

Schütziana

The Gymnocalycium Online Journal



Volume 4, Issue 1, 2013
ISSN 2191-3099

This document was made available as a pdf file: March 10th 2013

Contents

Papsch, Wolfgang	Editorial	p. 2
Papsch, Wolfgang	Gymnocalycium bruchii: History, Ecology and Systematics - Part 2	p. 3–26

Published: 10th March 2013

Legal notice

Publisher: WORKING GROUP SCHÜTZIANA, Fichtenweg 43, 14547 Fichtenwalde, Germany

Editorial team and responsible for the content: www.schuetziana.org/contact.php

Mario Wick, 14547 Fichtenwalde, Fichtenweg 43, Germany, mario.wick@schuetziana.org

Massimo Meregalli, 10123 Torino, V. Accademia Albertina, 17, Italy, massimo.meregalli@schuetziana.org

Wolfgang Papsch, 8401 Kalsdorf, Ziehrenweg 5, Austria, wolfgang.papsch@schuetziana.org

Tomáš Kulhánek, 67201 Moravský Krumlov, Tylova 673, Czech Republic, tomas.Kulhaneck@schuetziana.org.

SCHÜTZIANA is the journal of the WORKING GROUP SCHÜTZIANA.

Source of supply: SCHÜTZIANA is available only as a pdf-file via World Wide Web and can be downloaded from: www.schuetziana.org/download.php.

The content of the respective article expresses the opinion of the author and need not being in agreement with the opinion of the WORKING GROUP SCHÜTZIANA.

The issues of SCHÜTZIANA are free of charge and may be distributed freely. The content and the pictures of the article of SCHÜTZIANA are property of the author and may not be used for other purposes than reading, printing and storing without permission.

© 2013 WORKING GROUP SCHÜTZIANA. All rights reserved.

ISSN 2191–3099

Cover picture: *Gymnocalycium bruchii*, MaW 13-363/583, south of Santa Cruz, Prov. Cordoba, Argentina (photo: Mario Wick)

Editorial



Dear *Gymnocalycium* enthusiast!

In the 2nd part of the revision of *Gymnocalycium bruchii* by Wolfgang Papsch the morphological characteristics of the *Gymnocalycium bruchii* populations are discussed and evaluated. Particular attention is paid to the seed. Based on this study a taxonomic reassessment is proposed.

Two taxa which are possibly associated with *G. bruchii* have been described recently. In *Schütziana* 3(1): 3-12 (2012) *Gymnocalycium meregallii* was described by Ludwig Bercht and in the Russian magazine *Cactus Club* 1/2: 47 (2011; publ. 3/2012) *Gymnocalycium carolinense* ssp. *fedjukinii* by Gapon and Neuhuber. Both taxa were discovered in the south of the Sierra de Comechingones (Provincia Cordoba). Current knowledge about these plants is still too little to make clear statements. The results of further studies on this subject will be found here.

Error correction

Two errors occurred in the last issue on page 6. In the translation of the original German manuscript two names were also translated into English by mistake.

- instead of fa. enormous Oehme read **fa. enorme** Oehme
- instead of William Simon read **Wilhelm Simon**

We would like to express our special thanks to Mr. Graham Charles (United Kingdom), who supports us with the English language, to Mr. Takashi Shimada (Japan), who translates *SCHÜTZIANA* into Japanese and to Mr. Daniel Schweich (France), who has mirrored our publication under: <http://www.cactuspro.com/biblio/>.

***Gymnocalycium bruchii*: History, Ecology, Systematics**

Part 2 (Continued from Schütziana 3 (2):3-43, 2012)

Wolfgang Papsch

Ziehrenweg 6, 8401 Kalsdorf (Austria)
e-mail: wolfgang.papsch@schuetziana.org



ABSTRACT

In a comparative study of the morphological characteristics of the studied populations of *Gymnocalycium bruchii* they undergo a critical evaluation. Special attention was paid to the reproductive features (flowers, fruits, seeds). In this study the results of recent molecular research were also taken into account. Based on the geographical location areas, morphological and molecular data, a new classification structure for *Gymnocalycium bruchii* is proposed.

Keywords: *Gymnocalycium bruchii*, morphology, SEM, systematics

1. PLANT MORPHOLOGY

Some remarkable features appear on comparing all the populations investigated in this study. They are generally divided into two groups with regard to plant morphology. The eastern line is characterised by plants with more or less densely arranged and mainly white spines. It includes the type population of *G. bruchii*. All populations comprise small, spherical to hemispherical, sometimes short cylindrical plants. Likewise, they all have a more or less strong tendency to offset. This tendency is more pronounced in cultivated plants than in those growing in their natural habitat. Their epidermis colour is mostly a conspicuous green. It can be stated that within this group those plants which occur at the northern rim of distribution, namely the transition region to the Sierra de Ambargasta, show a tendency to a somewhat cylindrical form of the above-ground body. The spines are shorter and more pectinate (ssp. *niveum*, ssp. *pawlovskyi*). Along the entire range of the Sierra Chica the plants correspond to this type form (ssp. *lafaldense*, ssp. *multicostatum*, ssp. *elegans*, ssp. *implexum*, ssp. *lacumbrense*). South of Alta Gracia, along the eastern side of the Sierra de Comechingones, a change with respect to increase in spine length and, in combination with it, a

contortion of spines can be noticed (ssp. *glaucum*, ssp. *cumbrecitense*, ssp. *renatae*, ssp. *melojeri*). At the southern end of this line of forms, spination becomes even longer and harder and more central spines are formed (ssp. *ludwigii*, ssp. *eltrebolense*). Situated to the west of the Sierra Chica is the Sierra Grande, which is populated by plants of this type only at few sites, such as west of La Cumbre (ssp. *lacumbrense*), west of La Falda (ssp. *shimadae*) and at the altitude of and in immediate vicinity of the type locality (ssp. *susannae*).



figs 1-9 Morphological characteristics of the plant body: *G. bruchii pawlovskyi* MaW 05-72/90 (1), *G. bruchii niveum* Ch 08-117 (2), *G. bruchii lafaldense?* MM 1019 (3), *G. bruchii elegans* MM 1054 (4), *G. bruchii multicosatum* MM 1401 (5), *G. bruchii implexum* MM 1404 (6), *G. bruchii shimadae* MM 1362 (7), *G. bruchii lafaldense* MM 1380 (8), *G. bruchii susannae* GN 230/686 (9).



figs 10-18 Morphological characteristics of the plant body: *G. bruchii bruchii* MM1455 (10), *G. bruchii glaucum* WP 452/870 (11), *G. bruchii cumbrecitense* WP 454/872 (12), *G. bruchii renatae* WP 456/874 (13), *G. bruchii melojeri* MM 1216 (14), *G. bruchii melojeri* WP 457/876 (15), *G. bruchii melojeri?* MM 1233 (16), *G. bruchii ludwigii* GN 162/442 (17), *G. bruchii eltrebolense* WP 76/100 (18).

A second, western group is formed by the ssp. *carolinense* and ssp. *ludwigii* of the Sierra del Morro, ssp. *matznetteri*, var. *brigittae* and possibly, according to the features described, ssp. *atroviride* as well. With the exception of the ssp. *atroviride*, these plants can be found in the Sierra de San Luis and in the Sierra Grande. The average altitude of localities is, except for the population in the Sierra del Morro, slightly higher than the altitude of the typical *G. bruchii* forms. The colour of the epidermis is darker, non-glossy with a frequently occurring tendency to bluish-green. Spination is shorter and

does not cover the plant completely, however, the spines are stronger. This makes the plants appear more bluish-green with an open spination. Attention must also be paid to sprouting behaviour. The plants known as ssp. *matznetteri* sprout, like *G. andreae*, from areoles near the apex. This kind of offsetting has not been observed in *G. bruchii* sensu stricto so far.

