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CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society

Volume 31, No. 2

June 2002



CARNIVOROUS PLANT NEWSLETTER

Journal of the International
Carnivorous Plant Society
www.carnivorousplants.org

Volume 31, Number 2
June 2002



Front Cover: *Sarracenia minor* var. *okefeokeensis* at type location in Ware County, Georgia, USA. Article on page 36.

Back Cover: *Triphyophyllum peltatum*. Note the distinct difference in the length of internodes and the hooked leaves on the elongated shoot, as the plant makes the transition from the rosetted growth of a juvenile plant to elongated growth of young liana. Article on page 44. (Photo: H. Rischer)

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ICPS, Inc.
PMB 330
3310 East Yorba Linda Blvd.
Fullerton, CA 92831-1709, USA
icps@carnivorousplants.org

President
Vice President
Secretary
Seed Bank

David Gray, email: david@carnivorousplants.org
Carl Mazur, email: carl@carnivorousplants.org
Cindy Slezak, email: cindy@carnivorousplants.org
John Brittnacher, email: john@carnivorousplants.org, seedbank listed in this issue.

Editors:

Barry Meyers-Rice, P.O. Box 72741, Davis, CA 95617, USA, email: barry@carnivorousplants.org
Jan Schlauer, Zwischenstr. 11, D-60594 Frankfurt, Germany, email: jan@carnivorousplants.org
Page Layout: Steve Baker, email: steve@carnivorousplants.org

Date of effective publication of the March 2002 issue of Carnivorous Plant Newsletter: 7 March 2002.

The ICPS is the International Cultivar Registration Authority (ICRA) for cultivated carnivorous plants according to The International Code For The Nomenclature of Cultivated Plants. Send relevant correspondence to the ICPS, Inc.

PUBLISHER: ICPS, Inc., Fullerton, California. Published quarterly with one volume annually. Desktop Publishing: Steve Baker, 5612 Creek Point Drive, Hickory, NC 28601. Printer: Kandid Litho. Logo and masthead art: Paul Milauskas. Dues: \$25.00 annually. Reprints available by volume only © 2002 Carnivorous Plant Newsletter. All rights reserved. ISSN #0190-9215.

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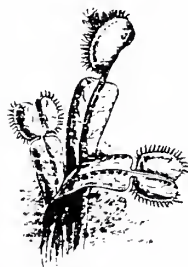
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SARRACENIA MINOR WALT. VAR. *OKEFENOKEENSIS*
SCHNELL: A NEW VARIETY.

DONALD SCHNELL • 3753 Morehead Lane • Pulaski, VA 24301 • USA

Keywords: new taxa: *Sarracenia minor*, Georgia (USA).

Received: 24 August 2001

Description

Sarracenia minor Walt. var. *okefenokeensis* Schnell, var. nov.

A var. *minore* ascidio tenero, longitudine 70-90 cm, habitu peruvindo gaudenti, anthesi in vere plerumque aliquot hebdomadam seriore, circumscriptione proxima in regione paludis Okefenokee dictae rei publicae Georgiae differt.

Differs from var. *minor* in that the pitchers average 70-90 cm in length, prefers very wet habitat, flowers on average two weeks later in the spring, and is confined to the immediate region of the Okefenokee Swamp in Georgia, USA.

TYPE LOCALITY: United States. Georgia. Ware County, ca. 15.5 km southeast of Waycross, Georgia. Herbarium material collected from type location June, 2001, D. E. Schnell *s.n.* (HOLOTYPE: US).

ETYMOLOGY: Epithet *okefenokeensis* refers to range in immediate region of and within the Okefenokee Swamp.

RANGE: Okefenokee National Wildlife Refuge (ONWR) and immediate environs to an extent of roughly 1-5 km beyond the borders, particularly north and east.

HABITAT: Floating prairies in Refuge, or immediately on the edge of or in shallow water, or on low hummocks in shallow water in hemic or sapric soils.

CONSERVATION COMMENT: The rather large number of plants located within the Refuge on several prairies are legally secure. The plants are also ecologically secure due to the size and physiography of the Okefenokee Swamp. However, outside the ONWR boundaries (including the type location!), smaller populations are under the usual attack by drainage and timber operations.

Discussion

Sarracenia minor Walt. var. *okefenokeensis* Schnell is relatively well-known by students and aficionados of *Sarracenia*. Horticulturists have even established a cultivar name for the plant, i.e. *Sarracenia minor* 'Okee Giant' (D'Amato, 1998). However, there have been doubts concerning the genetic constancy of the variety. I have reasons to believe that the plants in the wet locations of the Okefenokee area are truly genetic entities rather than merely ecophenes, and accordingly am describing the variety here. The cultivar name *Sarracenia* 'Okee Giant' is coextensive with the taxon *Sarracenia minor* Walt. var. *okefenokeensis*

Harper (1918) was one of the earliest authors to note the variety. His paper included two photos: one of the plants with his hat for sizing on an Okefenokee prairie, and the other with him standing among them. He remarked on their size but had no further comment.

Bell (1949) approached the plants in the Okefenokee by boat. He noted that under his growing conditions the larger Okefenokee plants maintained their size



Figure 1: Range map of *Sarracenia minor* var. *minor*. The location for *Sarracenia minor* var. *okefenokeensis* is indicated by the filled dot.

over var. *minor* obtained from drier habitat. Still, he concluded that they were ecophenes.

McDaniel (1966) noted the two size variations of *S. minor* but after field and herbarium observations felt that there was gradation in the pitcher size making demarcation impossible. McDaniel did not, however, consider the use of pitcher head versus height proportions.

In addition to my own observations and growing experiments, I have discussed the matter with David Kutt and George Newman (*in litt.*) who have also grown the plants, including from seed, and they essentially agree with my conclusions.

Sarracenia minor var. *minor* has a stockier pitcher compared with var. *okefenokeensis* (see below), reaching an average height of 25-35 cm, although individuals to 45 cm are noted in wetter habitats. The variety seems to grow most vigorously in wetter natural and horticultural habitats, but in nature is found most often in dryish areas of savannas where there is presumably less competition with other pitcher plant species. The predominant prey is ants—I have opened many pitchers in the field and found this to be so. Plants of var. *minor* growing in the same latitude as var. *okefenokeensis* flower on the average two weeks earlier, and this remains consistent even in greenhouse grown plants here in Virginia.

When mature, *Sarracenia minor* var. *okefenokeensis* has a more slender, clearly taller pitcher than var. *minor*, being on the average 70-90 cm tall in prime habitat, but individuals to 130 cm are commonly noted (see Front Cover). The taller, mature pitchers of var. *okefenokeensis* have hoods and mouths about the same size as mature pitchers of the shorter var. *minor*, which contributes to the slender, “willow” appearance. After studying the plants, one can rather quickly identify them in aspect without comparisons or measurements; as George Newman says, “They just look different.” These differences are discernable even in one or two year old seedlings. A younger or dry-stressed, shorter pitcher of var. *okefenokeensis* when compared to a mature pitcher of var. *minor* of the same height has a smaller hood and mouth, still contributing to the slender appearance. Interestingly, I have also examined the contents of var. *okefenokeensis* pitchers in the field, and the predominant prey still consists of ants, in spite of the wet habitat! The plants occur on the margins of wet ditches or marshes, or even in shallow water, and of course on hummocks in open water and the floating “islands” (prairies) of the ONWR. Those plants

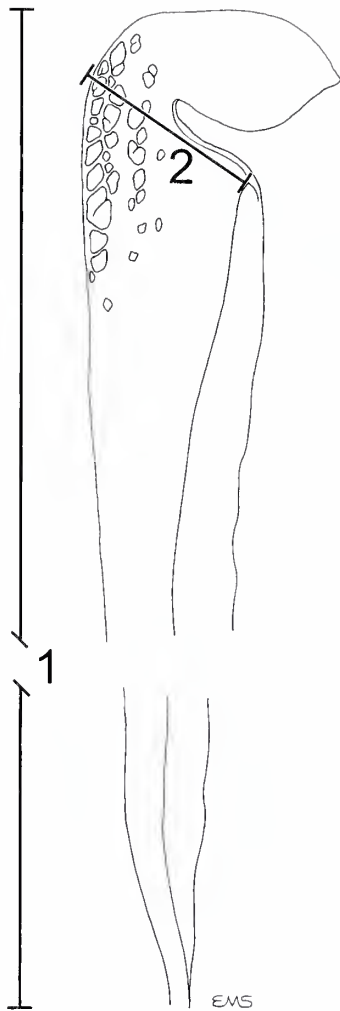


Figure 2: *Sarracenia minor* pitcher with the two dimensions from the text indicated. Drawing by Elizabeth Salvia.

