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Brief information about the species status of *Utricularia cornigera* Studnička.

MILOSLAV STUDNIČKA

Liberec Botanic Gardens, Purkyňova 630/1, CZ-460 01 Liberec, botangarden@volny.cz

Abstract: The carnivorous plant *Utricularia cornigera* Studnička was described in 2009, but authorities of the International Carnivorous Plant Society published an opinion that it is not a true species, but only a natural hybrid of *U. reniformis* and *U. nelumbifolia*. The role of heterosis is discussed, because *U. cornigera* is much larger than both theoretical parents. Seedlings, the very characteristic feature of bladderworts (*Utricularia*), are different in all the bladderworts described, that is in the named species and in artificial hybrids of *U. nelumbifolia* and *U. reniformis*. No support for the hypothesis supposing a hybrid origin of *U. cornigera* was found.

Keywords: *Utricularia cornigera*, hybrid, heterosis, apomixis.

Introduction

Recently a hypothesis appeared that *U. cornigera* Studnička could be a hybrid of *U. nelumbifolia* Gardn. x *U. reniformis* A.St.-Hil. (Schlauer 2011, Fleischmann 2012). Consequentially, the new species was rejected from the Carnivorous Plant Database (cited above). Nevertheless it was accepted in the International Plant Name Index (IPNI 2005 etc.). This article presents the results of new experiments with artificial crossings of both theoretical parents proposed by the authors.

The manner of germination and specifically the appearance of the seedlings are crucial phenomena in the life strategy of bladderworts. In the *Utricularia* species from the section *Iperua* there are two different ways of germination: either by floating seedlings (e.g. *U. cornigera*, *U. nelumbifolia*), or by terrestrial seedlings (e.g. *U. geminiloba*, *U. nephrophylla*, and the true *U. reniformis*).

The difference was described and pictured as a very important diacritical attribute of *U. cornigera* as compared with *U. reniformis* (Studnička 2009). As mentioned in the previous paper, *U. reniformis* does not have whorl-shaped seedlings and it cannot germinate in water, but *U. cornigera* germinates in water. The floating whorl-shaped seedlings of *U. cornigera* are rather similar to the also whorl-shaped seedlings of the Brazilian *U. nelumbifolia* and the Venezuelan *U. humboldtii* Rob. Schomb. These species can use phytotelmes within the leaf rosettes of certain host plants to germinate (Taylor 1989, Studnička 2011).

Methods

Cultivated plants¹ were used for manual hybridization, which was carried out during July and August 2012 in Liberec Botanic Gardens (see the address above). Very numerous fresh seeds (the whole content of at least 2 full seed capsules of each species or hybrid) were put into water in a glass and cultivated in a greenhouse. The seeds of *U. reniformis*, which could not germinate in such conditions, were also placed on a wet soil mix of peat and dried *Sphagnum* moss 1:1 and were also cultivated in the greenhouse. Just the soil surface provides suitable conditions for *U. reniformis* to germinate.

The seedlings of *U. reniformis*, *U. nelumbifolia*, *U. nelumbifolia* x *U. reniformis* and *U. reniformis* x *U. nelumbifolia* were documented by photographs taken using a Pentax 35 mm macro lens. The floating hybrid seedlings were compared with the seedlings of *U. cornigera* formerly used to describe the species (Studnička 2009).

Possible heterosis was evaluated according to the maximal size of the leaf blades found. The bladderwort *U. cornigera* was measured in natural localities as well as in cultivated specimens, both giant (Studnička 2009). The species *U. nelumbifolia* found thanks to F. Rivadavia near Teresópolis in Serra dos Órgãos was much smaller than the specimens cultivated in Liberec Botanic Gardens, which is why I present a measurement of a cultivated plant here. The leaf of the flowering cultivated specimen of *U. reniformis* used in this research was also measured and compared with the largest leaf found in natural conditions (cf. Studnička 2009).

Results

The question is whether the prospective hybrid theoretically resulting in *U. cornigera* would be an F₁ generation or a descendant of multiple breeding. To assess this problem measurements of the largest known leaves in all three species in question are needed. I can give these dimensions: *U. cornigera* 24.4 x 20.7 cm (cultivated specimen), but also up to 17.5 x 13.0 cm in natural conditions; *U. reniformis* 9.2 x 7.5 cm (cultivated specimen), but even 10.5 x 8.5 cm in natural conditions; *U. nelumbifolia* 9.9 x 9.6 cm (cultivated specimen)ⁱⁱ, but distinctly smaller specimens were seen in natural conditions. It was documented that the leaf laminas of the theoretical parental species are both about half the size of those of *U. cornigera* (Fig. 1-3). If *U. nelumbifolia* and *U. reniformis* were the parents of *U. cornigera*, the giant size of its leaf lamina would be a sign of heterosis.

