Photography of seeds and some consequences

Johan Pot

Seeds of a species do not easily change their shape. Therefore they are a suitable source of information about relationships. In the genus *Weingartia* however they do not supply the wanted information at the level of species, because seeds of different mother plants of the same population may differ significantly. However at the level of genera a combination of characteristics was found, with which one can separate *Rebutia* and *Weingartia* clearly.

The usb-camera

If you have ever worked with a light microscope, you are familiar with the problem of focusing. The moment you get one part sharp, the previous one is already out of focus. The same thing happens, if you take photographs using a microscope.

At the end of 2008 together with Clazien Bouwman and Ludwig Bercht I visited a shop selling optical equipment which was certainly not every-day. Ludwig was looking for a usbcamera, which could be mounted onto a light microscope. (Fig. 1). I myself hesitated then, but a few years later I took the same decision.

The camera can be mounted onto various microscopes. It is connected to the computer by a usb-cable. The camera is supplied with supporting software. The installation with OS Windows XP gave no problem. According to the salesman this software should be suitable as well for Windows 7. In 2011 the price of the camera was € 375,-.

A simple photo editing program is

Fig. 1 USB-Camera on a Yashima microscope

provided together with a TWAINdriver. I myself do not use this program. Instead I import the images from the camera using Adobe Photoshop. A single frame has a size of 5 MPixels.

I had intended to mount the camera on a Russian stereomicroscope МБС-10, but the results appeared to be disappointing. By chance I had once acquired a Yashima microscope, which did give satisfactory results. I have little understanding of microscopes, but saw immediately a huge difference of quality on the screen of the computer. In other words, the usb-camera is no guarantee for an acceptable image. A proper microscope is key.

Using the 4×object glass of the Yashima, it appears that almost all the seeds of *Weingartia* fit within the frame to be recorded. The original images have horizontally 2592 pixels, which corresponds to 1,86 mm of the object to photograph. A slide frame is provided with a piece of adhesive tape, onto which the seed to photograph is put. Therefore it does not roll away and can be fixed in different positions. After quite some experimentation I got the best shot with natural light, but not in the full sun.

The hilum and testa are photographed. Between 6 and 15 shots of both are taken with always a little difference in focus. Then I choose a particular image as a base and replace blurry parts by sharp parts of other images (cut and paste in a photo editing program). A classic example of painstaking work: a complete editing took between 30 and 60 minutes. But the results were exciting enough to continue.

A few months ago Claude Bourleau pointed out a program, Zerene Stacker, that would be able to do this patient work for me. Indeed, the results with this user-friendly program are amazing. Note that I have used this function of the program and no other. In 2012 the program cost € 89.

However nice the images may be, they are not comparable with SEM images of course. Nevertheless, they do give rise to some speculations.

Similarity

Children resemble their parents. For example, both of them may have blue eyes or both walk in the same way. Relationship is suggested by agreement in constant characteristics.

Years ago it was explained to me that seeds are very conservative. Their morphological features are little affected by the environment. This suggests, that plants may be related if their seeds resemble each other. But in what way do we determine similarity? A computer can not be programmed with vague criteria. I tried to select a number of characterisitics, with which the computer calculates which seeds are similar to each other – to my taste. (Refer to Appendix.) Is every seed eligible for this project? I was told that the shape of the

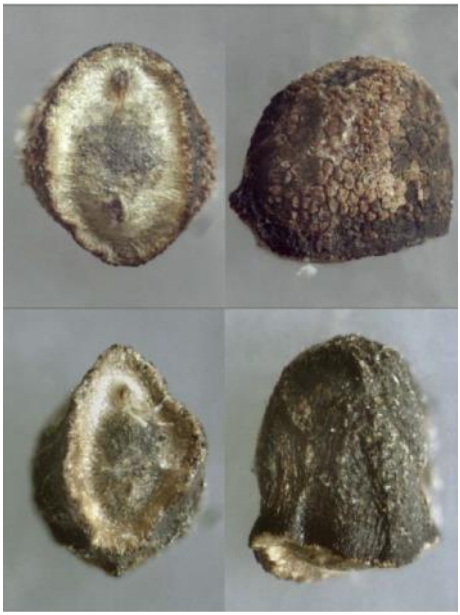

Fig. 2 : Above: seed of a red flowering S. losenickyana JK204; under: seed of a magenta flowering S. losenickyana JK204.

seed is determined exclusively by the mother plant. The father plant has no effect in this regard. Seeds achieved by foreign pollination would not be a problem.[1]

For readability, in this article I will use the names *Weingartia* and *Sulcorebutia* in the classic way, though these genera cannot really be distinguished.

It was expected that plants of the same species would have more or less identical seeds. But often this was not the case. Fig. 2 shows an extreme example of *S. losenickyana* JK204. All seeds photographed by me of so called losenickyana's with red flowers west of Ravelo resemble more or less the upper seed. The second seed in the picture comes from a magenta flowering plant, the only one I know of that whole area. In my view the two seeds in Fig. 2 are not very similar. One could believe, that the magenta flowering plant came "out of the blue". The different seed is another indication that immigration takes place in populations with sulcorebutia's.

According to my computer program the seed of the magenta flowering plant resembles the one of *S. robertovasquezii* VZ725 most, of which the habitat is 100 miles away. Would you have expected this?