Some first descriptions explicitly mention strong tap roots (ssp. *carolinense*, var. *eltrebolense*, ssp. *glaucum*, ssp. *implexum*, ssp. *ludwigii*, ssp. *pawlovskyi*, ssp. *shimadae*, ssp. *susannae*) or turnip roots (ssp. *atroviride*, ssp. *elegans*, ssp. *niveum*). This feature is completely unsuitable as a distinctive feature. All populations investigated form long tap roots as early as in their seedling stage, and these roots are indistinguishable from the above-ground plant and their formation depends on substratum composition.



figs 19-24 Morphological characteristics of the plant body: *G. bruchii carolinense* WP 351/744 (19), *G. bruchii ludwigii*? WP 353/747 (20), *G. bruchii brigittae* WP360/755 (21), *G. bruchii brigittae* P 214 (22), *G. bruchii brigittae* (matznetteri) WP 357/752 (23), *G. bruchii atroviride*? LB 1086 (24).

Gymnocalycium andreae has high conformity with the taxa of the western group (ssp. *carolinense*, var. *brigittae*, ssp. *matznetteri*, ssp. *atroviride*) with respect to plant morphology. The altitude of its localities is above that of *G. bruchii*. Sympatric occurrence of both species in the overlapping locality around an altitude of 2000 m in the Sierra Grande could be observed in only few places. They are said to occur together in many localities in the Sierra Chica (Neuhuber 2009b).



figs 25-27 Morphological characteristics of the plant body: *G. andreae* R 567a (25), *G. andreae* R 567a (26), *G. andreae pabloi* A 05-18 (27).

2. RIB AND SPINE MORPHOLOGY

In all populations investigated the ribs run straight and vertical. The ribs are more or less dissolved into tubercles and their number varies between 8 and 17. In the eastern group the areoles are very close to each other, spination extends across the ribs, spines are numerous and fine.



figs 28-35 Morphological characteristics of ribs and spines: *G. bruchii pawlovskyi* WP 385/793 (28), *G. bruchii niveum* WP 364/762 (29), *G. bruchii lafaldense* SNE 04-114 (30), *G. bruchii shimadae* A 09-31 (31), *G. bruchii susannae* WP 88/121 (32), *G. bruchii* WP 449/867 (33), *G. bruchii melojeri* SNE 04-127 (34), *G. bruchii ludwigii* GN 162-442 (35).

In the ssp. *niveum* and ssp. *pawlovskyi* the spines are shorter, pectinate and in parts densely interconnected. Here the highest number of spines (up to 24) can be found. These plants have the most homogeneous and characteristic appearance.

The populations along the Sierra Chica are very variable. The distance between the areoles gets greater, thus making spination seem more open, although average spine length becomes shorter. In the southern populations spination is often even longer and more changeable, forming a noticeable, tuft-like covering at the apex in many individuals. Less striking in their natural habitat, but partly very much noticeable in cultivation, are the plants from the southern point of the Sierra de Comechingones and the Sierra de Portezuelo. They show a tendency to stronger growth and formation of longer central spines.

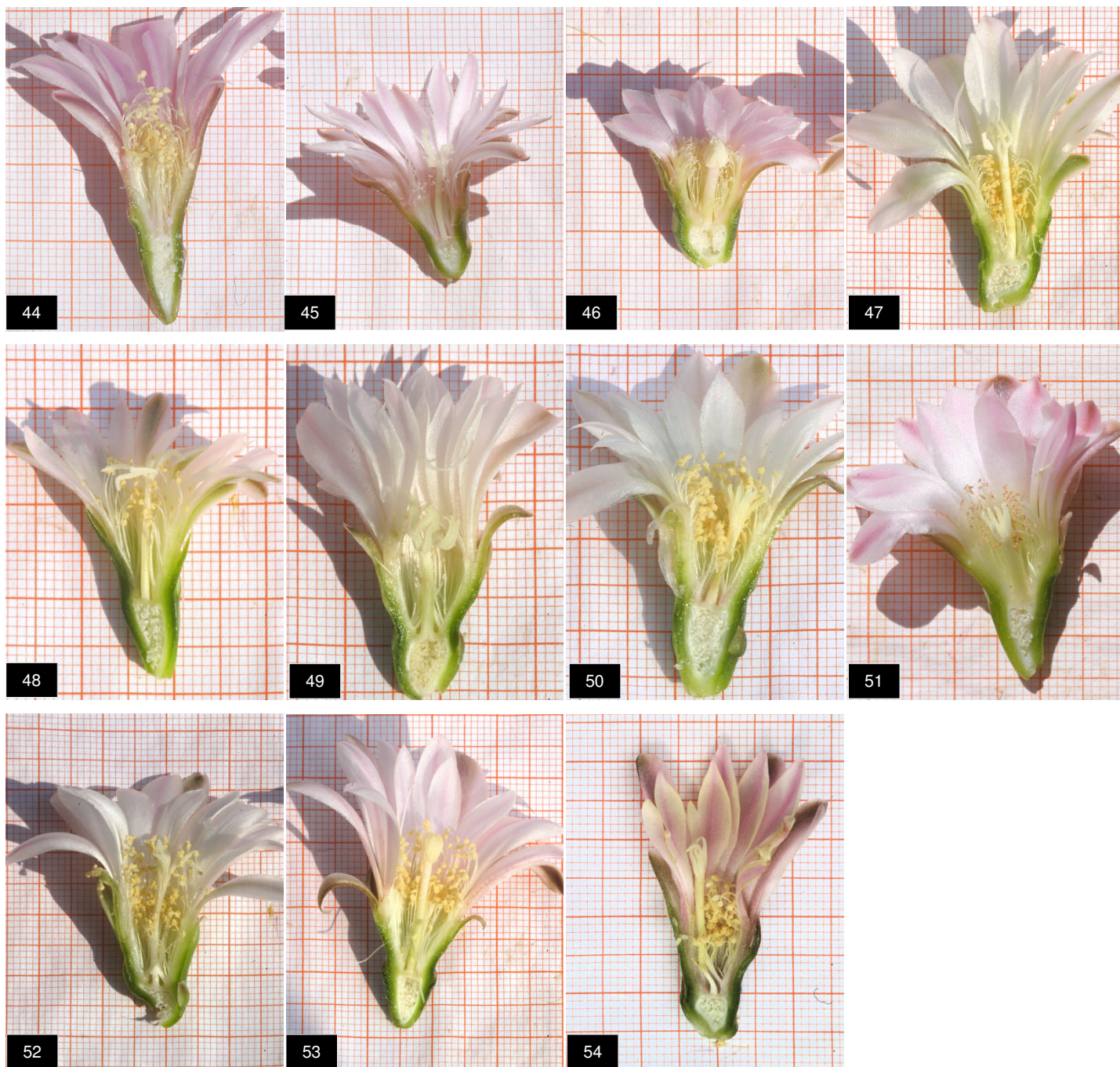
In the western group the largest sizes of plants can be found. The distance between the areoles is significantly greater than in the plants of the eastern group. The ribs are divided into higher tubercles. Spination is not so numerous and rarely extends across the ribs. The spines are short and mostly stiff, thus the plants appear to be of a darker green with larger and more rounded tubercles.



figs 36-43 Morphological characteristics of ribs and spines: *G. bruchii carolinense* GN 90-293 (36), *G. bruchii ludwigii?* WP 353/747 (37), *G. bruchii brigittae* STO 502 (38), *G. bruchii brigittae* WP360/755 (39), *G. bruchii brigittae* WP 429/845 (40), *G. bruchii brigittae* WP 430/846 (41), *G. bruchii brigittae* MM 1009 (42), *G. bruchii atroviride?* LB 1073 (43).

