

ATTEMPT TO DETERMINE THE OPTIMAL CONDITIONS FOR CULTURE OF ENDANGERED PLANTS SPECIES OF THE GENUS *DROSERA*, IN TERMS OF THEIR *EX SITU* CONSERVATION

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Summary. The aim of the pilot study was to determine the optimal substrate conditions in *ex situ* cultivation of carnivorous plants of the genus *Drosera* (*Drosera rotundifolia* and *Drosera intermedia*). In August 2010, specimens of studied species were collected from natural stations and transferred into greenhouse. The second stage involved the biometric measurements and observations of plants kept in created conditions. The results of observations conducted in 2010–2011 confirmed the possibility of *Drosera rotundifolia* and *Drosera intermedia* culturing in unnatural conditions. It was found that the acidic peat was the best kind of substrate for genus *Drosera* growth. Sand substrate was inappropriate for proper growth of *Drosera intermedia* and *Drosera rotundifolia* in the *ex situ* culturing.

Key words: *Drosera rotundifolia*, *Drosera intermedia*, *ex situ* conservation, habitat conditions

INTRODUCTION

Specific habitat conditions occurring in the bog ecosystems determine particularly large share of species with narrow or extremely narrow ecological amplitude in the flora [Wysocki and Sikorski 2002], which include representatives of carnivorous species of the genus *Drosera*.

Genus *Drosera* is a cosmopolitan, represented on all continents, in different climate zones plants. The center of differentiation of this genus is considered to Australia and New Zealand, where he recorded the greatest diversity of growth and the greatest variety of habitats occupied by different species of the genus *Drosera* [Conran 1997, Kosinski and Krzyściak-Kosińska 2007].

There are three species of sundew in Poland: round-leaved sundew (*Drosera rotundifolia*), long-leaved sundew (*Drosera anglica*), intermediate

sundew (*Drosera intermedia*) [Polakowski 1995]. Due to very narrow ecological amplitude of these species and increased anthropopressure in their habitat, all of them are under the legal protection in Poland and worldwide [Crowder *et al.* 1990, Cheers 1992, Podbielkowscy 1992, Lewkowicz-Mosiej 2003, Millet *et al.* 2003, Nordbakken *et al.* 2003, Piekos-Mirków and Mirek 2003]. At that moment plant protection involve strictly protected and partially protected species specified in the Regulation of the Minister of Environment of 9 July 2004 on the species of wild plants under protection [Dz.U. Nr 168, poz. 1764].

Carnivorous plants occurring in Łęczna-Włodawa Lakeland are extremely sensitive to any changes in their natural habitats. Conservation may be necessary if the decrease in the population number of carnivorous plants in the Łęczna-Włodawa Lakeland will not be stopped over the coming years. Conservation may include the transfer of single plants or groups from natural stations to the specially created conditions to provide them possibility to reproduction and save their gene pool.

The studies in 2010–2011, were aimed to verifying the adaptability of two species of the genus *Drosera* (*Drosera rotundifolia*, *Drosera intermedia*) to ground conditions. The main objective was to identify optimal conditions for cultivation of these plants in greenhouse in the aspect of their *ex situ* protection.

MATERIAL AND METHODS

The plant material was collected from two stations in the Łęczna-Włodawa Lakeland as a whole plants *Drosera intermedia* and *Drosera rotundifolia*, in July 2010 (Permission from the Regional Directorate of Environmental Protection in Lublin: RDOŚ-06-WPN-66310-005/10/mpr). Station I: peatbog near Brzezicno Lake (south bank of the lake, Permission from the Regional Directorate of Environmental Protection in Lublin: RDOŚ-06-WPN-66301-009/10/mpr), where *Drosera intermedia* specimens were growing on the border of transitional bogs and on the lake water surface; station II: the eastern shore of Piaseczno Lake, where *Drosera rotundifolia* individuals were growing in the sandy littoral of the lake. 12 plants from each population were collected randomly. Whole plants with a small amount of natural substrate were placed together in glass containers.

The second stage of studies involved taking the plants in the greenhouse. Specimens collected from the wild were placed in three different substrates (for 3 plants in each container): substrate No. 1 – live peat-moss taken from the peatbog near Lake Brzezicno, substrate No. 2 – pure sand, substrate No. 3 and 3' – an acid peat (pH 3.5–4.5) purchased in the garden store.