I have chosen the infraspecific level of variety since the ranges of the two varieties abut without presently overlapping. If they were widely geographically separated, subspecies might have been indicated. To date, I have not spotted potential hybrids in the field.

¹Results of the index calculations had a similar mean and mode for each taxon, indicating that distribution curves were not skewed and that specimen range and numbers were adequate. Frequency distribution indicated a small overlap so that accuracy is 97%. This is adequate for identification. However, multiple sample measurements of plants in the field are recommended if possible for greatest assurance.

left higher and drier due to habitat modification have shorter pitchers, but with the same proportions as described above. Flowering is about two weeks later than in var. *minor* growing in the same latitude.

Plants of *S. minor* var. *minor* and var. *okefenokeensis* have been growing side by side in my greenhouse for 10-20 years. They are both potted in *Sphagnum*, the pots set in trays of water 5-8 cm deep, and grown in full sunlight. Over this time, both varieties have maintained their characteristics, including the difference in flowering period. Seeds have been treated with the usual stratification prior to germination, and by the second year, seedlings are easily discerned one variety from the other.

A numerical index based upon the ratio of two leaf dimensions was devised—this index can be used to distinguish the two varieties of *Sarracenia minor*. I made measurements of some fifty pitchers of as many plants in each variety (plants of var. *minor* were originally from southeastern North Carolina, eastern Georgia and northern Florida) and concluded that the following two measurements (see Figure 2) and a simply calculated index is the easiest and most reliable to use for identification:

Measurement 1—Measure the total height of the pitcher from the base of its attachment to the rhizome up to the tallest part of the arching hood. Measurement 2—"Head depth". Measure from the point where the mouth lip meets the upper portion of the ala along a line with the lip margin back to the most convex part of the arching hood (the hood may be flattened to facilitate this measurement).

Divide measurement 1 by measurement 2. If the resulting index is less than 10, the plant is var. *minor*; if greater than 10, var. *okefenokeensis*. (For *S. minor* var. *minor* the index ranged from 5.8 to 9.8 with a mean of 8.3, while for *S. minor* var. *okefenokeensis* the index ranged from 10.3 to 20.2 with a mean of 14.8).¹ The index seems suitable for seedlings at least 3 years old.

Summary

I have concluded that certain plants of *Sarracenia minor* of the Okefenokee region in Georgia are sufficiently discontinuous in characters as well as ecologic and horticultural behavior to indicate genetic differences with var. *minor* and to warrant varietal status as var. *okefenokeensis*.

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NEW CULTIVARS

Keywords: cultivar: *Sarracenia leucophylla* 'Cronus', *Sarracenia* 'Tornado', *Sarracenia* 'Fireworks'.

Sarracenia 'Tornado'

Received: 21 December 2001

Sarracenia 'Tornado' was created in May 1983 by crossing a very dark red (black-red) form of *S. alata* with an maternal parent hybrid developed at Botanique nursery. The maternal parent is a deep red, velvety-textured hybrid selection of *S. (leucophylla* × *purpurea*) × *S. alata* (the *S. alata* in this cross is also a dark red clone). Thus, the derivation of *S.* 'Tornado' is: *S. ((leucophylla* × *purpurea*) × *alata*) × *alata*. I performed the pollination in hopes of improving the shape and vigor of the maternal parent, which has a huge open mouth that is prone to rain damage. The overarching lid character of *S. alata* successfully was transferred to several selections from this cross, one of which is *S.* 'Tornado', selected and named in November of 1989.

S. 'Tornado' pitchers emerge green, flushed with red and red veins and showing white and pink spots. The pitchers quickly become nearly black-red, without the irregular coloration problems found in many *S. alata* clones. The upper one half to two thirds of each pitcher matures essentially all black-red without noticeable contrasting venation. The dark red color mixes with green in the lower section, then quickly becomes nearly all green at the bottom of the leaf. Many pitchers are produced throughout the season, each being somewhat flattened, along the front to rear centerlines. This creates an oval cross section, near the mouth. Mature pitcher height is about 61-66 cm (24-26 inches). A dark red lid covers the wide, slightly pouched pitchers and inhibits rain entry and breakage; this lid is usually reniform and can reach 9 cm (3.5 inches) across on taller pitchers.

Flower petals are pink. However, only one flower has been observed so far, due to several late-season frosts which damaged developing buds. The one flower was not particularly noteworthy, but future flowers will be examined to present a more detailed description.

Because of the unique color and complex parentage, this hybrid must be vegetatively propagated. Botanique plans on putting *S.* 'Tornado' into tissue culture as soon as possible.

Plants of this cultivar are sold under the trade-mark *Sarracenia* 'Vortex'TM

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Sarracenia leucophylla 'Cronus'

Received: 21 December 2001

Sarracenia leucophylla 'Cronus' was selected from numerous seedlings resulting from crossing plants originally from Seminole Co., FL with plants originally from Baldwin Co., AL. I performed this pollination during May 1981 in Greene County, Virginia. By crossing from two different population areas, I hoped to achieve some plants with increased vigor. Reemay® bags were used to regulate pollination.

In November of 1985, the largest of the seedlings from the above breeding was named *Sarracenia* 'Cronus' for its unusually large size and vigorous growth. Botanique first offered this cultivar for sale in January of 2001, two years after having established it in tissue culture. The first public offering appeared in the Botanique web site (<http://www.pitcherplant.com>) where a color image also appeared.

Sarracenia leucophylla 'Cronus' has produced fall pitchers over 96.5 cm (38 inches) tall. The mouth typically is 6-9 cm (2 1/2-3 1/2 inches) across. The upper pitcher shows more white than many forms of *S. leucophylla*, with deep red veins dividing the white background. The rim of the mouth is white, with reddish marbling. Because the lid is adequately large and angled over the mouth, rain is less likely to damage the pitchers than it may with many open mouthed forms of *Sarracenia*. Despite the very dramatic pitchers, the flowers are not significantly different from the wild forms, being medium red and about 6.3-7.6 cm (2 1/2-3 inches) across and in height (sepal to distal tip of petal). The flower stem is a bit shorter than normal, typically reaching 25-36 cm (10-14 inches). We have observed that this plant is not a good seed producer (often, few or no seeds form in the pods). In order to maintain the complex characteristics of this cultivar, vegetative propagation is needed to multiply it.

We have observed this cultivar to grow faster than most other *Sarracenia*, when shifting from tissue culture (flasks or test tubes) to marketable size (approximately a 3.8 liter (one gallon) pot). Due to quick size increase, it is recommended that *S. leucophylla* 'Cronus' be planted in containers or gardens at least 30 cm (12 inches) deep and spaced at least 41 cm (16 inches) from other plants. In plantings with other *S. leucophylla* types, *S. leucophylla* 'Cronus' has consistently grown larger than these other types, in identical situations. As with most *S. leucophylla*, the largest and showiest pitchers are produced in late summer to fall.

Plants of this cultivar are sold under the trade-mark *Sarracenia* 'Titan'TM

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Sarracenia 'Fireworks'

Received: 21 December 2001

Sarracenia 'Fireworks' was one of the hybrids I created by crossing a female *S. rubra* subsp. *jonesii* × *purpurea* with pollen from a heavily red-pigmented form of *S. leucophylla*. The pollination was performed in May of 1977, with seed produced that same fall. Pollination was controlled using Reemay® bags to prevent random out-crossing. The seed was germinated in the George Mason University greenhouse, Fairfax County, VA, in late December of 1977. These seedlings were not given a dormancy until worthy seedlings were identified in 1979, 1980 and 1982. I am evaluating other plants from this breeding and hope to register additional selections in the future.