3. FLOWER MORPHOLOGY

All populations often, and in some cases even mainly, include flowers which are clearly sexually determined for one gender, along with hermaphroditic flowers. This dioecism, however, seems to depend strongly on climatic conditions and other environmental influences during the formation of buds. Dioecism is regarded as a more highly developed feature, which would suggest that *G. bruchii* is on a more recent step on the evolutionary ladder.



figs 44-54 Flower section: *G. bruchii pawlovskyi* SNE 04-29 (44), *G. bruchii niveum* WP 364/762 (45), *G. bruchii lafaldense* SNE 04-114 (46), *G. bruchii susannae* STO 415 (47), *G. bruchii lafaldense* WP 351/756 (48), *G. bruchii glaucum* SNE 04-125 (49), *G. bruchii eltrebolense* WP 76/100 (50), *G. bruchii ludwigii* GN 162/442 (51), *G. bruchii brigittae* LB 988 (52), *G. bruchii brigittae (matznetteri)* WP 357-752 (53), *G. bruchii carolinense* WR s.n. (54)

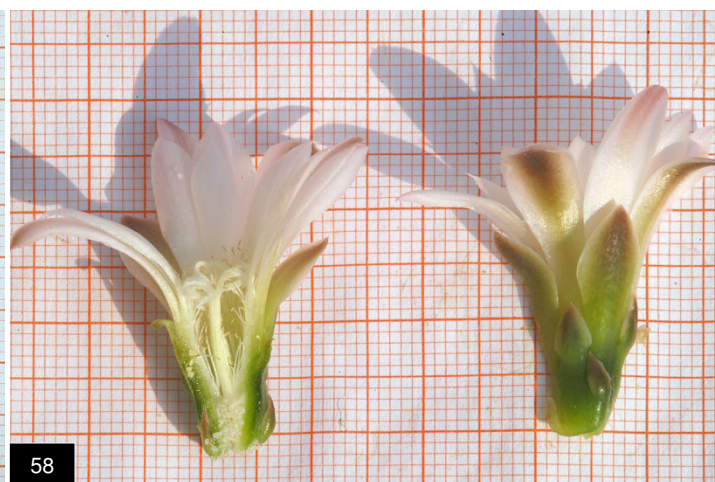
In all clearly single-gender individuals the rudimentary organs of the other gender can be found. Female flowers have reduced stamens, whereas male flowers possess a small stigma. This issue has to be taken into account when flower features are evaluated. The sizes of flowers, which are mentioned in descriptions, are only of limited value when it comes to taxonomy. For instance in the protologue of the ssp. *elegans*, a section of a clearly female determined flower is added as “small, archaic”. The section of a ssp. *lacumbrense* flower with its rudimentary anthers does also not show a

hermaphroditic flower structure, the same applies to sections of the ssp. *melojeri* and ssp. *lafaldense*. Two flower sections are added to the description of *G. carolinense* ssp. *ludwigii* var. *eltrebolense*. The author makes us believe that both show the same flower structure. Here the author is certainly mistaken.

Sections of flowers from various individuals of one sowing or one collection of samples suggest evidence of heterostyly. Length of style (long or short), appearance of the stigma (long or short papils) and position of the anthers (elevated or low) can be found in combination everywhere. As far as evolution is concerned, *G. bruchii*, with its formation of dioecism and heterostyly, seems to develop away from autophily (self pollination) as both flower types promote allogamy (external pollination).



figs 55-56 Gender of flower in *G. bruchii carolinense* WP 351-744.



figs 57-58 Gender of flower in *G. bruchii eltrebolense* WP 76-100.

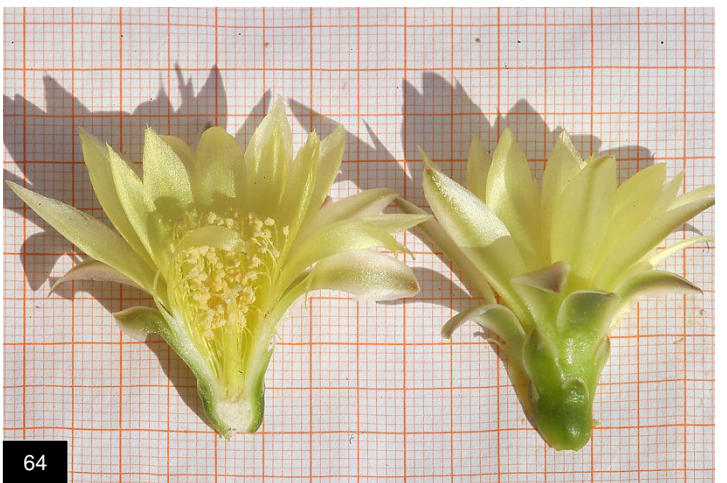


figs 59-60 Heterostyly in *G. bruchii niveum* WP 364/762.



figs 61-62 Heterostyly in *G. bruchii* WP 361-756.

For *G. andreae* the time of flowering is somewhat later than for *G. bruchii*. Flowers open to a wide funnel shape. Dioecism could so far not be observed in original material. However, dioecism is frequent in non-documented material.



figs 63-64 Flower and flower section: *G. andreae* SNE 04-96



figs 65-66 Flower and flower section: *G. andreae?* MN 80 (65-66).

4. MORPHOLOGY OF FRUITS

Relatively large, barrel-shaped fruits develop from flowers which have been pollinated in an optimal way. Fruit size varies between 10-15 mm in length and diameter. When the fruit has reached ripeness, its pericarp splits longitudinally. Each fruit contains an average of 350 seeds. Much smaller fruits develop from flowers which have not been pollinated in an optimal way, the seeds are clearly smaller and so is the number of seeds. On sowing it has been found that the percentage of germinated seeds is lower when they are taken from badly pollinated fruits.



figs 67-69 Fruits at *G. bruchii lafaldense* WP 314-684, pollinated in an optimal (67) and non-optimal way (68, right), ripe fruit (69).





figs 70-81 (figs 71-77 previous page). Fruits in *G. bruchii pawlovskyi* SNE 04-29 (70), *G. bruchii niveum* WP 357-752 (71), *G. bruchii bruchii* WP 361-756 (72), *G. bruchii lafaldense* WP 314-684 (73), *G. bruchii susannae* WP 88-121 (74), *G. bruchii melojeri* WP 456-874 (75), *G. bruchii glaucum* GN 230-686 (76), *G. bruchii eltrebolense* WP 76-100 (77), *G. bruchii carolinense* SNE 66b (78), *G. bruchii ludwigii* STO 880 (79), *G. bruchii brigittae* WP 360-755 (80), *G. bruchii atroviride?* LB 1086 (81).

5. SEED MORPHOLOGY

G. bruchii is a representative of the *subgenus* *Gymnocalycium*. The seeds of this subgenus do not differ in size, form and surface structure as much as the seeds of other subgenera (for instance *Scabrosemineum*). The dimensions of the so far investigated seeds of other subgenera show only slight differences and range from 1.2 to 1.4 mm. The basal hilum-micropylar area is usually of a wide drop shape and appears somewhat indented by a surrounding low ridge with coarsely grained cells. The isometric, hexagonal cells of the testa are low concave with a pronounced plication of the cuticula. The cells are separated by wide declination lines. The cell form can still be recognized when plication is pronounced. It is interesting to note that in the most southern (ssp. *ludwigii*) and most northern (var. *niveum*, ssp. *pawlovskyi*) plants almost identical cell structures occur, namely a minimal plication of the cuticula, limited to the highest point of the cell.

