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EX SITU CONSERVATION OF *SAUSSUREA PORCII* DEGEN IN Y. FEDKOVYCH NATIONAL UNIVERSITY BOTANIC GARDEN

DEREVENKO TATIANA[1]

Abstract: The International Agenda for Botanic Gardens in Conservation emphasizes on conservation of rare species *ex situ* as the main task and its aim is the creation of a reserve stock for the possibility of active recovery in nature. We have introduced in the culture and first have been studied rhythm of phenological development and flowering, depending on weather conditions, seed production and added guidelines for breeding the endangered Eastern Carpathians endemic species - *Saussurea porcii* Degen, which is listed in the Red Data Book of Ukraine and the European List of Globally Threatened Animals and Plants. We have created a field bank *S. porcii* – it is our contribution to the conservation of plant diversity.

Key words: *Saussurea porcii* Degen, *ex situ* conservation, Red Data Book of Ukraine, a field bank, the biology of developing

Introduction

The Global Strategy for Plant Conservation states that the conservation of living plants collections of endangered species of regional floras, especially endemics, as the most vulnerable is very important. [GLOBAL STRATEGY FOR PLANT CONSERVATION, 2002]. From the Carpathian region`s 219 endemic taxons [ТАСЄНКЕВИЧ, 2006] in the collections of CHNU Botanic Garden today are saved specimens of 11. *Saussurea porcii* Degen is the Eastern Carpathians endemic, which has the phylogenetic relationships of Siberia. In Ukraine it is distributed in: Chornogora mountain range (Polonyna Rogneska, ur. Primaratik), the upper Chornyi and Bilyi Cheremosh (Mountain Gnetesa, polonyna Glystuvata, between polonynas Glystuvata and Preluky). In Romanian Carpathians it has been cited from the Maramureşului Mountains (at Borşa and Lanul Cercănel [ŞTEFUREAC, 1971], and in Rodna Mountains (on the Mountain of Corongiş, under the rocks called "Porţii", as well as on the opposite slope of it [ŞTEFUREAC, 1971; NYÁRÁDY, 1933]. This species is listed as disappearing into the Red Data Book of Ukraine [ДІДУХ, 2009], as critically endangered (CR) in Ukraine and as extinct (EX) in Romania – accordingly to the Red Data Book of Carpathians [ТАСЄНКЕВИЧ, 2002], as endangered (EN), in the *European List of Globally Threatened Animals and Plants* (1991). Today are known only 6 populations of *S. porcii* in the Carpathian Mountains [БАГЛЕЙ & ДАНИЛИК, 2009], mostly on wetlands in the crooked green alder in the subalpine zone. It needs to establish reserves to protect it. Basically, it has a small populations numbering

[1] Yuriy Fedkovych Chernivtsi National University Botanic Garden, Fedkovych 11, 58022, Chernivtsi – Ukraine, e-mail: tderevenko@ua.fm

from 400 to 1000 individuals. The most numerous one has several thousand individuals and occupying an area of several tens of hectares on the polonyna Glystuvata (the Chyvchyn Mountains) (Fig. 1). Only this population from all has a high level vitality constituent individuals (Fig. 2) [БАГЛЕЙ, 2011].

Currently, only CHNU Botanic Gardens living collection present some specimens of *S. porcii*, unlike all the botanical gardens of Ukraine [ЛЕБЕДА, 2011].

Material and methods

Saussurea porcii Degen is a hemikryptophyte, herbaceous perennial plant, to 80 cm height, with sessile lanceolate leaves, forming wings along the stem and inflorescence corymbose. From polonyna Glystuvata locality the planting material has been introduced CHNU Botanic Gardens, in 2007. In the Botanic Garden a place in partial shade for planting *S. porcii*, and a high soil moisture provided by regular watering this population-locus was chosed (Fig. 3).

Monitoring the phenological stages was carried out by conventional methods, recommended by the Botanical Gardens of USSR Council [МЕТОДИКА ФЕНОЛОГИЧЕСКИХ НАБЛЮДЕНИЙ В БОТАНИЧЕСКИХ САДАХ СССР, 1979], and mathematical processing of phenological observations were carried out according to the method of the Central Botanical Garden [КРАТКОЕ ПОСОБИЕ ПО МАТЕМАТИЧЕСКОЙ ОБРАБОТКЕ ДАННЫХ ФЕНОЛОГИЧЕСКИХ НАБЛЮДЕНИЙ, 1972]. The study of seed production was carried out according to the guidelines by T. O. RABOTNOV [РАБОТНОВ, 1992] and VAYNAGY [ВАЙНАГИЙ, 1974].