I named *S.* 'Fireworks' in May of 1979. At an early age, this hybrid displayed many desirable qualities in the pitchers, and was selected for further evaluation and retention in my collection. As the plant matured, its features became more apparent, and the first flowers appeared in 1983. By this time, the plant had been transferred to Botanique, in Greene County, VA. Here, many divisions were eventually made. After establishing the plant in tissue culture, divisions were offered for



Figure 1: *Sarracenia* 'Tornado'



Figure 2: *Sarracenia leucophylla* 'Cronus'



Figure 3: *Sarracenia* 'Fireworks'

sale in March of 2000. Plants were also sold in early 2001. An image of the pitcher and flower was posted in the Botanique web site (<http://www.pitcherplant.com>) on March of 2000.

The pitchers are usually 15.2-25.4 cm (6-10 inches) tall, with a ruffled lid. The lower half of the pitchers are green with red veins. The upper portion is mostly white, with deep maroon veins. The lip is usually deep maroon. A maroon flushing, on the inner ala and lid, is most intense near the mouth, and fades to white with red veins toward the distal portion of the inner lid. Red pigments are most vibrant in mid to late summer. The widest point of the pitcher, excluding the lid, typically ranges about 2.5-4 cm (1-1 1/2 inches).

S. 'Fireworks' performs well in the garden by producing many pitchers throughout the growing season. The lid is angled to assist in keeping rain out of the pitchers. Flower color is a deep burgundy red, without noticeable odor. These appear above developing foliage on strong stems, averaging 31-36 cm (12-14 inches) tall. The influence of *S. rubra* subsp. *jonesii* is apparent not only in the flower color, but in the growth habit of making many crowns in a short time. The many crowns, or "leads," create a foundation for a beautifully lush display of flowers and pitchers. Pitchers and flowers often appear simultaneously, especially on established plants. Phylloдия (flat leaves) are rarely produced. This hybrid must be propagated vegetatively in order to maintain its complex characteristics.

Plants of this cultivar are sold under the trade-mark *Sarracenia* 'White Sparkler'TM

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THE TROPICAL LIANA *TRIPHYOPHYLLUM PELTATUM* (DIONCOPHYLLACEAE): FORMATION OF CARNIVOROUS ORGANS IS ONLY A FACULTATIVE PREREQUISITE FOR SHOOT ELONGATION

GERHARD BRINGMANN, HEIKO RISCHER, JAN SCHLAUER, KRISTINA WOLF • Institut für Organische Chemie der Universität • Am Hubland • 97074 Würzburg • Germany
ANDREAS KREINER, MARTIN DUSCHEK • Botanischer Garten der Universität • Julius-von-Sachs-Platz 2 • 97082 Würzburg • Germany
LAURENT AKE ASSI • Centre National de Floristique • B. P. 172 • Abidjan 08 • Ivory Coast

Keywords: cultivation, observations: *Triphyophyllum peltatum*.
Received: 19 July 2001

Summary

The complete life cycle of *Triphyophyllum peltatum* (Dioncophyllaceae) has been observed under greenhouse conditions. Without passing through the carnivorous stage, the plant reached maturity and, after flowering abundantly, developed the unusual seeds. This cultivation success permitted valuable observations on floral and fruit biology of *T. peltatum*.

Introduction

The palaeotropical plant family Dioncophyllaceae (Airy Shaw 1951) consists of three species: *Triphyophyllum peltatum* (Hutch. & Dalz.) Airy Shaw, *Habropetalum dawei* (Hutch. & Dalz.) Airy Shaw, and *Dioncophyllum thollonii* Baillon. Of these, only *Triphyophyllum* is known to bear carnivorous glandular leaves, and this only occurs during a certain period of its life. The systematic position of the Dioncophyllaceae was very unclear for a long time. At the time of the discovery of *Triphyophyllum peltatum* (originally called *Dioncophyllum peltatum*) in Sierra Leone in 1927, the describers placed it in the Flacourtiaceae (Hutchinson & Dalziel, 1927). Since then many authors expressed their opinions on the relationships of the Dioncophyllaceae to other plant families, based on morphological evidence. Recently, genetic investigations confirmed its placement within the Caryophyllidae as a sister clade of the noncarnivorous Ancistrocladaceae and as a close relative of the carnivorous Drosophyllaceae (Meimberg *et al.*, 2000). This placement is chemotaxonomically supported by the presence of naphthylisoquinoline alkaloids both, in the Dioncophyllaceae and in the Ancistrocladaceae (Bringmann & Pokorny, 1995) and by the occurrence of structurally and biosynthetically closely related naphthoquinones in most of the closely allied families (Nepenthales) within the Caryophyllidae (Hegnauer, 1989).

Among carnivorous plant enthusiasts *Triphyophyllum peltatum* is particularly famous for its “part-time carnivorous” habit (Bringmann *et al.*, 1996), which distinguishes it from all other known carnivorous plants. In this paper we complete our observations on this intriguing species based on further observations on greenhouse grown plants.

Materials and Methods

In April 1996 juvenile *T. peltatum* plants, which had not been carnivorous before, were received from the Centre National de Floristique in Abidjan, Ivory Coast. The plants had been grown there for a time after having been legally collected in the Parc de Tai.

The plants were grown in the greenhouse of the Botanical Garden in Würzburg propagation chambers as described previously (Bringmann *et al.*, 1999). Slow release fertilizer (Osmocote®, NPK 14/14/14, Urania Agrochem GmbH, Hamburg, Germany) was added to the substrate. When the plant started to elongate it was repotted in a 65 liter vessel in hydroponic substrate and was placed outside the chamber in the greenhouse.

Results and Discussion

1. Stem Elongation of Rosetted Plants: Possible without Carnivorous Stage

In our previous communication (Bringmann *et al.*, 1999) we reported on the germination of *Triphyophyllum peltatum* and the development of rosetted plants in the greenhouse. Our expectation that the plants would develop glandular leaves (Marburger, 1979) capable of catching and digesting prey was not fulfilled.

Field studies (Schmid, 1964; Green *et al.*, 1979) suggested that the development of *T. peltatum* proceeds through two distinct phases, as is known in many other tropical lianas. Juvenile plants remain small for a considerable period of time (up to several years), and the leaves are separated from each other by very short internodes, so they are arranged in rosettes or short shoots. It is only then, right after the unique carnivorous stage, that a marked change occurs: The internodes elongate considerably, and the resulting elongated shoots start climbing into the canopy of high trees, which, in the case of *Triphyophyllum*, is facilitated by hooked leaves that are formed on elongated shoots. The two lateral subapical hooks are positively thigmonastic (coiling in the direction of contact) and anchor the slender climbing shoots on their way up.

In contrast to these observations in the field, in October 1998 one plant (two and a half years old, 35 cm high with a rosette of 30 mature lanceolate leaves 20 to 40 cm in length, which had not been carnivorous before) elongated by producing new leaves which were separated by much larger internode length (see back cover) and formed the characteristic hooked leaves (Figure 1), which account for the familial name "Dioncophyllaceae." Within a few weeks the shoot reached nearly 2 m in height. Because of limited greenhouse space the shoot was trained to a horizontally fixed wire (1.5 m high). In the lower part of the plant the stem exhibited a clearly visible secondary growth. Then signs of lignification became visible and the outer bark started bursting (Figure 2). From the point of the first attachment to the wire, the elongated shoot grew for another 2 m in the horizontal direction. About every fifth leaf was attached manually to the wire by its hooks because the free end of the shoot tended to grow obliquely upwards.

These observations prove for the first time that carnivory is not a prerequisite for shoot elongation in *T. peltatum*.

2. Flower Development and Morphology

Surprisingly the *Triphyophyllum* plant began to produce numerous inflorescences. On June 5, 1999, several flower buds were observed on specialized short flowering shoots formed in the axils of the elongated shoot leaves. The total inflo-

rescence comprised 34 consecutive nodes at the apical portion of the elongated shoot. The flowering branches had 1 to 5 buds arranged in a cymose cluster, the bud on the longest branch usually opening first. Within two weeks the buds enlarged from 3 mm diameter (spherical) to a size of 2 cm length \times 6 mm width (elliptical). On June 20, 1999 two flowers of *T. peltatum* opened, to the best of our knowledge the first ever obtained in cultivation.