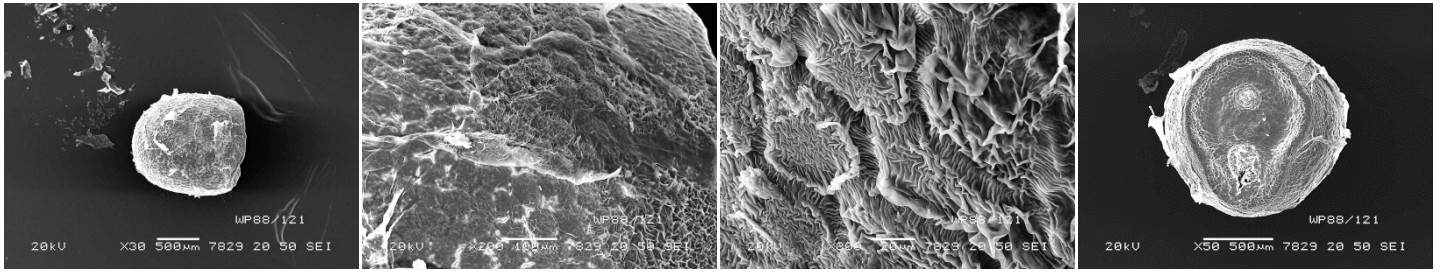


fig 82 *G. bruchii susannae* WP 88/121

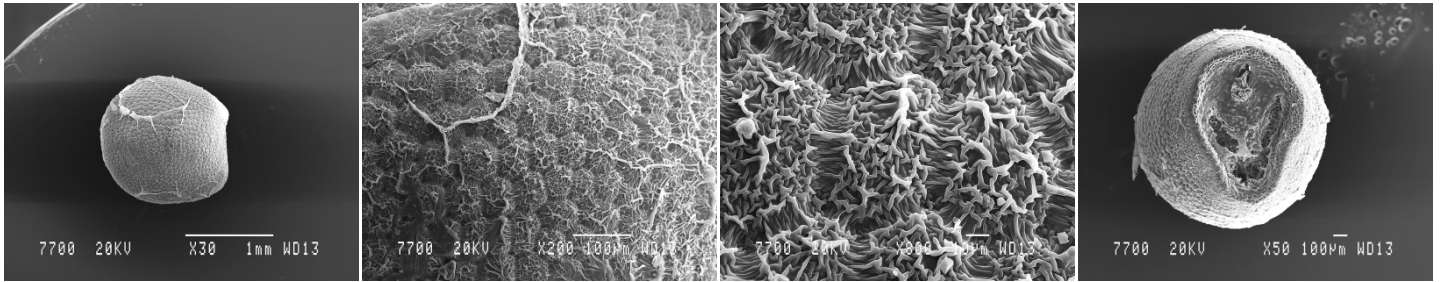


fig 83 *G. bruchii elegans* WP 368/770

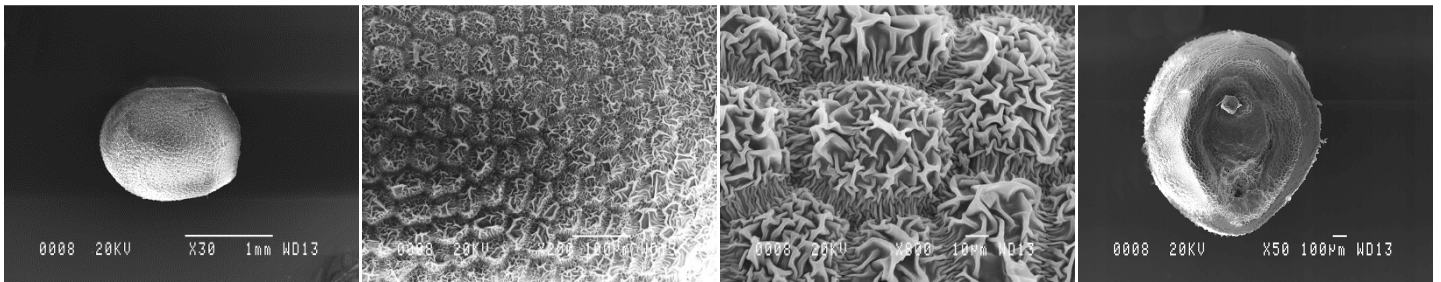


fig 84 *G. bruchii implexum?* WP 361/756

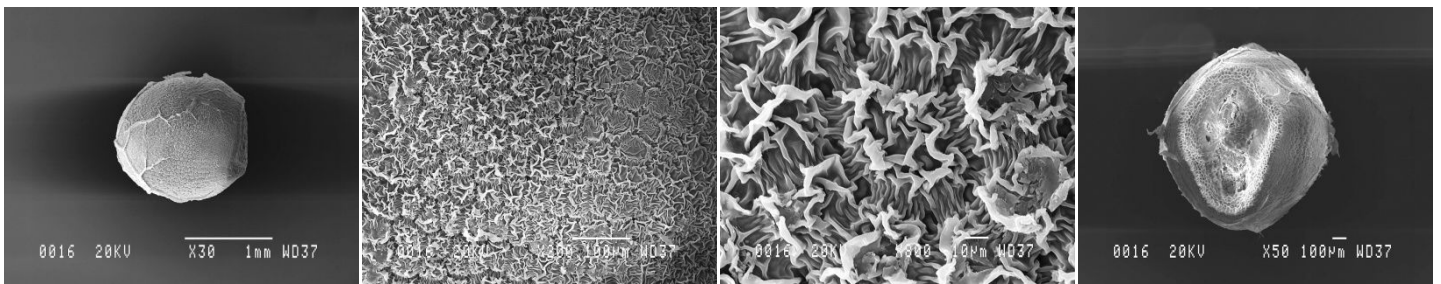


fig 85 *G. bruchii lafaldense* WP 314/684

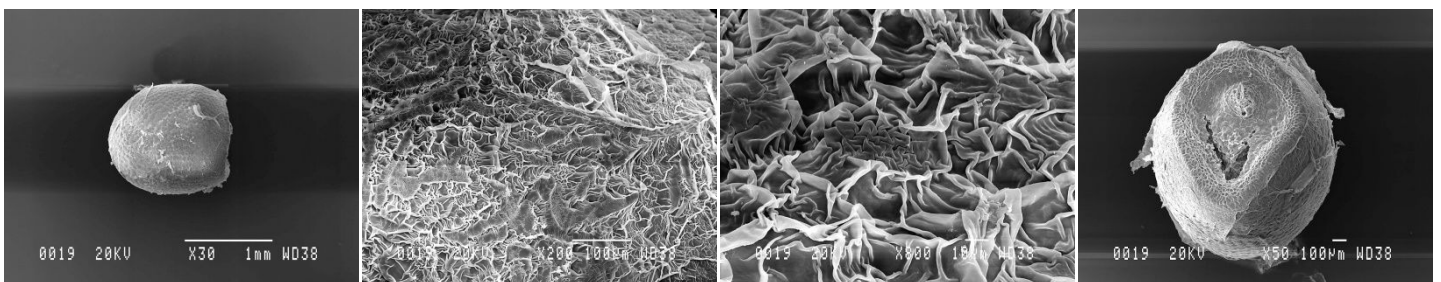


fig 86 *G. bruchii lafaldense* WP 316/687

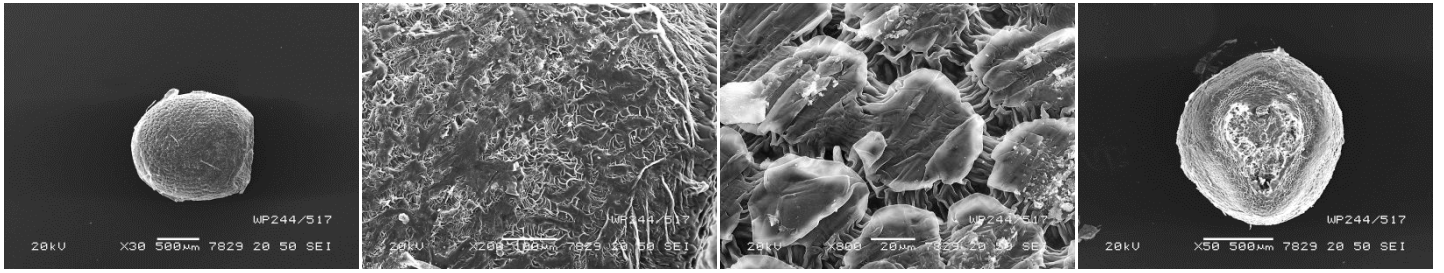


fig 87 *G. bruchii niveum* WP 244/517

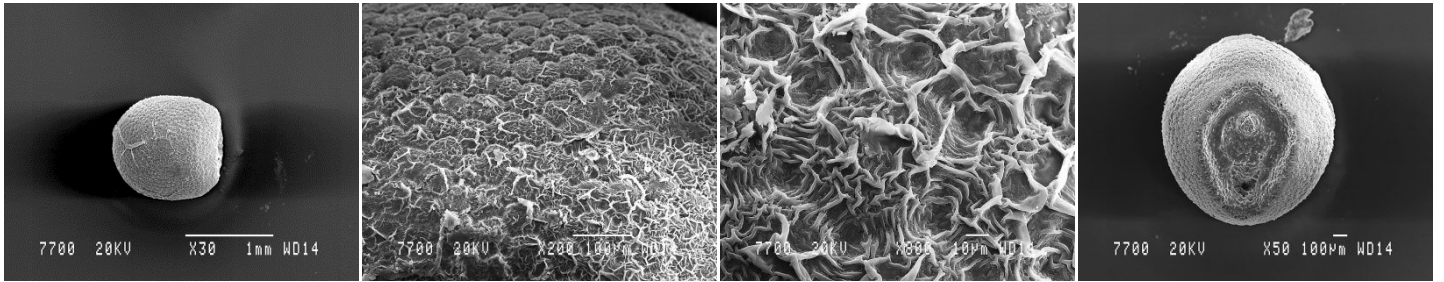


fig 88 *G. bruchii niveum* WP 364/762

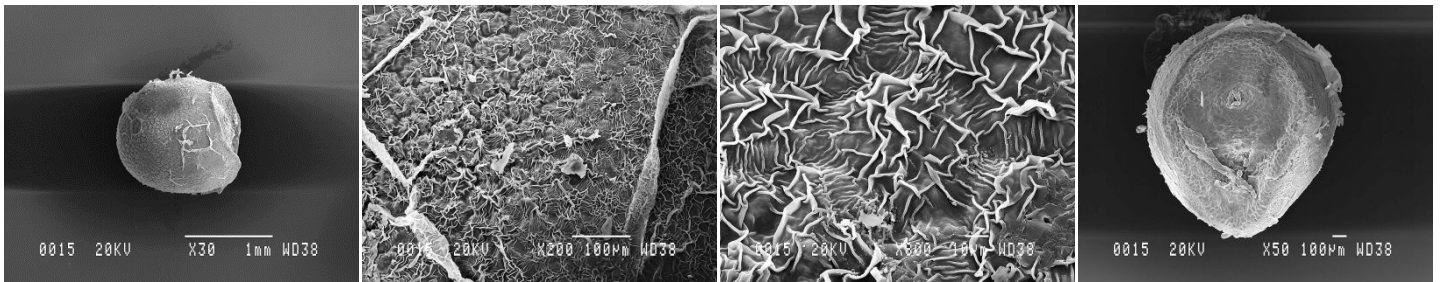


fig 89 *G. bruchii ludwigii?* WP 353-747

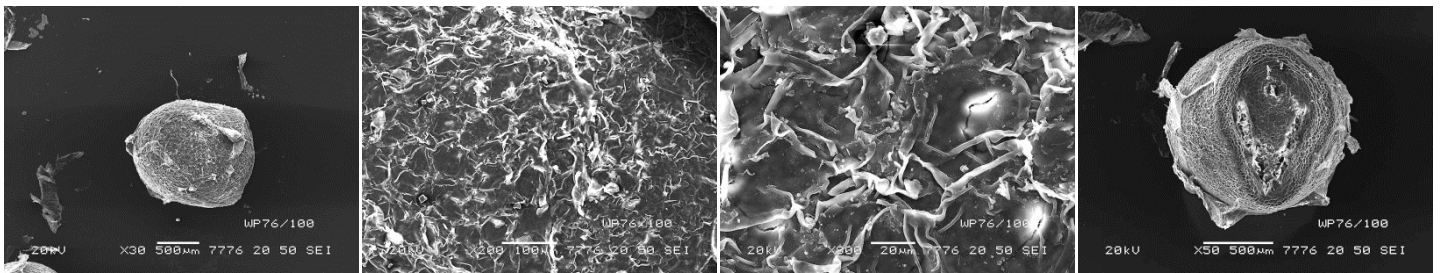


fig 90 *G. bruchii eltrebolense* WP 83/100

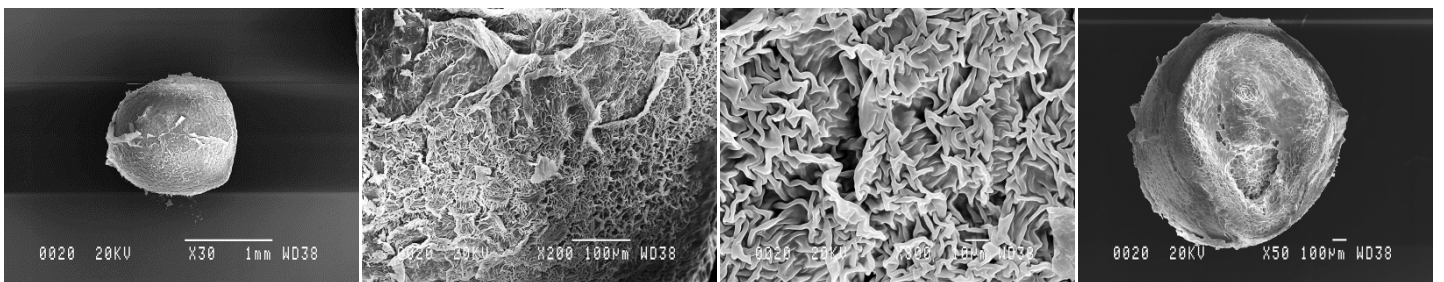


fig 91 *G. bruchii carolinense* WP 351-744

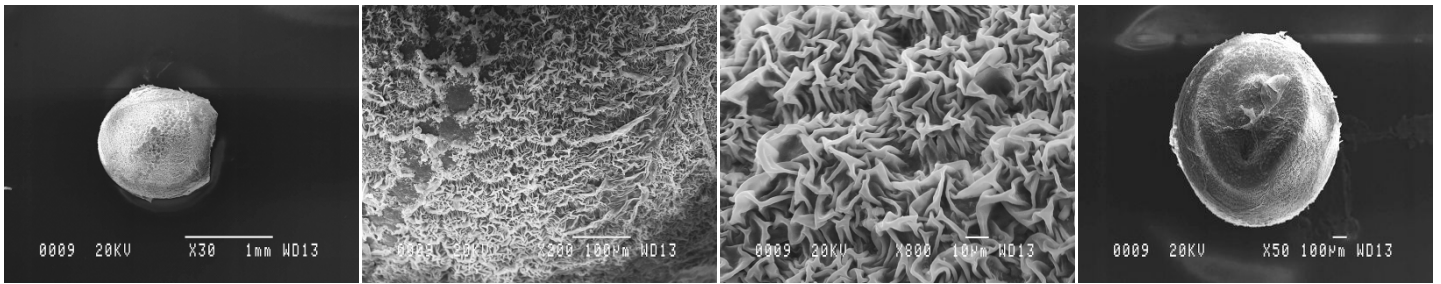


fig 92 *G. bruchii brigittae* (matznetteri) WP 360/755

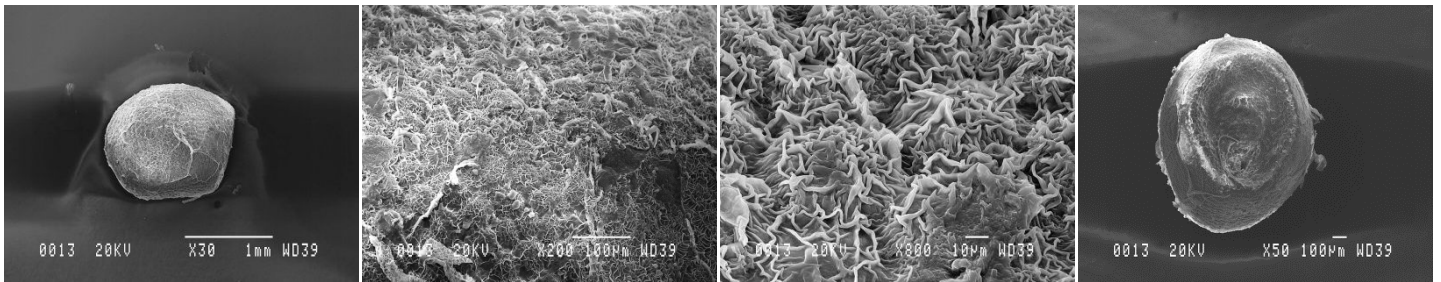


fig 93 *G. bruchii brigittae* WP 357/752

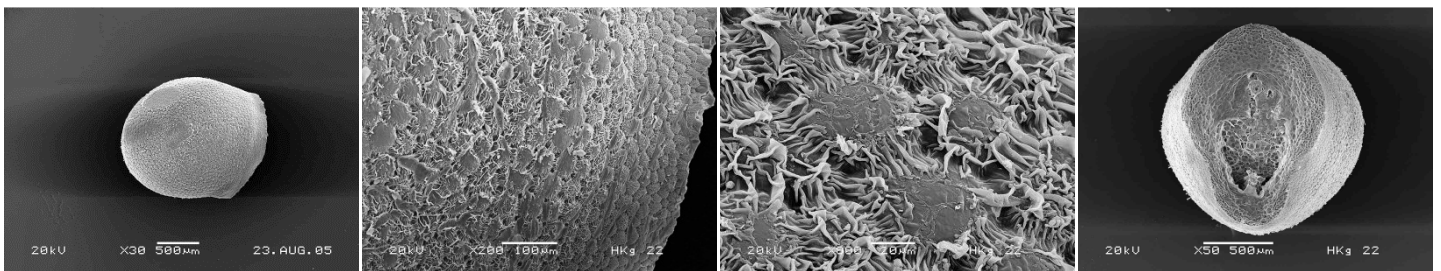


fig 94 *G. rauschii* HK 922

The seed of *G. carolinense* is very similar to that of *G. andreae*. Testa and dimension of the hm-region show conformity. The testa of the seed of *G. andreae* has a strong overall plication, so that the form of the cell cannot be distinguished anymore and the anticlinal lines are covered as well. The basal hm-region is larger than in *G. bruchii*, it is of a wide, drop-formed shape and its dimension corresponds to the diameter and length of the seed.

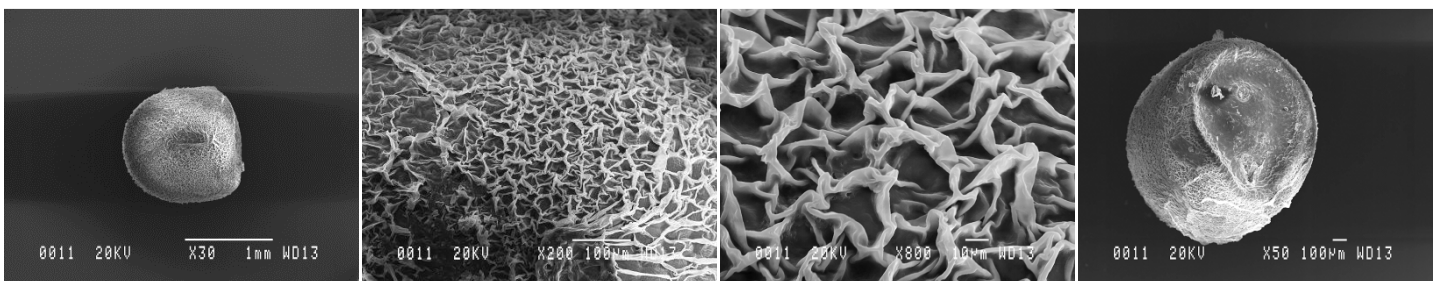


fig 95 *G. andreae* fa. WP 358/753

6. CONCLUSION

These investigations suggest that there are several closely related taxa in the area which comprises Sierra Grande, Sierra Chica and Sierra de Comechigones in the province Córdoba as well as Sierra