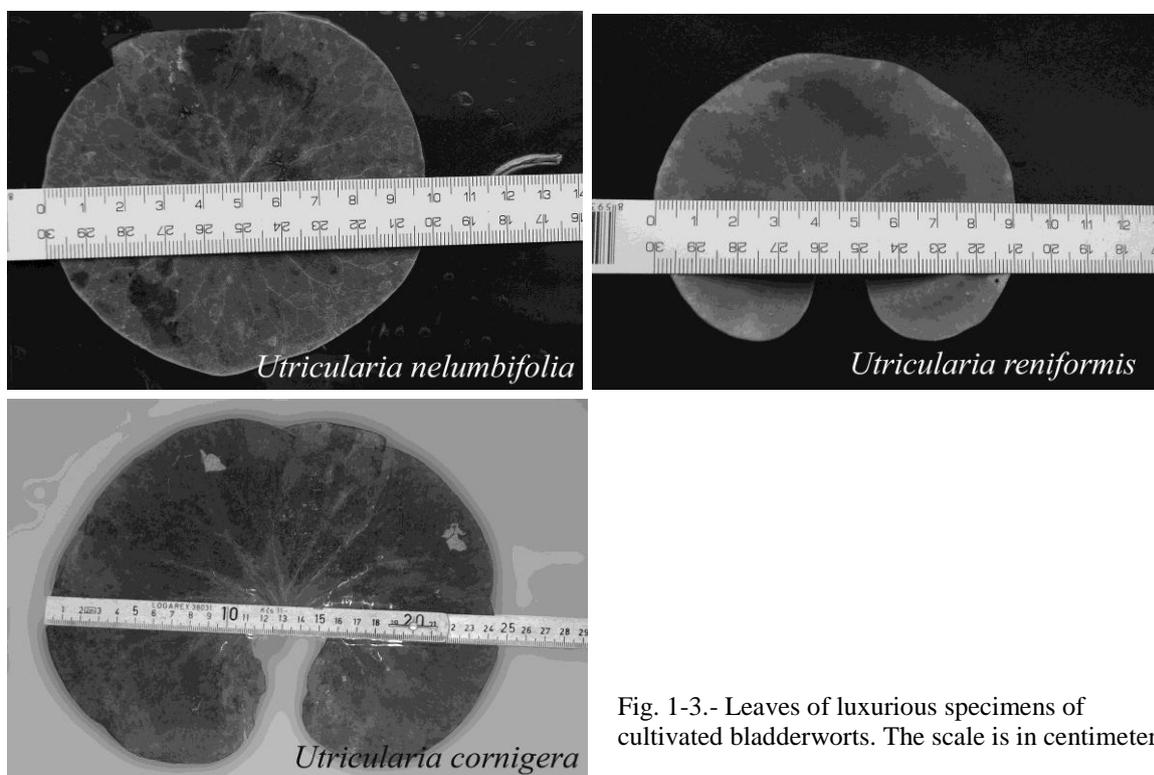


Fig. 1-3.- Leaves of luxurious specimens of cultivated bladderworts. The scale is in centimeters.

The seedlings of all three species are very characteristic. Are the juvenile hybrids of *U. nelumbifolia* x *U. reniformis* (and conversely) similar to *U. cornigera*? The results of crossing experiments are documented below (Fig. 4-8).



Fig. 4-5.- Floating seedlings of *Utricularia nelumbifolia* (left) and terrestrial seedlings of *U. reniformis* (right). These theoretical parents of *U. cornigera* were crossed artificially. (See the following figures.)