All parts of the flower are glabrous (Figure 3). The flowering pedicel is 2.5-4 cm long and *ca.* 2 mm wide, terete, and dull red. It is usually subtended by a small bract 1-10 mm long. The flower is actinomorphic. The 5 persistent sepals remain short (*ca.* 2 mm long, 1 mm thick), triangular, acute, spreading, and form a star-shaped calyx. The petals are contorted in bud, coriaceous, whitish, *ca.* 20 mm long and 5 mm wide, slightly involute, and narrowly elliptical. The petals are fragrant (pores on the adaxial surface), and the fragrance lasts as long as the flowers are open (just one day, see below). It is pronouncedly sweet and is reminiscent of ripe fruit or carnations. The 10 stamens consist of short stout, white filaments and acute, narrowly triangular anthers *ca.* 2 mm long (Figure 4), bearing yellow pollen, located in two series alternating with and opposite the petals, respectively. Apart from their insertion, there is no pronounced difference between the stamens of the two series. The ovary is globose, green, 5-carpellate, and *ca.* 3 mm in diameter. The 5 white styles are *ca.* 6 mm long, separate from their base and repeatedly divided in their apical, stigmatic portion. The stigmatic area is minutely papillose (Figure 5). The up to 25 spherical ovules are borne on 5 parietal placentae and arranged in two rows on each placenta so that ovules from neighboring placentae are stacked alternately above each other in 5 columns, parallel to the longitudinal axis of the ovary.

The flowers opened at sunrise and started withering in the evening of the very same day. The petals, stamens, and styles turned brown and usually dropped off 2-7 days later, the styles being somewhat more persistent than the petals and stamens. A total of 47 flowers opened on 5 consecutive days (Figure 6a). None of the buds present after this first period of anthesis produced any more flowers. Half of the flowers were pollinated with pollen from freshly opened flowers of the same plant, and a few flowers were pollinated with pollen of *Drosophyllum lusitanicum*, *Nepenthes* \times *mixta*, and *Ancistrocladus abbreviatus*, plants from families that are phylogenetically closely related to Dioncophyllaceae. The short stamens that do not reach the stigma at any time of anthesis make autogamy unlikely. Several hovering flies were observed to visit the open flowers in the greenhouse. It is not known if these insects effect pollination of *T. peltatum* at natural habitats (hovering flies do occur there, as proved by the investigation of prey caught by *T. peltatum* in its carnivorous phase (Bringmann *et al.*, 2001)). Anyway, the pollinating agent is most likely a diurnal animal, as judged from the timing of anthesis.

3. For the First Time in a Greenhouse: Fruit Ripening

Whether manually pollinated or not, within 10 days after anthesis the ovary of each flower enlarged into an obovoid capsule 1.5-2.5 cm long and 6 mm wide. All fruits split open 2-3 weeks after anthesis, but only 4 of them produced a cumulative total of 5 seeds. All ovules, whether fertilized or not, were flattened (most of them 3 mm in diameter, only the fertilized ones being larger) so they had a mushroom- or nailhead-like appearance, supported on the funicle attached to the center of the ovule (Figure 7). The developing seeds (from fertilized ovules, Figure 8) showed a rapid growth of both the circular wing surrounding the embryo and the funicle. Most of the ovules ceased growth at some stage (the largest undeveloped seed produced a wing 1 cm in diameter and a funicle 1.5 cm in length).

None of the flowers pollinated with pollen from other species produced any seeds. The low number of seeds produced from selfed flowers indicates *T. peltatum*



Figure 1: *T. peltatum*. Hooked adult leaf. (Photo: H. Rischer)



Figure 2: *T. peltatum*. Stem showing signs of secondary growth. (Photo: H. Rischer)



Figure 3: *T. peltatum*. Details of flowers—mature (left), withered (right). (Photo: H. Rischer)

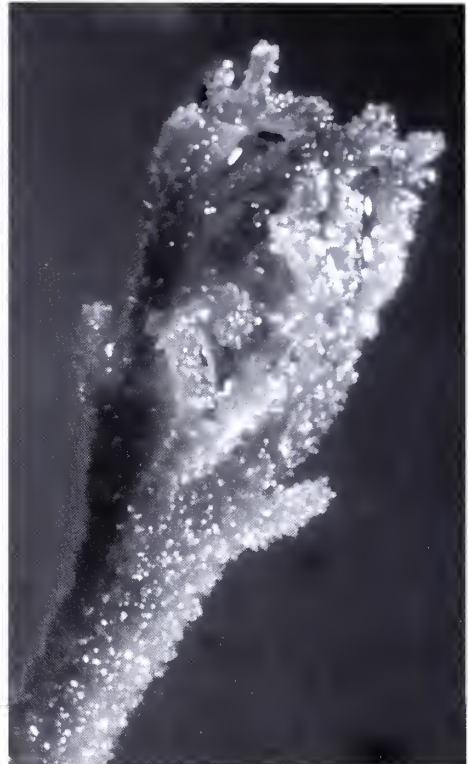


Figure 4: *T. peltatum*. Flower with petals and ovary removed to show the arrangement of anthers. (Photo: H. Rischer)

Figure 5: *T. peltatum*. Stigmatic area of style. (Photo: H. Rischer)

to be moderately self-fertile, if at all.

The opening of the capsule long before the seeds are fully developed presents a unique opportunity to study seed development and maturation, in a noninvasive and nondestructive way. The funicles of the developing seeds became *ca.* 4.5 cm long and 2 mm thick, resembling the pedicels in all respects, including a red coloration. This coloration was lacking in the funicles of non-developing ovules. The seed wing reached an ultimate diameter of 10 cm with the embryo embedded in a disk of endosperm positioned in the center. The seeds were first green and then became reddish from the centre. After maturation, *ca.* 8 weeks after anthesis, the wing dried and became brown and brittle (Figure 9) and the seeds detached from the apical end of the funicles. In relation to their size (see above) the seeds were light (*ca.* 0.45 g each) and they floated gently in the air, the funicular pole pointing downwards, sinking with a constant speed of (0.9-) 1.5 (-2.3) m/sec.

4. Second Flowering Period

Simultaneous with the maturation of the seeds from the June flowering event, the nodes above the fruiting ones developed new flower buds. This time, 14 flowering branches were formed; they produced a total of 24 flowers, which opened between August 22 and August 26, 1999 (Figure 6b). Despite selfing, none of these flowers yielded seeds.