The first biometric measurements of plants: the diameter of leaf rosettes (cm), number of leaves and floral stems, floral stems height (cm), and observations of the color of the leaves was made after a period of plants acclimatization in new substrates (10 days). The pots with tested plants were

stored in plastic inspections end exposed to full sunlight for three months (from July to September 2010). Plants were watered with rain water which reached the level to three-quarters of pots.

Biometric measurements were repeated in September 2010, additionally, the number of shoots with mature seeds bags were identified.

One pot with plants of both species was transferred in the ground 3' to the heated room with a constant temperature of 25°C (before the first temperature drops below 5°C) in October 2009. They were lightened by halogen lamps which emitted natural day light for 12 hours a day from October to March. The other plants were left outdoors for the winter season.

Diameters of rosettes were measured again in March and the leaves number of transferred in October to a heated room plants were noted. Observations of the plants which were left to overwintering were continued since May 2011.

RESULTS

During the first observations on plants transferred into greenhouse *Drosera rotundifolia* and *Drosera intermedia* (July 2010), differences in the color of the leaves of both species was noted. Trap-leaves of *Drosera rotundifolia* were whole pigmented green and the leaves of *Drosera intermedia* were tinged in red. *Drosera intermedia* leaf rosette were more imposing and contained more trap-leaves (Tab. 1). Studied plants had not have mature seed pods yet.

Table 1. The biometric features of specimens *Drosera rotundifolia* and *D. intermedia*, measured immediately after transfer to various substrates, July 2010

Biometric features	Substrat											
	1			2			3			3'		
	specimens studied											
	1	2	3	1	2	3	1	2	3	1	2	3
<i>Drosera rotundifolia</i>												
Diameter of leaf rosettes, cm	5	7	6	9	6	5	5	5	7	6	5	8
Number of leaves	7	11	8	12	9	9	8	8	10	10	6	12
Number of floral stems	5	3	4	6	2	4	3	1	4	2	1	3
Floral stems height, cm	8	12	9	15	13	18	7	10	11	7	9	16
<i>Drosera intermedia</i>												
Diameter of leaf rosettes, cm	9	7	9	10	7	8	9	6	10	11	8	6
Number of leaves	11	9	10	14	12	13	8	8	11	15	10	9
Number of floral stems	3	1	3	4	2	3	4	1	3	4	2	1
Floral stems height, cm	10	6	8	11	6	9	8	7	10	12	7	5

An increase in diameter and the number of leaves in *Drosera rotundifolia* in all pots was noticed after three months. On average, 4 to 5 flowers stems of each plants placed on the substrate No. 1 gave seeds. On the ground No. 2 noted the lowest increase the number of floral stems, among the individuals growing on the surfaces of test, at the lowest estimate floral stems formed a seeds. The individuals on the substrate No. 3 and 3' had the most of floral stems, which formed the seeds (Tab. 2).

Table 2. The biometric features specimens *Drosera rotundifolia* and *D. intermedia*, measured after three months growth on various substrates, September 2010

Biometric features	Substrat											
	1			2			3			3'		
	specimens studied											
	1	2	3	1	2	3	1	2	3	1	2	3
<i>Drosera rotundifolia</i>												
Diameter of leaf rosettes, cm	7	8	7	10	6	6	8	10	12	9	8	11
Number of leaves	10	13	11	13	10	11	10	14	17	13	11	14
Number of floral stems	6	5	7	7	3	6	6	4	7	5	5	6
Floral stems height, cm	12	15	14	16	15	18	10	14	17	16	16	18
Numer of floral stems formed a seeds	4	4	5	4	1	2	6	4	7	5	4	6
<i>Drosera intermedia</i>												
Diameter of leaf rosettes, cm	11	8	10	8	6	4	12	10	14	15	11	10
Number of leaves	14	11	12	10	6	7	13	11	14	18	14	12
Number of floral stems	5	2	5	2	1	1	6	4	6	7	5	3
Floral stems height, cm	12	9	11	15	14	8	14	10	15	16	13	14
Numer of floral stems formed a seeds	2	1	3	0	0	0	5	4	6	6	4	3

Table 3. The biometric features of *Drosera rotundifolia* and *Drosera intermedia* specimens on the substrate 3', March 2011