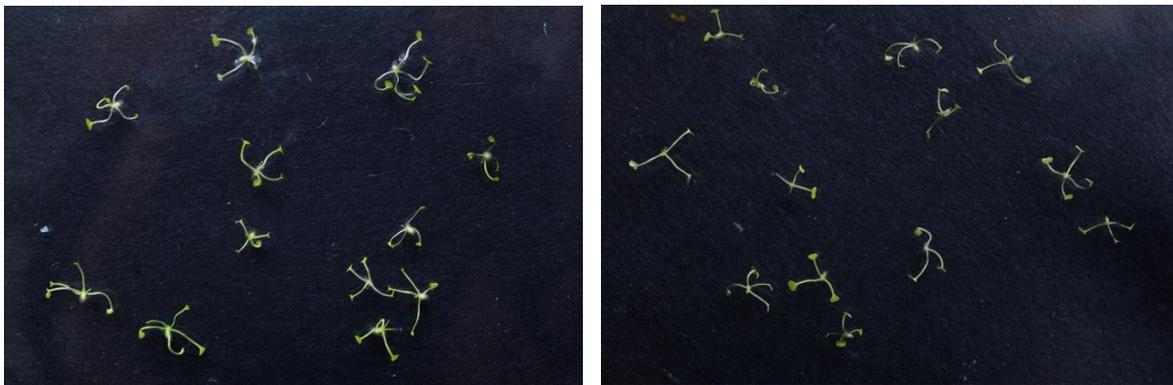


Fig. 6-7.- Seedlings of the hybrid *Utricularia nelumbifolia* ♀ x *U. reniformis* with 4-5 leaf primordia (left) and of the hybrid *U. reniformis* ♀ x *U. nelumbifolia* with 3-4 leaf primordia (right).

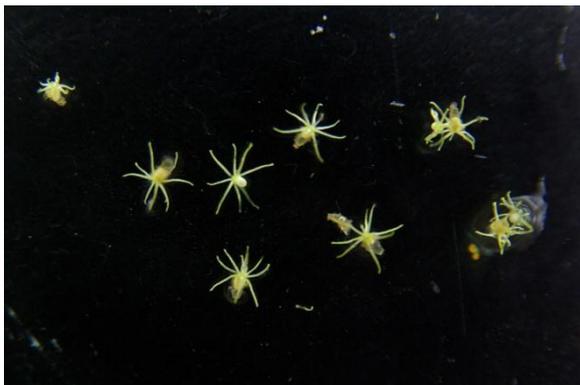


Fig. 8.- Seedlings of *Utricularia cornigera* with 6-8 leaf primordia are dissimilar to the hybrids pictured above.

Discussion

The bladderwort *U. cornigera* is much more vigorous than both *U. nelumbifolia* and *U. reniformis*. Therefore, the heterosis effect in the F1 crossbred generation should be noted, if *U. cornigera* were to be considered as a hybrid. The heterosis effect is, however,

unsustainable in subsequent generations. The gigantism in *U. cornigera* (considered a hybrid) would be stable solely by two prerequisites: 1. It is a primary hybrid; 2. It propagates only asexually.

U. cornigera produces viable seeds, but they could theoretically be a result of apomixis. Nevertheless, research of seedlings made by cross-breeding experiments between *U. nelumbifolia* and *U. reniformis* indicates lower numbers of leaf primordia in these hybrids in comparison with *U. cornigera*. This is clear evidence that the seedlings of *U. cornigera* cannot be an apomictic derivative of the hybrids *U. nelumbifolia* x *U. reniformis* or *U. reniformis* x *U. nelumbifolia*.ⁱⁱⁱ As the aforementioned prerequisites are not fulfilled, which does not support the idea that *U. cornigera* originated as a hybrid.^{iv}

Conclusions

1. The seedlings originating from both crossings of *U. nelumbifolia* and *U. reniformis* are dissimilar to seedlings of *U. cornigera*.
2. This fact excludes the possibility that *U. cornigera* could be an apomictic primary hybrid.
3. The bladderwort *U. cornigera* is the most vigorous species of the three named bladderworts, but no heterosis could survive in many generations of the sexually multiplying bladderwort. That is why it can hardly be a stabilized hybrid of much smaller parents.

References

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ⁱ Specific identity of *U. reniformis* is granted by a previous study made using the same material (Studnička 2009). Specific identity of *U. nelumbifolia* is clear because the stoloniferous plants distributed in European botanic gardens are of natural origin.

ⁱⁱ The preserved leaf of *U. cornigera* photographed in this article is located in the PRC herbarium; the leaves of the other species are found in Liberec Botanic Gardens (www.botaniliberec.cz).

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- iii Experience with a cultivated *U. cornigera* indicates that manual pollination is necessary to obtain seeds and seedlings. That is also a sign of normal sexual propagation.
- iv According to this preliminary result, it arose owing to reproductive isolation, like other endemic plants restricted to the same area, rather than from a hybrid origin. The future study of traps, and or fertility/sterility in mature hybrids would also be interesting corroboration of the species status of *U. cornigera*.

Revised by Professor R. J. Válka Alves (Univ. Federal do Rio de Janeiro) on September 13th 2012.

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