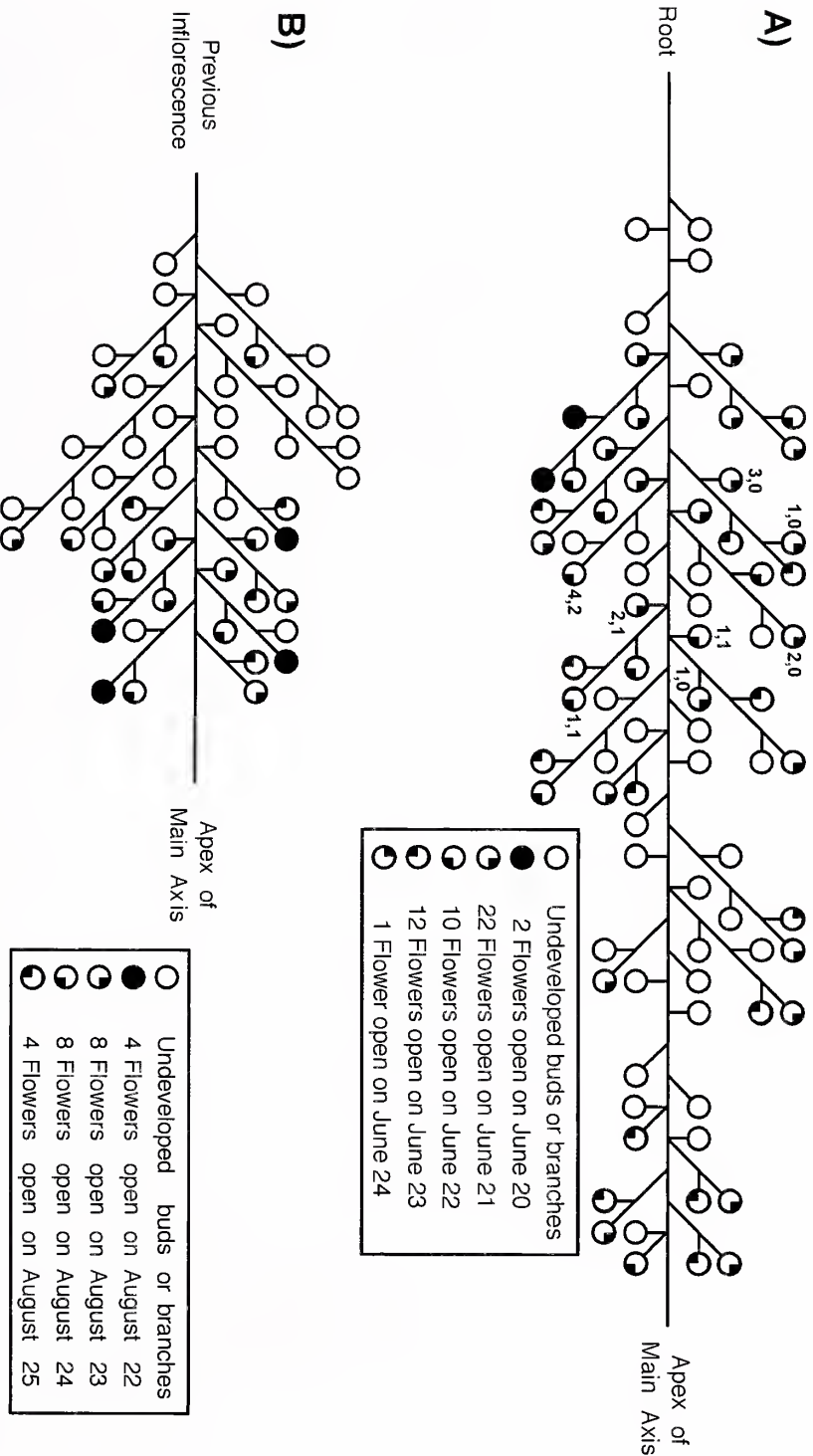


Figure 6: (a) Schematic representation of first inflorescence; the branching pattern of the short flowering shoots is simplified in order to visualize the relative positions of flowers. The pairs of numbers by eight flowers indicate the number of seeds that began to form, and the number of seeds that did not abort. (b) Schematic representation of second inflorescence. No seeds developed.



Figure 7: *T. peltatum*. Cross-section of young fruit. (Photo: H. Rischer)

Figure 8: *T. peltatum*. Opening young fruit. (Photo: H. Rischer)



Figure 9: *T. peltatum*. Almost ripe seeds on open fruits. (Photo: H. Rischer)

5. Further Flowering Periods

Three further flowering periods occurred in 2000. The first and longest one in May lasted 5 days and yielded 125 flowers, the second one was in July and the third one was in September. The September flowering period yielded two fruits from selfed flowers, which produced one seed each.

6. Ecological Implications

Field observations on *T. peltatum* are scarce, with only five reports in the literature: (Airy Shaw, 1951; Schmid, 1964; Green *et al.*, 1979; Lamb, 1991; and Bringmann *et al.*, 2001). Because of the inaccessible habitats of the plants observations depend on cultivated plants. This study provides the first long-term observation on the life cycle of *Triphyophyllum*.

The flexibility of *T. peltatum* with respect to the formation of carnivorous glandular leaves seems to be greater than previously noticed. The fact that mature specimens are able to develop glandular leaves when chopped was already noted by Green *et al.* (1979). It seems that glandular leaves are only formed when the plants run into a deficiency of special nutrients for the building of the large biomass associated with the elongated growth. These nutrients (Green *et al.* (1979) especially mention K) are probably deficient in the natural soils, especially during certain climatic periods (e.g. the transition from the dry to the wet season). For this or other reasons, the uptake of existing nutrients by the plants may be too low during these periods, so the carnivorous phase would have great benefit to the plant at this time. Meanwhile, the absence of the carnivorous phase in our cultivated plants may be due to the fact they were well-fertilized. It is nonetheless astonishing that only one plant elongated although all plants were of the same age and virtually the same size. It might be that the other Dioncophyllaceae species, which have never been observed to be carnivorous, might likewise develop insect-trapping organs under nutrient-deficient conditions. The actual trigger remains unknown.

Acknowledgements

This work was supported by the Deutsche Forschungsgemeinschaft (SFB 251 "Ökologie, Physiologie und Biochemie pflanzlicher und tierischer Leistung unter Stress"), the Max-Buchner-Forschungsförderung (grant for H. R.), and the Fonds der Chemischen Industrie. We gratefully acknowledge the support by the Botanical Garden of Würzburg, Germany. All the plants in the illustrations were grown at the Botanical Garden of Würzburg.

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| <i>Drosera auriculata</i> | <i>D. nidiformis</i> |
| <i>D. binata</i> —Coromandel, NZ | <i>D. rotundifolia</i> —Rhode Island, USA |
| <i>D. burmannii</i> | <i>D. spatulata</i> |
| <i>D. capensis</i> —narrow leaf | <i>D. stolonifera</i> subsp. <i>stolonifera</i> |
| <i>D. capensis</i> 'Albino'—white flower | <i>Nepenthes (maxima × fusca)</i> |
| <i>D. capensis</i> —wide leaf | × (<i>spathulata</i> × <i>spectabilis</i>) |
| <i>D. capillaris</i> | <i>Sarracenia alata</i> |
| <i>D. dielsiana</i> | <i>S. flava</i> |
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| <i>D. glanduligera</i> | <i>S. purpurea</i> |
| <i>D. intermedia</i> | <i>S. rubra</i> |
| <i>D. intermedia</i> —Florida, USA | <i>Utricularia lateriflora</i> |
| <i>D. intermedia</i> —North Carolina, USA | <i>U. multifida</i> |
| <i>D. intermedia</i> —Rhode Island, USA | <i>U. violaceae</i> |
| <i>D. macrantha</i> subsp. <i>macrantha</i> | |

This is a partial list of the seeds available. A complete list is available online at the ICPS web site, <http://www.carnivorousplants.org/> or by sending a self-addressed (stamped if USA), envelope to the seed bank address.

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The money raised by the seed bank is used by the ICPS to pay for seed bank expenses, web site ISP charges, and ICPS educational and conservation programs. Donate seed and get credit for free seed from the seed bank. Seeds of selected varieties are available free to teachers for use in the classroom and to scientists and conservation organizations. It is ICPS policy not to sell seed of plants protected by CITES Appendix I or the US Endangered Species Act.

John Brittnacher, Manager • john@carnivorousplants.org

NEWS AND VIEWS

Steve LaWarre (slawarre@meijergardens.org, Frederik Meijer Gardens, 1000 E. Beltline NE, Grand Rapids MI 49525 USA) supplied us with a summary about a horticultural innovation, Trichoderma, that has readers of the on-line carnivorous plant community fascinated: "Trichoderma" is one of the many, many species of fungi that can form a symbiotic association with the roots of some plants, via mycorrhizae. Mycorrhiza (pl. mycorrhizae) is a symbiotic association between certain fungi and plant roots, and is a characteristic of most vascular plants. It has been said, for example, that the soil structure of a native tall grass prairie is as biologically diverse as the canopy of old growth rain forest. This is predominantly because of the myco-fauna. Most vascular plants, in their native habitats have some sort of mycorrhizal association. The seeds of many vascular plant genera also depend on a fungal association to aid in germination (i.e. orchids). Basically, the fungus receives elements from the plant that would normally be unavailable in the soil, and the plant may receive nutrients via the fungi that are more readily available due to this association.

The use of mycorrhizae in greenhouse production is fairly new (8-10 years). Many mycorrhizal inoculation products are available commercially, such as MYCOSTOP, ROOTSHIELD, and ROOTS2. These products are by no means a silver bullet for perfect root health, but they have had fair results. Several people on the carnivorous plant listserve have had good things to say about the use of these products.

It is important to note that these products have been developed for the commercial greenhouse industry, they were tested and formulated for things like poinsettias and geraniums.

They should not hurt your plants, but due to the vast number of beneficial fungi found in natural mycorrhizal associations, it is safe to assume that these products will not have the same results when used for everything from palms to primroses. So, in closing—try this stuff, take notes, read the directions, and let us know what happens.