Biometric features	Specimens		
	1	2	3
<i>Drosera rotundifolia</i>			
Diameter of leaf rosettes, cm	4	4	5
Number of leaves	8	6	7
<i>Drosera intermedia</i>			
Diameter of leaf rosettes, cm	8	6	5
Number of leaves	7	8	6

An increase in diameter and the number of leaves in *Drosera intermedia* in 1, 3, and 3' substrat was noticed. Diameter of leaf rosettes of plants which were growing on the substrate No. 2 were decreased by an average of 2–3 cm

and lost at 4–6 leaves. Only plants which were growing on the substrate No. 2 did not form the seeds (Tab. 2).

Biometric measurements of plant transferred to the heated room with a constant temperature of 25°C and illuminated halogen lamps (made in March 2011) have shown that *Drosera rotundifolia* rosettes were small (4–5 cm) and had 6–8 leaves. *Drosera intermedia* rosette diameter reached 5–8 cm and contained 6 to 8 leaves. In specimens of both species was not observed any floral stems. Pigmentation of their leaves were green (Tab. 3).

The observations in May 2011 showed that only individuals of *Drosera intermedia* planted in the substrate No. 2 does not survive the winter and have not started vegetation.

DISCUSSION AND CONCLUSIONS

Specific habitat requirements are characteristics for the species of the genus *Drosera*. According to Zarzycki *et al.* [2002] both *Drosera intermedia* and *Drosera rotundifolia*, prefer substrate rich in organic matter. *D. rotundifolia* has a wider range of tolerance in relation to the abundance of habitat, reaction, and granulometric structure of substrate [Horn *et al.* 2003, Kamarainen *et al.* 2003].

Results of observations made in 2010–2011 confirmed that an acidic peat determined good conditions for growth of genus *Drosera* plants in the greenhouse. Sandy substrate, in the *ex situ* culturing was proved to be inappropriate for *Drosera intermedia*, and did not provide proper growth of *Drosera rotundifolia* specimens. Type of soil (the reaction, organic matter content and structure) next to habitat components such as sunlight and water level, determines the proper growth of genus *Drosera* plants in natural habitat as well as in specially created conditions. Wolf *et al.* [2006] found that the best way to protect *Drosera rotundifolia* is the conservation of its habitat. This species has the stations in many regions in Poland, but their number is still decreasing. In the case of this species, which has now exposed to extinction status (V), the protection of its habitat is certainly appropriate and may result in improved health of the population located in the Łęczna-Włodawa Lakeland.

Drosera intermedia populations are becoming less numerous in the country and the region, and the species has particularly threatened with extinction status (E). In the case of this species the conservation by the restitution or supply the population may be necessary. So it seems to be necessary to continue research that was started in 2010 and expands them to more ecological and population studies of the genus *Drosera*.

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PRÓBA OKREŚLENIA OPTYMALNYCH WARUNKÓW HODOWLI ZAGROŻONYCH GATUNKÓW ROŚLIN Z RODZAJU *DROSERA* W ASPEKCIE ICH OCHRONY *EX SITU*

Streszczenie. Celem pilotażowych badań było określenie optymalnych warunków podłoża w hodowli *ex situ* roślin mięsożernych z rodzaju *Drosera* (*Drosera rotundifolia* i *Drosera intermedia*). W sierpniu 2009 r. pobrano całe osobniki badanych gatunków ze stanowisk naturalnych i przeniesiono je do inspektu. Drugi etap badań obejmował pomiary biometryczne i obserwacje roślin utrzymywanych w sztucznie stworzonych warunkach. Wyniki obserwacji prowadzonych w latach 2009–2010 potwierdziły możliwość hodowli w warunkach sztucznych roślin z gatunku *Drosera rotundifolia* i *Drosera intermedia*. Stwierdzono, że podłożem zapewniającym odpowiednie warunki do wzrostu roślin z rodzaju *Drosera* był torf kwaśny. Podłożem piaskowym w hodowli *ex situ* było nieodpowiednie dla *Drosera intermedia*, a także nie sprzyjało prawidłowemu wzrostowi oraz rozwojowi *Drosera rotundifolia*.

Slowa kluczowe: *Drosera rotundifolia*, *Drosera intermedia*, ochrona *ex situ*, warunki siedliskowe