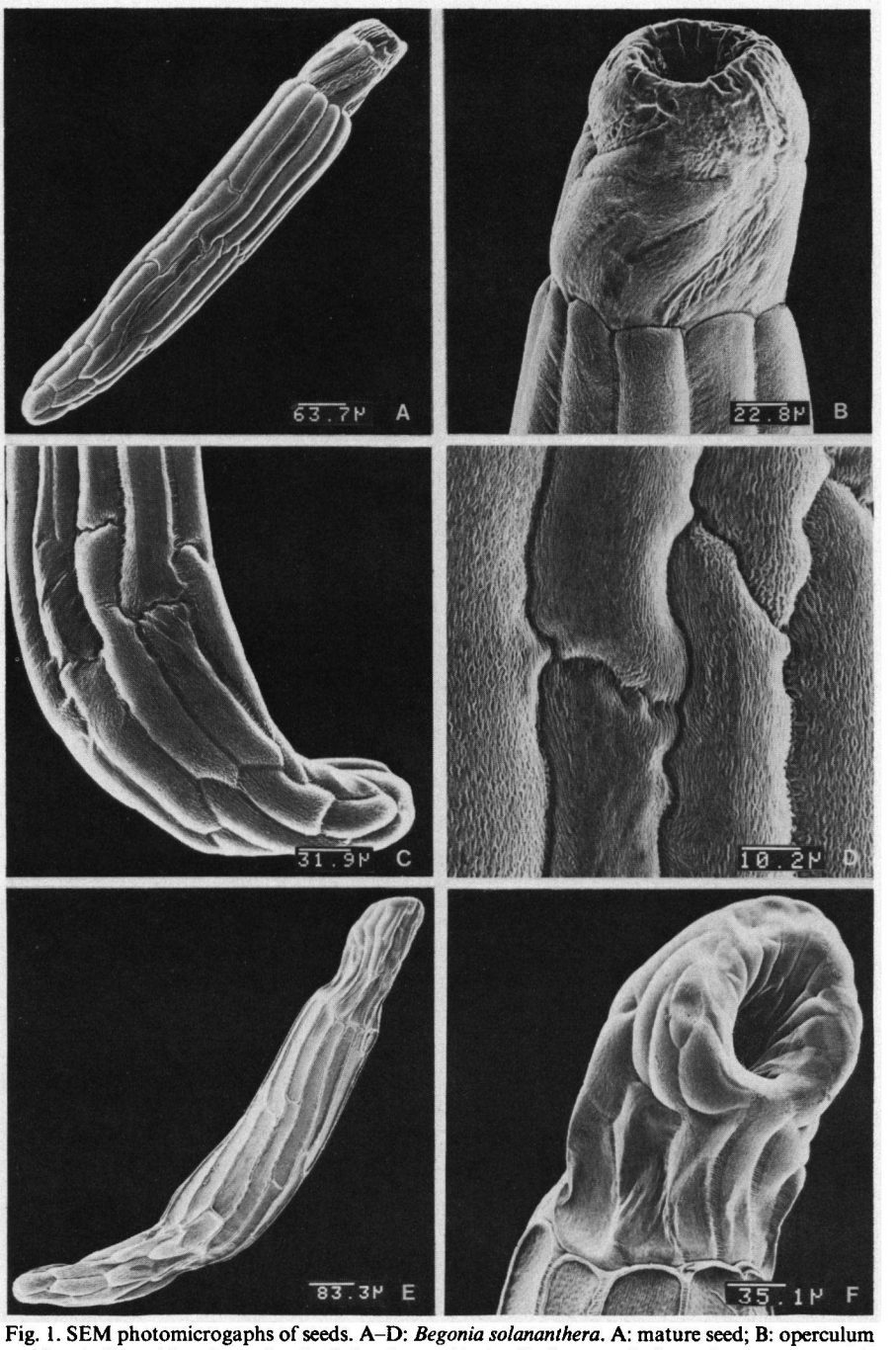

Fig. 1. SEM photomicrogaphs of seeds. A–D: *Begonia solananthera*. A: mature seed; B: operculum and borderline with collar cells; C: chalazal part; D: detail of testa cells from the central part; E, F: *Begonia procumbens*, mature seed and operculum, respectively.