William DiLapi "Tamlin" (tamlindd@yahoo.com) sent us information about the US Postal Service's plans with regard to irradiate mail. As originally announced, the US Postal Service's protocol to irradiate all US mail with sterilizing radiation would have destroyed our ability to operate our inexpensive seedbank. William's email was a pleasure to read: I had a letter today from my associate, the Principal seed Analyst of the Idaho State Herbarium with the following information secured by Kathleen Willey, President of the A.O.S.A (Association of Official Seed Analysts) from the Federal Authorities. It was stated that the US Postal Service representatives say that the only mail that will be irradiated at this time is mail going to the Federal offices, the Capitol and the White House. There are also two zip codes in the Washington D.C. area that are also going to be using irradiation. Presently there should be no fear of irradiation to other seed shipped in this country by mail.

GENLISEA AUREA ST.HIL.

FERNANDO RIVADAVIA • Rua Inacio Pedroso 230 • Sao Paulo, S.P. 05612-050 • Brazil • fe_rivadavia@hotmail.com

Keywords: observations: *Genlisea aurea*, *Genlisea pygmaea*.

Genlisea aurea St. Hil. (Lentibulariaceae) was discovered and described by the French botanist Auguste de Saint-Hilaire in the early 19th century (Saint-Hilaire, 1833). This species is endemic to Brazil, where it is widespread on sandstone highlands from the states of Mato Grosso in the west, to Bahia in the northeast, and to Santa Catarina in the southeast (Fromm-Trinta, 1979).

This species is a perennial herb typically found at altitudes varying from 550 m to 2550 m, often among grasses. It occurs in waterlogged seeps, which usually remain boggy even during the dry season, and where the soil is black, humus-rich, and usually mixed with sand. A film of cold flowing water usually covers the compact leaf rosettes, and I have even observed specimens growing in streams, beneath several centimeters of water. The black soil is humus-rich, and is often mixed with sand.

Genlisea aurea is one of the largest species in its genus (Taylor, 1991), and its unique rosettes consist of dozens of almost linear leaves only about 2 mm wide. Although the leaves are usually 5-50 mm long, the rosettes are at most 5 cm in diameter, because only the leaf tips emerge from the soil. The rest of the leaves (long white petioles) are buried underground. The leaf bases all connect to a beige stem about half a centimeter thick, and two or three centimeters long.

Even though *Genlisea aurea* may flower at any time of the year, it is not easy to catch flowering specimens in the wild. This is strange, considering it is not a rare species and large populations are common. Fortunately, on a few occasions I have been blessed with the view of grassy fields covered with *G. aurea*'s large bright-yellow to golden-yellow blooms. What a view!

The flower scapes are very robust and are usually 10-30 cm in height, but sometimes surpass 55 cm. Each inflorescence commonly bears one to three open flowers at its apex, but may produce a total of eleven flowers. The entire inflorescence is densely covered with both simple and glandular hairs (Fromm-Trinta, 1979).

The largest-flowered *G. aurea* I know are at the Chapada dos Veadeiros National Park (in northern Goiás state, central Brazil). These plants probably have the largest flowers in the genus, and measure nearly 3 cm in length and over 2 cm in width (Figure 1). The lower lip is a wide apron, instead of deeply trilobed as in other locations. The flowers of this form are a spectacular, rich golden-yellow color!

The inverted Y-shaped traps of *Genlisea* apparently come in two types in most species. As drawn by Studnicka (1996), some traps are short and grow more or less horizontally beneath the soil surface, while others are longer and grow straight downwards. Unfortunately these descending traps are extremely difficult, if not nearly impossible, to collect whole in nature. They are very brittle and break exasperatingly easily when you try to wash off the soil around the plants. Fromm-Trinta (1979) recorded traps up to 10 cm in length for *G. aurea*, measured from herbarium specimens, but I believe this may be highly underestimated. As for prey, *G. aurea*,



Figure 1: A hand-held bundle of *G. aurea* flowers from Chapada dos Veadeiros National Park.



Figure 2: Mucilage-covered *G. aurea* rosette, Grão Mogol.

G. margaretae, and *G. violaceae* (and thus possibly all *Genlisea* species?) have been discovered recently to be specialized in the capture of protozoans (Barthlott *et al.*, 1998).

Genlisea pygmaea seems to be the Brazilian species most closely related species to *G. aurea*—both have inflorescences densely covered in simple and glandular hairs. The smaller forms of *G. aurea* are often very similar in flower shape, size and color to larger forms of *G. pygmaea*—they have often confused me in the field! Other than the overall size of the plants, there are not many field characteristics that one can use to separate these two species—unless one has a microscope handy. Some useful tips in the field are that *G. pygmaea* usually grows in sandier soils; it has fewer, shorter, wider, darker green leaves; flower scapes are a thinner and a darker green (almost black) in color; and the flowers are smaller and narrower.

Other Brazilian *Genlisea* species that occur south of the Amazon Basin are easily distinguishable from *G. aurea*. Both *G. repens* and *G. filiformis* have yellow flowers, but are much smaller in size. Furthermore, *G. repens* is the only *Genlisea* species which has elongated underground stems (like most *Utricularia*), and its small flowers are produced on thin glabrous flower scapes. *G. filiformis* has even tinier flowers with an obtuse-tipped spur, borne on delicate inflorescences that are covered by long glandular hairs only (i.e. simple hairs are absent). Finally, *G. guianensis*, *G. violacea*, *G. uncinata*, and *G. lobata* have purplish to white flowers with an orange-yellow to whitish patch at the base of the lower lip. Furthermore, the latter three taxa have pedicels that become pendulous when in fruit (versus erect) and

the seed capsules split into two longitudinal valves (versus circumscissile) (Taylor, 1991).

When not in flower, *G. aurea* is the easiest Brazilian *Genlisea* species to recognize, because of its distinctive, large rosettes composed of dozens of narrow leaves covered by a thick layer of gelatinous transparent mucilage (Figure 2). This mucilage is particularly obvious on plants in shady habitats and it is also usually present on *G. pygmaea*, to a lesser degree. I still do not know what the function of this mucilage is. Protection against fires is unlikely since *G. aurea* habitats are usually wet year-round and so do not burn—while the annual *G. pygmaea* is usually dead by the time the (dry season) fires begin. Furthermore, the *G. aurea* rhizome—located a few centimeters below the soil surface—is safely protected from fires. I believe the mucilage probably serves as a mechanical or chemical barrier against predation from snails or other small invertebrates.

Whenever botanizing in Brazil I always like to herborize specimens of the carnivorous plants I find. Special care is needed to herborize *G. aurea*, since the mucilage glues to the paper as it dries. The delicate leaves become nearly impossible to pry off afterwards. However, if you wipe the *G. aurea* rosettes against your trousers several times, most of the mucilage is removed and the number of leaves that become glued to the paper is decreased. No damage is done to your clothes, in case you are wondering—and after all the hiking, they will be covered in dirt by the end of the day, anyway!

I have never been able to keep *G. aurea* in cultivation for more than a year. In fact, these picky plants usually rot soon after being brought from the wild—if not during the long trip from its natural habitat to my hometown São Paulo. The seeds of this species have so far proved nearly impossible to germinate in cultivation. I have never been able to germinate any myself and have only heard of a few success reports from friends around the world. I believe gibberellic acid may help induce seed germination in several *Genlisea* species. The only mature *G. aurea* plants I know of in cultivation are growing at the Bonn Botanic Garden in Germany, which I saw during the 1998 ICPS Conference. Unfortunately they are cultivating the most unattractive of all *G. aurea* races: a small form with pale-yellow flowers, native to the Diamantina area of Minas Gerais state.

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A CURE FOR THE COMMON COLD

DOUG PEEL • 7617 Hayes • Overland Park, KS 66204 • USA •

Keywords: cultivation: bog-garden, Kansas (USA).

Since bog-gardens are not as common as terrarium plants, there is not that much information about how to build and operate them. There is even less information on the cold hardiness of carnivorous plants. Conflicting tales of cold-hardiness abound. I have heard many stories of plants surviving ice age-like conditions, but I have also heard about very light frosts that killed plants instantly. Inundated with confusing stories, I decided to see for myself. Since I was running out of room on my patio for my carnivorous plants and I live in a temperate climate, an outdoor bog-garden seemed like a good idea. So during the spring of 1999, I planted a bog garden. About 30 cm (1 foot) deep, it is not sunken into the ground, but is more like a raised-bed planting.