de San Luis in the province San Luis. These taxa have a common ancestor but have developed in different directions. *G. andreae* represents the most primitive species, this becomes manifest in its habitat in higher altitudes, its simple, reverse cone-shaped and always hermaphroditic flowers and its two-dimensional, folded seed testa. *G. andreae* also shows the tendency to offset from younger areoles near the apex.

G. carolinense which occurs in the Sierra de San Luis has some features in common with *G. andreae*. Arguments in favour of relatedness are altitude of locations, plant morphology and seed structure. All locations known so far are situated between 1.500 and 1.750 m above sea level. Spination is strongest and most variable within this plant group. The flower structure with its modifications, however, suggests a more advanced development and results in significant conformity with that of *G. bruchii*. The flowers are mostly hermaphroditic, although there are occasionally clearly female or male determined flowers. The seed surface is strong with a two-dimensional plication, the individual cells are only vaguely distinguishable. Young plants from reference sowings can be clearly distinguished from *G. andreae* seedlings. Characteristic for these populations is their solid, early developing spination.

G. bruchii brigittae, which is found in the northern part of the Sierra Grande, must be considered as closely related to *G. carolinense* judging from its morphologic features. The altitude of its localities is, as with *G. carolinense*, in the region between 1.500 and 1.800 m. Only at the eastern side of the main ridge, in the area between Los Gigantes and Chuchilla Nevada, are there occasional occurrences up to an altitude of 1.900 m above sea level. *G. bruchii brigittae* can be found beyond the main ridge of the Sierra Grande in western direction in some places. The sympatric occurrences of *G. andreae* and *G. bruchii brigittae* in this area show that there are representatives of different species. Their flowers have a strong tendency to dioecism. The seed surface shows less plication and cells can be clearly distinguished.