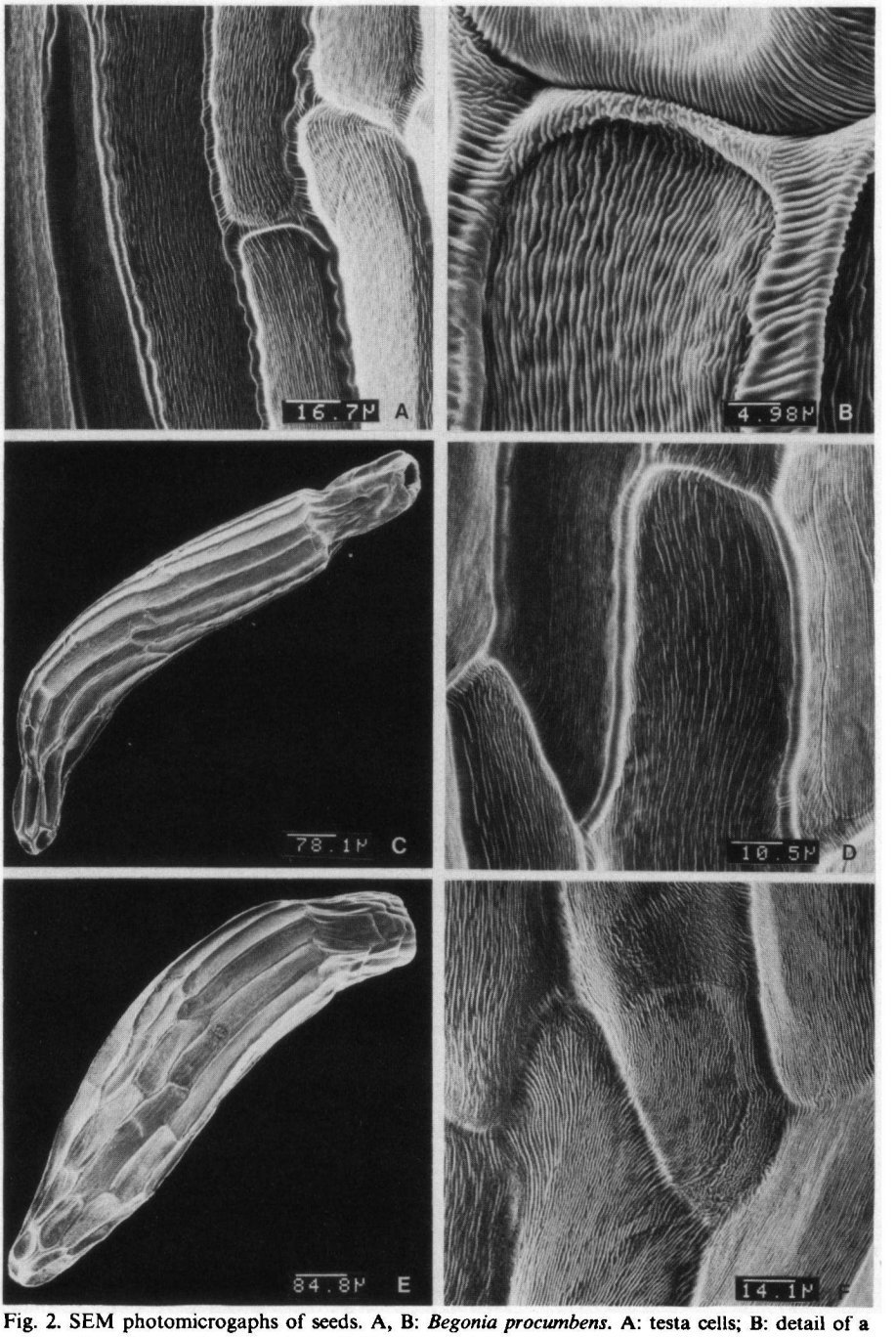

Fig. 2. SEM photomicrogaphs of seeds. A, B: *Begonia procumbens*. A: testa cells; B: detail of a collar cell bordering the operculum; C, D: *Begonia integerrima* var. *integerrima*. C: mature seed; D: detail of testa cells; E, F: *B. integerrima* var.*cardioides*. E: mature seed; F: detail of testa cells.

Collar cells mostly strongly elongated, the anticlinal walls between the cells finely S-undulated, towards the operculum sometimes straighter. Outer periclinal walls collapsed, pressed against the inner periclinal wall, faintly reflecting the pits. Testa cells elongated, in line with the collar cells Those adjacent to the collar cells with undulated anticlinals and collapsed outer periclinal walls. The testa cells of the chalaza, not covering the embryo, with straight anticlinals and bulging outer periclinal walls.

Operculum funnel-like with sunken hilum, obtuse, mostly two cells high. The cells of the ring bordering the collar are the longest and have partly collapsed outer periclinal walls. The uppermost cells with convex outer walls.

Micromorphology. Cuticular sculpture as in *B. solananthera*, but in the uppermost cells of the operculum less prominent.

3.3. *Begonia integerrima* Sprengel. (fig. 2C, D)

Seeds narrowly elliptic to narrowly obovate in outline, mostly straight, some slightly J-shaped. Variation in length from 845 to 990 $\times 10^{-6}$ m, in width from 145 to 165 $\times 10^{-6}$ m; mean 885 $\times$ 155 $\times 10^{-6}$ m. Ratio length: width 5.7. Collar cells varying in length from 135 to 415 $\times 10^{-6}$ m; mean 315 $\times 10^{-6}$ m. Ratio collar: seed length 1:2.8.