This is an uncommon way of growing plants (I am probably the first to try this in Kansas' climate!), so I thought I should write about my experiences. I hope they will benefit anyone wishing to own a bog in a temperate to cold temperate climate. Believe me, bog-gardens are simply the best way to show off temperate carnivorous plants.

Temperature preferences are a hotly debated topic. One minute you hear about flytraps dying from a light frost. The next you hear about bog gardens freezing into a block of ice, but all the plants surviving (In *The Savage Garden*, read the section on the cold hardiness of carnivorous plants.) If you want to set up the best bog to impress your pals, but do not want to risk your precious collection, which story should you believe? Believe it or not, stick to the story about the block of ice. Sounds like something you might regret? Wrong! You are reading an article by someone that has done it.

There are many factors that contribute to cold weather survival. The first is the cold-hardiness of the species itself. Trumpets often survive the cold better than flytraps do. Most fork leaf sundews (*D. binata* varieties) will not survive unharmed below -9°C (15°F), but that does not mean you cannot grow them in your bog if it does drop lower than that from time to time. While most of your fork leaf sundews may die in the cold, some plants may regenerate from the roots.

Another factor is the length of the growing period. If you are dealing with hardy plants the harshness of the winter may not be the most important factor determining winter survival rate. The length of the growing season helps determine whether the hardy plants have stored enough nutrients or not. Incidentally, if you have bought a carnivore out of season at a novelty shop, it will probably not survive as it will suffer too much shock. I bought a *Dionaea* 'Dentate Traps' during the winter, but which had summer leaves, and planted it in my frozen bog. It did not survive the winter.

Bog depth is also important. My plants survived in a bog that was above ground, and it was only 30 cm (12 inches) deep. But a safer option is to dig it into the ground some, as it protects plants even further. Bogs that are deeper also store more water, and they give plants more root space. Unlike exposed pots, deep bog-gardens can insulate the roots of the plants. The plants tolerate freezes better if their roots do not freeze.

Genetics are important. Venus Flytraps have an incredibly varied gene pool. Some clones may just be better at surviving the cold than others. For example, one of my plants which occasionally produces more than one trap per leaf also happens to survive the winter the best. It is extremely vigorous, produces many offshoots, and is the only one that stays mostly green all winter, despite the root and soil-freezing conditions which can last for several weeks at a time. In the spring, none of its leaves from the previous year blackened. This plant may lead to the creation of a new culti-



var that might be better suited for bog gardens. In any event, it is clear that some plants are just more cold-hardy than others.

Plant age is important. Seedling plants should have heavy protection, and should be spared from deep freezes. I lost seedling *S. leucophylla* plants in winter conditions that my mature plants survived. Meanwhile, my minute flytraps survived (just to be dug up and lost by an inquisitive squirrel—a pox on gray squirrels!).

Finally, protection is critical. You must always cover the bog with about 15-30 cm (6-12 inches) of straw if you live in a place like I do. (Even better, use a tarp, too.) Although heavily mulched, chances are, the top 5-13 cm (2-5 inches) of bog soil may still freeze.

I have not grown any bladderworts or butterworts outdoors, so I still have much more experimentation. But from what I have learned, flytraps and trumpets seem to tolerate deep freezes very well if properly protected. In fact, the most common cause of plant death in my bog-garden this year was from an August heat wave, when temperatures were above 38°C (100°F) for several days.

It is amazing you can grow carnivorous plants in conditions where the soil freezes deep enough to freeze the roots. Anyone wanting to grow a bog that is living in a temperate zone—all the best of luck! It can be done! Just make sure you can keep your plants alive before you attempt any freeze blasting!

Below are a few samples from my horticultural journal, so you can see some of my observations and experiences for yourself.

Fri., Nov. 5, 1999—Unpleasant times—the temperatures dropped below freezing on Tuesday, November 2nd. I was confident that the plants would be OK so I risked leaving the tarp off this time to see what would happen. I checked to see on Wednesday, and ever since, to see how they have been. The flytraps had ice that formed around them. The water in the *Sarracenia purpurea* subsp. *venosa* was frozen solid. I was a little surprised though. None of the *S. purpurea* leaves (except for a newly emerged one) were damaged from the ice. The tall *Sarracenia*—*S. leucophylla*, *S. flava*, *S. 'Judith Hindle'*, *S. rubra* subsp. *rubra*, and *S. oreophila*, and my *S. psittacina* × *leucophylla* —were not affected at all. None of these plants had damaged or flimsy leaves; they were almost totally unaffect-

ed. The flytraps had their leaves a little mutilated, they became soft and some of the leaves died. The very small, baby flytrap that was completely covered by ice looks ok. The temperatures at night have been 2-7°C (35-45°F).

Friday, Christmas Eve, December 24th, 1999: Harsher times—Merry Christmas! And what a surprise! It has been a few weeks below freezing. It has dropped below -1°C (30°F) during the day, and much colder at night. Unfortunately, no snow for Christmas. Despite the layer of straw, the garden still freezes on the top layer of soil. It may stay frozen for days. That worried me. I checked it out today to see if the plants are still alive. Amazingly, they still had green leaves under the soil. They have not wilted like the other leaves on top of the soil (the flytraps). I believe they are still alive. The water in the *S. purpurea* is frozen, but the foliage has not blackened or wilted! (I later discovered these plants did survive this freeze!)

Late November, 2000— Since the soil was not wet enough, I moved the flytraps, *D. filiformis* ‘California Sunset’ and *D. binata* var. *dichotoma* (a small red form) into pots, watered them, and then buried the pots in the middle of the bog-garden, where it would be warmest. I also covered them up with a little wet soil, as winter ice would add further insulation. I mulched the garden in late November with a 30 cm (12 inch) layer of straw. I placed old logs around to anchor a tarp over the bog. Then I left it alone for the winter.

December, 2000—temperatures were below freezing all month, with lows for some days around the single digits and the teens, and wind chills far below -18°C (0°F). We also had over 15 cm (6 inches) of snow, which stayed on the ground all month without melting. School was also canceled for three days because of the snow! But it certainly was beautiful. But how were the plants? I was pretty sure they were all right, because they survived almost unharmed last winter. But this year was harsher.

Feb. 19th, 2001- Today I went out to check my bog garden. The *S. purpurea* subsp. *venosa* plants had frozen water in them, and the soil was frozen 5-10 cm (2-4 inches) down. Some leaves were brittle, but those below the mulch were still in fairly good condition. The other *Sarracenia* all had some greenery underneath the mulch despite the layer of frozen soil, but everything above was brown. Then, I examined the flytraps. The leaves that were above the frozen soil blackened. But overall, the rest of the plants were still green and were doing just fine. I couldn't really identify the winter bud of the *D. filiformis* ‘California Sunset’ under the frozen soil covering it, but it is probably just fine. I am not so sure about the *D. binata*. The temperatures had dropped below -9°C (15°F), and I have not found any green, even at the crown. The plant may have died. I moved the pot to in my warm house to spark any growth.

—Freezing is definitely not the only winter problem in a temperate climate; heavy precipitation and frequent freeze-thaw cycles in the cold season may lead to root rot and massive losses. Growers in temperate zones are encouraged to experiment with the treatment of plants during the winter, but caution should be exercised, especially with prized plants!—BMR.

BOOK REVIEW



Romanowski, Nick. 2002. *Gardening with Carnivores: Sarracenia Pitcher Plants in Cultivation & in the Wild*. Published simultaneously by University Press of Florida, Gainesville, Florida, and University of New South Wales Press Ltd., Sydney. ISBN 0-8130-2509-5, 106 p., approximately 85 color photographs, figures and maps. Paperback, 17 × 24 cm (6.75 × 9.5 in), \$US29.95.

Reviewed by Barry Meyers-Rice

As its title implies, this book describes the details of cultivating *Sarracenia* pitcher plants. In this capacity it does a good job, and any fan of *Sarracenia* would do well to read it to learn what a well seasoned grower like Romanowski thinks are important horticultural considerations for the genus.