Let's make it even more exciting. The seed in the project that looks just like that of *S. arenacea* WR460, Ayopaya area, Bolivia, comes from *W. neumanniana* WR 42, Humahuaca, Argentina. These populations are geographically farthest apart, nearly 440 miles. (Fig. 3 and Fig. 4)

Also, the seed of *S. steinbachii* JK095 has great similarity to these seeds (Fig. 5). But this does not really apply to the seed of *S. steinbachii* WK300 (Fig. 6).

If the shape of the seeds really does

[1] Last season I tried to accomplish several pollinations of plants of different populations. Many times without result. In other cases there were sometimes several immature seeds in the fruit. It seems to me that these are not useful in this context.

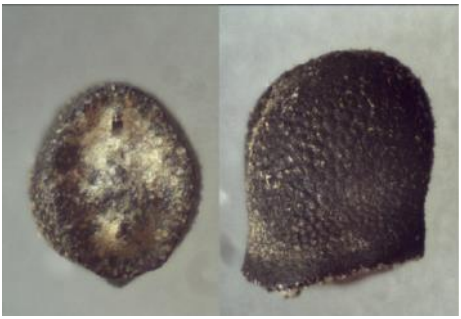

Fig. 3 : Seed of *S. arenacea* WR 460.

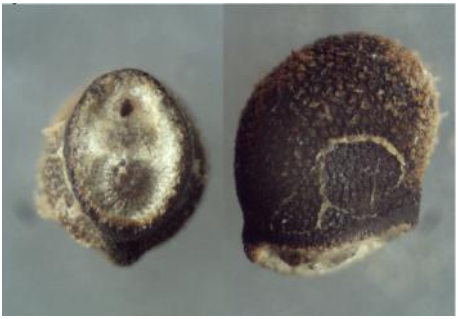

Fig. 4 : Seed of *W. neumanniana* WR 042

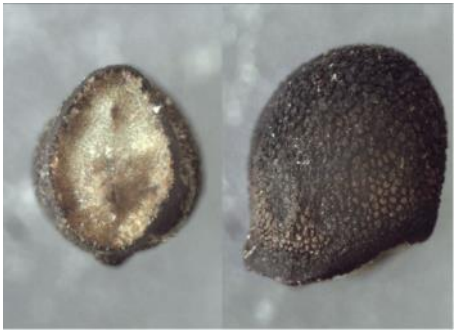

Fig. 5 : Seed of *S. steinbachii* JK 095

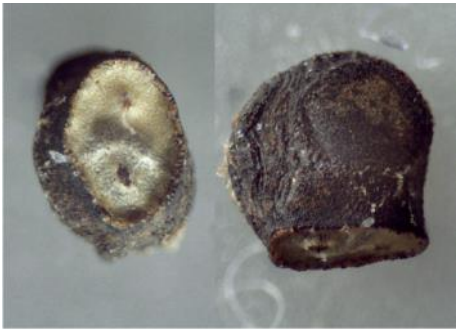

Fig. 6 : Seed of *S. steinbachii* WK 300

say something about relationship, our understanding of species in the genus *Weingartia* / *Sulcorebutia* needs a big review. Assuming that my interpretation of similarity is roughly correct.

But maybe the differences are only interesting at the generic level. In that case the information about the seed in a first description of a *weingartia* / *sulco-rebutia* seems to have no significance.

Rebutia

In my project 9 seeds of rebutia's were photographed (Fig. 7). All of them had to some extent a white tissue that capped the hilum. Someone mentioned the word "strofiola". I cannot judge whether this is correct. I did not find this tissue in any seed of *Weingartia*. This is

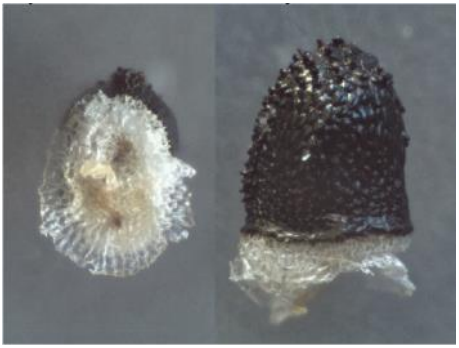

Fig. 7 : Seed of *Rebutia xanthocarpa* RW 055

also true for the extended tubercles. Rolf Weber (1994) wrote: “Remarkable are the thorny protrusions at the apical end.” This feature is even more interesting.

I suspect that the characteristics of seeds of rebutia’s listed here separate the genera *Rebutia* and *Weingartia* unambiguously. I don’t have much experience with seeds of other genera of cacti. But it seems worth investigating, if *Rebutia* as a genus is distinguished from all other cactus genera with these characteristics of seeds.

Appendix

Characteristics used to find similar looking seeds:

- Hilum regularly oval or irregularly
- Hilum light or dark
- Protrusions on the ridge (*Rebutia*)
- Waste light tissue at the testa
- Tubercles on testa visible
- Testa dented
- Creases in the testa
- Micropyle prominent
- Angle hilum with the back
- Volume is approximately <somevalue>
- Width / height ratio
- Ratio diameter seed / surface hilum

I would like to thank Jim Gras for proofreading the English translation.

Literature:

Weber R., (1994), Zum Beitrag: Über *Rebutia minuscula*, Informationsbrief Echinopseen 19:7-27.

Johan Pot
Gagarinstraat 17
NL-1562 TA Krommenie
E-mail : j.pot@tip.nl

This article was originally published in German in the journal

Echinopseen 10 (2) - 2013 (S. 80 - 84)

Reproduced with the permission of the author and the publisher

Translation : Johan Pot