Collar cells strongly elongated, the anticlinal walls between the cells straight or finely S-undulated. Outer periclinal walls collapsed, only locally faintly reflecting the structure of the underlying wall. Testa cells elongated, in line with the collar cells. Anticlinal walls straight or slightly S-undulated, those of the chalaza mainly straight. Periclinal walls of the testa cells collapsed, as are those of the chalazal end. Operculum funnel-like with sunken hilum, obtuse, mostly two to three cells high. The cells of the ring bordering the collar are the longest with collapsed outer periclinal walls. The uppermost cells with more convex walls.

Micromorphology. Cuticular sculpture as in *B. procumbens*.

3.4. *B. integerrima* var. *cardioides* Irmscher (fig. 2E, F)

The seeds of this variety closely resemble those of var. *integerrima*. They differ in size and in a more solid appearance of the chalaza. Variation in length from 840 to 1020 $\times 10^{-6}$ m, in width from 180 to 240 $\times 10^{-6}$ m; mean 945 $\times$ 210 $\times 10^{-6}$ m. Ratio length: width 4.5. Collar cells varying in length from 215 to 380 $\times 10^{-6}$ m; mean 300 $\times 10^{-6}$ m. Ratio collar: seed length 1:3.2.

4. DISCUSSION

The three species constituting the section Solananthera are clearly discernable from one another on the basis of their seed structure. Although all three species have scobiform seeds, they differ in size. *B. procumbens* has the longest seeds, *B. solananthera* the smallest. With respect to the micromorphology, *B. solananthera* has the most deviating type of seed in the section. The testa cells of operculum, central part and chalazal end have bulging outer periclinal walls. In *B.*

procumbens the outer walls of the testa cells of the central part collaps during seed maturation, whereas the cells of operculum and chalaza remain convex. In *B. integerrima* all testa cells collaps, the cells of the operculum bordering the hilar-micropylar ring excepted. *B. solananthera* exhibits the most pronounced cuticular sculpture.

Section *Solananthera* differs from the majority of other *Begonia* sections by the scobiform seed shape and convex testa cells. Next to the porate anthers, the seed characters are useful in the circumscription of the section. In the seeds of the majority of *Begonia* species the seed coat closely envelops the endosperm and embryo. The enlarged, air-filled micropylar and chalazal parts may be interpreted as adaptations to wind dispersal. They relatively enlarge the surface of the seed and lower its specific weight. The species of this section grow in forests where the wind velocity is much less than in open stands of vegetation. Moreover, in epiphytes the transport factor plays a more dominant role, since the substrate demands special devices for the arrival and settlement of diaspores (VAN DER PIJL 1982).

Comparable adaptations can be found in some epiphytes belonging to other sections. The five recognized species of section *Enita* are semi-shrubs with climbing stems often producing adventitious roots at the nodes. BRADE (1957) used for this newly established American section as an additional character the presence of cylindrical seeds, at the apex crowned with a group of larger cells arranged in a cap-like fashion. *B. convolvulacea* A.DC. and the type species *B. fagifolia* Fischer have seeds with obtuse micropylar and chalazal ends as observed by us. See also BRADE (1945) re *B. inconspicua* Brade.

B. glabra Aublet, placed in the related Section *Pritzelia,* closely resembles the above-mentioned species of Sect. *Enita* and probably must be transferred to the latter section. This is in accordance with a suggestion of Lyman B. Smith (pers. communication) based on other morphological characters. The same might hold for *B. angularis* Raddi, as may be concluded from a line drawing in BRADE (1957).

B. thomeana A.DC. from the monotypic section *Cristasemen* is the only African representative with seeds showing a marked adaptation to wind dispersal. Both ends of the seed consist of strongly swollen cells functioning as balloons. *B. thomeana* climbs on trees by means of numerous short adventitious roots. This habit represents a unique growth form as far as African *Begonia* species are concerned (DE WILDE 1984).

Other specialized fruits and seeds are found in the African sections *Mezierea, Tetraphila* and *Squamibegonia*, a group in which epiphytism is a common trend (DE WILDE 1985), but these sections developed fruit and seed characters which are functional for zoochory (BOUMAN & DE LANGE 1982).

Seeds with extended chalazal ends reminiscent of those of *B. integerrima* were encountered by us in the American sections *Scheidweileria, Rossmannia,* and (in American species of) *Begonia*, and in the Asiatic sections *Trilobaria, Parvibegonia* and *Baryandra.* See also SEITNER (1972). This seed shape has not been found in African sections. The relations between this seed shape, the type of

dispersal and the growth habit are not yet clear.

The interrelationships between sections of *Begonia* are in general very obscure. In the literature no suggestions about a possible affinity of section *Solananthera* have been made. It seems premature to use the seed characters described here in phylogenetic speculations. Probably the adaptation of seeds to wind dispersal resulted, at least in some cases, from convergent evolution.

ADDENDUM

According to J. GOLDING and C. E. KAREGEANNES (1986): Begoniaceae, Part II: Annotated species list, *Smithsonian Contr. Bot.* **60**: 131–278, which appeared while this paper was in press, *B. procumbens* Vellozo is a synonym of *B. radicans* Vellozo.

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