To describe this as only a horticultural book, though, would be inadequate. While Romanowski uses about 30 pages to describe *Sarracenia* horticulture, he dedicates 50 others to describe the individual species, especially in the context of where they occur in the wild. An additional peculiar, but interesting, 20 page section evaluates costs, strategies, profit margins, and other business details that would be associated with growing *Sarracenia* for the cut pitcher trade in a sustainable way.

The section on cultivation is perfectly fine, but probably would provide little new to the ICPS horticulturist who has D'Amato's "The Savage Garden" or one of the other recent carnivorous plant cultivation books. Rather, what gives this book a special flavor is its smattering of ecology, conservation, and restoration. The reader is exposed to topics like *Sarracenia* evolution, discussions of insects that prey upon or live inside pitchers, and wetland habitats. Many of the complex issues in conservation and wildland stewardship are noted such as land development, prescribed fire, invasive species, and poaching. It is nice to see these discussions, and they encourage carnivorous plant enthusiasts to broaden their knowledge and learn about wetlands, plant communities, and ecology.

Of course, the book is not perfect. The range maps, for example, are not always accurate. However, the book's greatest failing is in its incorrect explanation and usage of cultivar names. For example, Romanowski arbitrarily says that cultivars of pure species "must include the species name", and cites how the *S. leucophylla* cultivar *S. 'Schnell's Ghost'* must be written *S. leucophylla 'Schnell's Ghost.'* This is just wrong—both are entirely equivalent. Second, Romanowski mistakenly thinks that a cultivar name is official as long as it is "published in any appropriate journal or book...." Again, this is wrong. A cultivar must be described in the publication and in order to ensure its unambiguous application the name *must also be registered with the ICPS!* This last step is crucial. (This is not an arbitrary ICPS proclamation—the ICPS is the official international registrar for carnivorous plant cultivar names, an honor and responsibility that Jan Schlauer worked hard to obtain, maintain, and uphold.) Indeed, Romanowski spews unestablished, unregistered cultivar names like candy from a piñata—I counted about twenty-five in the figure captions alone! If Jan were to review this book, I suspect he would have become apoplectic!

Alas, the address given in the back of the book for the ICPS is incorrect, too.

These criticisms aside, I recommend the purchase of this book for those interested in the cultivation of *Sarracenia*, and some insights into their status in the wild.

LOOKING BACK: CPN 25 YEARS AGO

Joe Mazrimas wrote: "...I noticed a dramatic improvement in the growth and flowering of Mexican *Pinguicula* after a one-time watering of lime water. A thimbleful of hydrated agricultural lime was added to a pint of deionized water and shaken vigorously for two minutes. A cupful was poured into each pot and I tried to avoid splashing any on the plant leaves. Most of the plants are growing in an even mixture of perlite and living sphagnum moss. I continued to water them with deionized water and I noticed a rapid spurt of growth after about 3-4 weeks followed by the production of many flower spikes."

CARNIVOROUS PLANT
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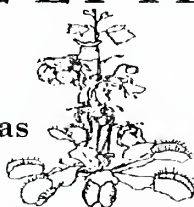
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LITERATURE REVIEWS

An, C.I., Fukusaki, E.-I. & Kobayashi, A. 2001, Plasma-membrane H⁺-ATPases are Expressed in Pitchers of the Carnivorous Plant *Nepenthes alata* Blanco. *Planta* 212: 547-555.

The authors demonstrate by RT-PCR, Northern blot, and in situ-hybridisation analysis that a gene with homology to known proton pumps (from other plants, fungi, and animals) is expressed in *N. alata*. After feeding fruit flies to the pitchers, the pH of the pitcher fluid increased rapidly to decline again within 12 h. It is supposed that the acidification is due to the action of proton pumps and that it is induced in response to ammonium. The in situ hybridization experiment showed that the identified proton pump genes are expressed in digestive glands, in parenchyma cells and in sclerenchymatic bundle sheath cells and that there does not seem to be a proton pump specifically expressed only in glandular cells. On the basis of studies with specific inhibitors, the authors conclude that a plasma membrane H⁺-ATPase of the head cells of digestive glands is involved in acidification of the pitcher fluid. (JS)

Eckstein, R.L. & Karlsson, P.S. 2001, The Effect of Reproduction on Nitrogen Use-efficiency of Three Species of the Carnivorous Genus *Pinguicula*. *Journal of Ecology* 89: 798-806.

Flowering decreases "nutrient use-efficiency" (because nutrients are removed from the plant body into reproductive structures that are detached), which in turn decreases the plants' probability to survive (ecologically speaking, they have a

reduced “mean residence time”) in a nutrient-poor environment as compared to non-flowering specimens. Nevertheless, the studied species (as populations and taxa, i.e. irrespective of specific individuals) have survived millions of years (including glaciations and other ecological disasters) on this planet. Apparently, they do not worry about NUE and MRT as much as ecologists do. (JS)

Yadav, S.R., Sardesai, M.M. & Gaikwad, S.P. 2000, Two New Species of *Utricularia* L. (Lentibulariaceae) from Peninsular India. *Rheedea* 10: 107-112.

Two intriguing plants from India are described as new bladderwort species (*U. janarthanamii* and *U. naikii*). Both do unambiguously belong to sect. *Oligocista* (plants terrestrial with distinct entire foliar organs sometimes carrying traps, traps with simple appendages and basal mouth opening, bracts basifixed, pedicel flattened, calyx lobes not identical, seeds not flattened nor with conspicuous appendages). The unusual characteristic of both species is the lack of bracteoles, paralleled in *Oligocista* only in the Philippine species *U. heterosepala*, with which one of the Indian plants (*U. janarthanamii*) appears to be related (judging from the elongating and spreading pedicels and finely sinuate seed testa cell walls). *U. naikii* is only known from cleistogamous specimens and is thus difficult to align with any other species. The relatives proposed in the paper (*U. uliginosa* and *U. nayarii*, considered conspecific by Taylor) do not appear to represent the sister groups as they have bracteoles and different seeds. (JS)

Cheek, M. & Jebb, M. 2001, Nepenthaceae. *Flora Malesiana Ser. I*, Vol. 15, 161 pp. ISBN 90-71236-49-8

The *Flora Malesiana* area covers most (but not all) of the global range of the genus *Nepenthes*. Given this restriction, the present account contains essentially the same information as the “skeletal revision” published in 1997 (cf. CPN 27:75, 1998). Some species described since (*N. benstonei*, *N. lavicola*, *N. mira*, and *N. sibuyanensis*) are recognized. *N. angasanensis* (described in 1999) is united with *N. mikei*. *N. faizaliana* (previously united with *N. stenophylla*) and *N. philippinensis* (previously doubtful) are now considered distinct. Nineteen (of 82 recognized) taxa are illustrated (line drawings). Unfortunately, recent work on previously overlooked type specimens (Schlauer & Nepi, *Webbia* 55:1-5, 2000) and on Sumatran species (Clarke 2001, cf. CPN 31:9, 2002) was not considered in the present account. Molecular identification and classification methods (removing all ambiguity) would have been more useful than the selection of epitypes to stabilize the names *N. stenophylla* and *N. pilosa*. Epitypes just serve to document an interpretation of the extant original material that is considered ambiguous by the authors (and less so by others). (JS)

Kurata, S. 2001, Two New Species of *Nepenthes* from Sumatra (Indonesia) and Mindanao (Philippines). *Journal of the Insectivorous Plant Society (Japan)* 52:30-34; figs. on cover and back cover of issue no. 2 of the same volume.

N. pyriformis is described as a new member of the *N. inermis* group of Sumatran pitcher plants. It is closely related to *N. talangensis* (described from the same mountain) and may be a hybrid involving this species, as assumed by Charles Clarke in “*Nepenthes* of Sumatra and the Malay Peninsula” (cf. CPN 31:9, 2002).

N. mindanaoensis is the first valid name for the plants that have been called *N. petiolata* in the horticultural trade. Only recently the true *N. petiolata* (strongly pubescent and with a coarse peristome) has been rediscovered, necessitating a reconsideration/renaming of the cultivated material. *N. mindanaoensis* is compared with *N. petiolata* and *N. alata*, which are considered related species. (JS)