In the case of the ssp. *matznetteri* the data situation is more than obscure. An exact locality is not given, the data of the respective Rausch field number list differ. Thus this taxon cannot be identified with certainty, therefore it seems best to classify it as doubtful and eliminate it. With the description of *G. bruchii brigittae* this very uniform cluster of forms can be identified without any doubt.

The eastern part of the range of distribution is populated by the numerous forms of *G. bruchii*. Their localities are found at an altitude between 850 m and 1.500 m on average. An exception is the ssp. *susannae*, which is found at an altitude of slightly above 1.600 m. Spination is characteristically light, white in a majority of individuals, fine and dense. Spination increases in the north-south direction, the most northern populations having the shortest spines with a pectinate arrangement.

The most southern ones have the longest spines. The latter differ more noticeably from the typical *G. bruchii*, whereas the plants from the northern point of the Sierra Chica as far the Sierra de

Comechingones, are distinguished by only a few features and must be assigned to one single type. Plication of the cuticula is further reduced, the cells are distinctly separated by wide declination lines.

The question of a possible taxonomic ranking arises. In the recent past the first DNA analyses of the genus *Gymnocalycium* have been published. Unfortunately, not all the taxa investigated here have been considered in those studies, so that no result can be deduced from them.



figs 96-97 3 year old seedling of *G. bruchii ludwigii*? WP 353-747.



figs 98-99 3 year old seedling of *G. bruchii carolinense* WP420-832.



figs 100-101 3 year old seedling of *G. bruchii brigittae (matznetteri?)* WP 360-755.



figs 102-103 3 year old seedling of *G. bruchii brigittae (matznetteri)* WP 430-846.



figs 104-105 3 year old seedling of *G. bruchii pawlovskyi* HGR 05-25 (104), *G. bruchii niveum* STO 1366 (105).

As far as *G. andreae* is concerned, the rank of a species is beyond question. In the study by Demaio et al. it is placed, well-supported by evidence, close to *G. uebelmannium* Rausch (Demaio et al. 2010, 2011). In this study *G. bruchii* is found together with *G. calochlorum* Backeberg and *G. baldianum* (Spegazzini) Britton & Rose on another subclade. The plant *G. calochlorum* Be 351/1694, which has also been investigated concerning its taxonomic position, is listed as *G. bruchii* ssp. *pawlovskyi* in F. Berger's field list (Berger 2003).





108



109

figs 106-109 3 year old seedling of *G. bruchii lafaldense* WP 314-684 (106-107, previous page), *G. bruchii lafaldense* WP 315-685 (108-109).



110



111

figs 110-111 3 year old seedling of *G. bruchii* CH 1150 (110), *G. bruchii* CH 1016 (111).

G. bruchii's rank as a species is also considered as not to be discussed. In Demaio et al. *G. bruchii* is clearly separated from *G. andreae*, whereas the separation of *G. carolinense* seems to be less certain. The most northern populations are the most fragile ones. They can easily be identified by the cylindrical form of growth of their bodies and their fine, pectinate spination. Here the rank of a subspecies seems to be justified. *G. bruchii* var. *niveum* is the link between *G. bruchii* sensu stricto and the ssp. *pawlovskyi*.



112



113



figs 112-115 3 year old seedling of *G. bruchii glaucum* GN 230 (112), *G. bruchii cumbrecitense* VG 469 (113), *G. bruchii eltrebolense* JPR 103/248 (114), *G. andreae pabloi* CH 1151 (115).

The majority of *G. bruchii*'s described subspecies are simply phenotypes of a variable species, where a dominating form cannot be clearly defined. In a southern direction the plants in general form a finer and more intertwined spination.

Clearly more deviating are the plants of the southernmost and south-westernmost localities because of their more elongated growth, especially pronounced in cultivation, and their dense and long spination with a central spine. Here the rank of a subspecies seems to be justified as well. Contrary to Neuhuber's attitude, these populations are regarded as *G. bruchii*'s ssp. *ludwigii*.

The populations known as *G. bruchii* var. *brigittae* from the north-western part of the distribution range are here also rated as subspecies, *G. andreae* ssp. *matznetteri* is deliberately excluded. There are overlapping areas with *G. bruchii* ssp. *bruchii* around Tanti and in the north near El Perchel.

DNA analyses show that *G. rauschii* and *G. bruchii* are closely related (Ritz et al. 2007, Meregalli et al. 2010). The molecular studies on *G. rauschii* were done by Ritz et al. in the study on Rebutia. They have deposited the sequence at Genbank, and their DNA was taken from propagations of original plants and not from seeds or seedlings. The markers used are all from chloroplast genes, thus from the female lineage. Now, the question refers to the original plants. If they were habitat-collected, they are surely *G. bruchii*. Till claims they were habitat plants, but this is useless, since he often wrote wrong information (Till & Till 1990). Judging from the original description, they seem to be seedlings, and in this case they might well be cultivation hybrids between *G. bruchii* (this is sure) and *G. uruguayense* or *G. denudatum* or one of the many hybrids that were growing in Till's greenhouse under various names. It is often easier to get a fruit by cross-pollinating, by chance, too, thanks to a fly or a bee, or one of these already self-fertile hybrids. So the only fact we know for certain is that the female origin of *G. rauschii* is a *G. bruchii* and that is beyond any doubt. If it was a natural plant or an artificial hybrid remains unknown unless we have a closer look at nuclear genes, but it is not

important. In case it is a natural plant, it is a *G. bruchii*. If it is a cultivation hybrid, it is certainly not a valid species. So the name must be ignored. It is not important what the F1 hybrids look like, they are cultivation hybrids. So the female lineage of *G. bruchii* can be relied on. There can be no *G. bruchii* in Uruguay, and for me the best solution is to get rid of *G. rauschii* by declaring it to be a synonym of *G. bruchii brigittae*, which the original plants belong to from a morphological (flower, fruits, seed) and (female) molecular point of view. Assuming that *G. rauschii* is identical with *G. bruchii var. brigittae*, this taxon can only be placed within *G. bruchii*. Morphology of the generative organs (flowers, seeds) of both support this assumption.

The so far available, unfortunately fragmentary, DNA analyses link *G. carolinense* to *G. leptanthum* (Spegazzini) Spegazzini (Meregalli et al. 2010), however, there is not much other evidence for this. *G. bruchii* is arranged here on a different subclade, too. It must be noted, that the existing studies are based on different data and therefore their value is limited as far as comparison, and interpretation, are concerned. In the comparative studies only strongly differing spination with fewer ribs and darker plants are noticeable. Period of flowering, morphology of flower and seed as well as characteristics of the seedlings show, however, much conformity with *G. bruchii*. Thus *G. carolinense* is here also considered a subspecies of *G. bruchii*. Individual collections from the Sierra del Morro could be seen as intermediate populations between *G. bruchii ssp. ludwigii* and the *ssp. carolinense*.

CONSPECTUS

1 *Gymnocalycium bruchii* (Spegazzini) Spegazzini **ssp. bruchii**

Basionym: *Frailea bruchii* Spegazzini

Breves Notas Cactalógicas. - Anales Científica Argentina 96: 73-75 (1923).

Type: Illustr. in Spegazzini (l.c.): 74 (lecto).

Synonym: *Gymnocalycium albispinum* Backeberg

Gymnocalycium bruchii ssp. atroviride Neuhuber

Gymnocalycium bruchii ssp. cumbrecitense Neuhuber

Gymnocalycium bruchii ssp. elegans Neuhuber

Gymnocalycium bruchii ssp. implexum Neuhuber

Gymnocalycium bruchii ssp. lacumbrense Neuhuber

Gymnocalycium bruchii ssp. lafaldense (Vaupel) Neuhuber

Gymnocalycium bruchii ssp. melojeri Neuhuber

Gymnocalycium bruchii ssp. melojeri var. rubroalabastrum Neuhuber

Gymnocalycium bruchii ssp. multicostatum Neuhuber

Gymnocalycium bruchii ssp. renatae Neuhuber

Gymnocalycium bruchii ssp. shimadae Neuhuber

Gymnocalycium bruchii ssp. susannae Neuhuber

Gymnocalycium bruchii var. *albispinum* (Backeberg) Milt
Gymnocalycium bruchii var. *glaucum* Neuhuber
Gymnocalycium bruchii var. *hossei* Backeberg nom. inval.
Gymnocalycium bruchii var. *spinosissimum* (Haage jun.) Y. Ito nom. inval.
Gymnocalycium lafaldense Vaupel
Gymnocalycium lafaldense fa. *deviatum* Oehme
Gymnocalycium lafaldense fa. *enorme* Oehme
Gymnocalycium lafaldense fa. *evolvens* Oehme
Gymnocalycium lafaldense fa. *fraternum* Oehme
Gymnocalycium lafaldense fa. *intermedium* Simon nom. inval.
Gymnocalycium lafaldense var. *spinosissimum* Haage jr. ex Simon nom. inval.

1b ***Gymnocalycium bruchii* ssp. *pawlovskyi*** Neuhuber

Type: Argentinien, Prov. Córdoba, zwischen La Esperanza und El Camarón, nordöstlich
Dean Funes, 985 m s. m., leg. G. Neuhuber GN 93-751/2193, 26.12.1993 (BA, holo)
Synonym: *Gymnocalycium bruchii* var. *niveum* Rausch

1c ***Gymnocalycium bruchii* ssp. *ludwigii*** (Neuhuber) Papsch comb. nov.

Basionym: *Gymnocalycium carolinense* ssp. *ludwigii* Neuhuber
Verbreitung und Diversität des *Gymnocalycium carolinense*. - *Gymnocalycium*
25(1): 1009 (2012).
Type: Argentinien, Prov. San Luis, Sierra de Portezuelo, 1032 m s. m., leg. G. Neuhuber
GN 162/440, 17.12.1989 (CORD, holo).

Synonym: *Gymnocalycium carolinense* ssp. *ludwigii* var. *eltrebolense* Neuhuber

1d ***Gymnocalycium bruchii* ssp. *carolinense*** (Neuhuber) Papsch com. nov.

Basionym: *Gymnocalycium andreae* ssp. *carolinense* Neuhuber
Gymnocalycium 7(3): 127-130 (1994)
Type: Argentinien, Prov. San Luis, Sierra de San Luis, 1400-1600 m s. m., leg. G. Neuhuber
GN 88-31/52, 28.04.1988 (WU, holo)
Synonym: *Gymnocalycium carolinense* (Neuhuber) Neuhuber

1e ***Gymnocalycium bruchii* ssp. *brigittae*** (Piltz) Papsch comb. nov et stat. nov. non. *G. bruchii*
ssp. *matznetteri* (Rausch) Neuhuber.

Basionym: *Gymnocalycium bruchii* var. *brigittae* Piltz
Succulenta 66(10): 213-216 (1987).
Type: Argentinien, Prov. Córdoba, Sierra Grande, 1800 m s. m., leg. J. Piltz P 214, 01.06.1980
(Köln, holo)

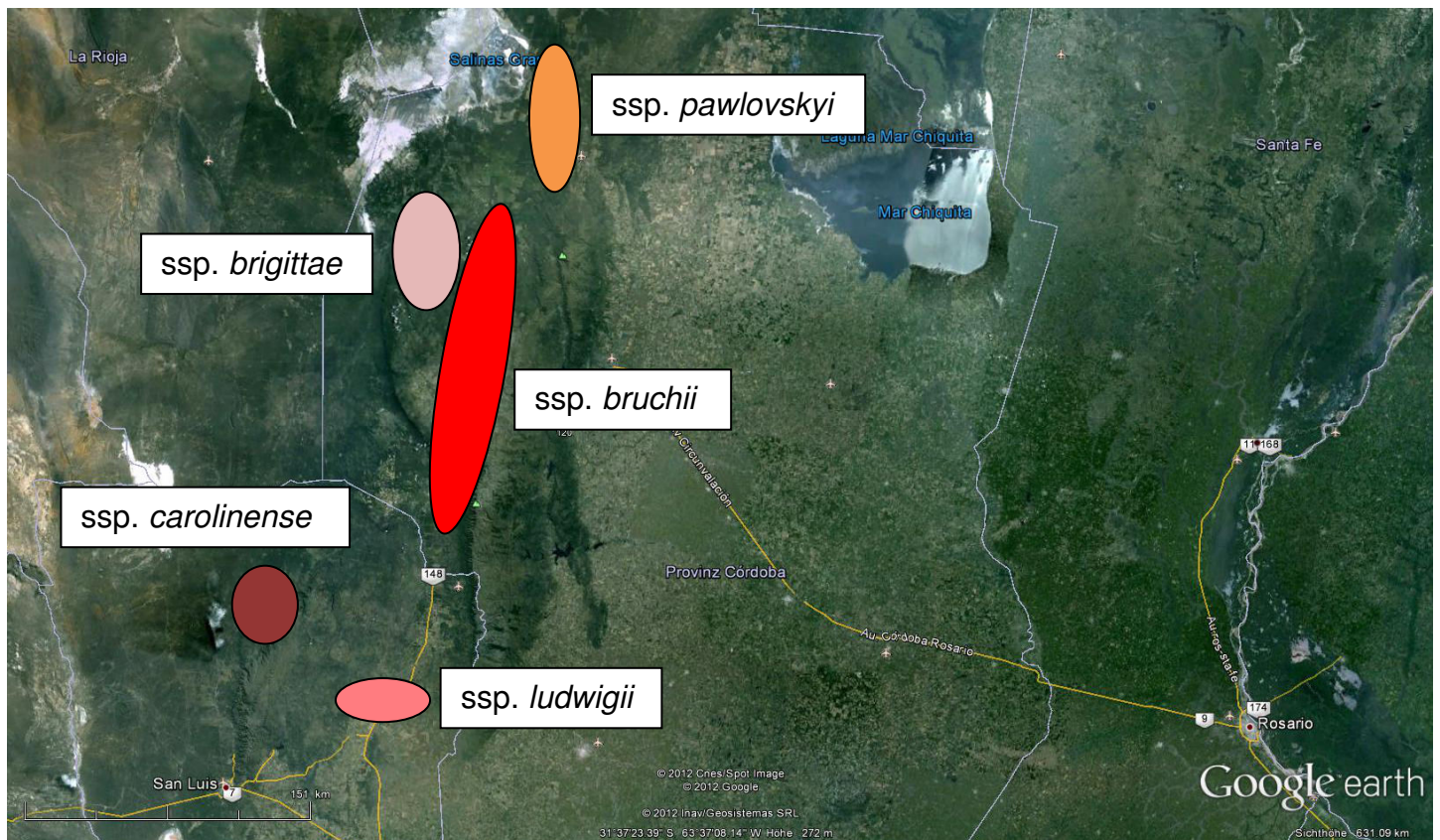
Synonym: *Gymnocalycium rauschii* H. Till et W. Till.

KEY TO *G. BRUCHII* AND ITS SUBSPECIES

- 1a flower yellow, cone-shaped → *G. andreae*
1b flower white, pink, funnel-shaped → 2
2a spination dense, mostly extending across the ribs,
white to reddish brown → 3
2b spination strong, open, mostly not extending across the ribs → 4
3a spines 16-24, 2-5 mm long, spination pectinate,
body cylindrical → *G. bruchii* ssp. *pawlovskyi*
3b spines 11-16, 3 to 13 mm long, spines mostly intertwined, fine → *G. bruchii* ssp. *bruchii*
3c spines up to 15 mm long, stiff, dense,
body cylindrical at advanced age → *G. bruchii* ssp. *ludwigii*
4a spines 7-9, 10 to 15 mm long → *G. bruchii* ssp. *carolinense*
4b spines 7-9, 3-5 mm long → *G. bruchii* ssp. *brigittae*

ACKNOWLEDGEMENTS

I wish to thank all my friends who provided me with photos of plants in the habitat, seeds, seedlings and various information. Thank you for this support especially Massimo Meregalli (Italy), Mario Wick, Volker Schädlich (Germany), Tomi Kulhanek, Jaroslav Chvastek and Lumir Kral (all Tzech Republic). Mario Wick has kindly edited the maps. Mrs. Iris Blanz (Fernitz, Austria) has generously made the translation into English. Graham Charles has kindly checked the English.



Map 1 Distribution areas of *G. bruchii* and its subspecies.

REFERENCES (see also part 1):

Berger, F.: (2003) Feldnummern Argentinien 1995-2003. - Eigenverlag-Lenzing.

Demaio, P. H., Barfuss, M., Till, W. & Chialella, J.: (2010) Entwicklungsgeschichte und infragenerische Klassifikation der Gattung *Gymnocalycium*: Erkenntnisse aus molekularen Daten. - *Gymnocalycium* 23(Suppl.): 925-946.

Demaio, P. H., Barfuss, M., Kiesling, R., Till, W. & Chiapella, J.: (2011) Molecular phylogeny of *Gymnocalycium* (Cactaceae). Assessment of alternative infrageneric systems, a new subgenus, and trends in the Evolution of the genus. - *American Journal of Botany* 98(11): 1841–1854.

Meregalli, M., Ercole, E. & Rodda, M.: (2010) Molecular phylogeny vs. morphology: shedding light on the infrageneric classification of *Gymnocalycium* (Cactaceae). - *Schumannia* 6: p. 257-275.

Ritz, Ch., Martins, L., Mecklenburg, R., Goremykin, V. & Hellwig, F.: (2007) The molecular phylogeny of *Rebutia* (Cactaceae) and its allies demonstrates the influence of paleogeography on the evolution of South American mountain cacti. - *American Journal of Botany* 94(8): 1321-1332.

Till, H. & W. Till: (1990) Een interessante nieuwe soort uit Uruguay: *Gymnocalycium rauschii*. - *Succulenta* 69(2): 27-28.