Results and discussions

The International Agenda for Botanic Gardens in Conservation emphasizes that conservation of rare species *ex situ* is the main task and its aim is the creation of a reserve stock for the possibility of active recovery in nature [МЕЖДУНАРОДНАЯ ПРОГРАММА БОТАНИЧЕСКИХ САДОВ ПО ОХРАНЕ РАСТЕНИЙ, 2000]. As for successful repatriation should be explored more fully the biological characteristics, which is possible only in *ex situ* conditions, we are studying the biology of developing and reproduction of *S. porcii* and it is a preparatory stage to the restoration in nature.

The results of the study of phenological rhythm of *S. porcii* in the collection of the CHNU Botanic Garden during 2007 – 2011 years are presented in Tab. 1. In the spring, *S. porcii* begins growing season in CHNU Botanic Garden in early April, when average daily air temperature did not fall below +5 ºC, the bud of resumption elongates, shoots and leaves starts to grow. About a week after the stable transition of mean daily air temperatures over +10 ºC an inflorescences are formed in the generative shoots, on average, this occurs early in the second decade of May, often coinciding with the transition of daily average temperatures over +15 ºC. From the beginning of growing season before the flowering passes near 88 days (Table 2). It comes into flower in the last third of June – mid of July, until early of August. The earliest onset of phenophases had been observed in 2009 – the

first decade of June, when flowering time was 1.5 months, which is obviously connected with the early spring practically without a rain right up to June and the second wave of drought lasted from July to early October. The average duration of flowering *S. porcii* over the years of observation was 33 days. The shortest flowering period noted in 2010 was of 18 days, due to the fact that the average air temperature during the flowering time was approximately 3 ºC above normal and reached 23.2 ± 0.7 ºC. Inflorescences of *S. porcii* (Fig. 4) have a diameter from 2.5 to 7.5 cm, and a height from 4.5 to 11 cm; on average the inflorescences are composed of 30 botryoidal florets (from 15 to 60), each predominantly having 9 disk florets (rarely 7 or 10). In the florescence of disc florets clearly are observed 2 phases, namely: staminale and carpellary one. We determined the duration of each phases in sunny weather and at average air temperatures about 20 ºC, starting by staminale phase, which lasts about 24 hours; after drying the stamens begins carpellary phase and lasts about 24 hours, too. Thus, about 20 hours lasts phase of the budding and florescence of disk florets actually lasts about 2 days.

We have observed there are infected plants by aphids in a phase of active growth of the inflorescence before flowering, which resulted in shrinkage of the tops of generative shoots and, accordingly, to a lack of florescence in 50% of generative shoots in the culture.

Seeds of *S. porcii* begin to ripen from mid August and by the end of it, dissemination is finish. Seeds are dark brown in color, having an oblong shape, slightly flattened at the sides, length from 0.72 to 0.62 cm and a diameter from 0.11 to 0.15 cm. Weight of 1000 seeds is about 1.400 Kg.

As an important indicator of the life of rare plants *ex situ* is their ability of generative reproduction. We investigated the seed production (SP) of generative shoots (a number of mature seed). *In situ* depending on the vitality of population SP ranges from 153.8 ± 2.01 to 280.2 ± 3.75 [БАГЛІЙ, 2009]. In the CHNU Botanic Garden this number is fluctuating between 10 and 135, with an average of 55.4 ± 7.8. Study of *ex situ* seed production coefficient (SPC) have found that mature seeds are formed only at 1/3 (32.4%) from all number of seed germs in each generative shoots of *S. porcii*. Well known is that the number of seed germs have a genetically fixed value and therefore varies considerably, with lower limits than the number mature seeds, which depends on a large number of different factors of exogenous and endogenous origin. The second level is repeated it again - the number of flowers in generative shoots (in the inflorescence) varies far less than the number of mature fruits. Both figures are in varying degrees depending on the specific conditions of growth of individuals of a particular species. In our case, such difference between seed productivity in nature (*in situ*) and in culture (*ex situ*) can be explained by the fact that the culture reduce the florescence period (only part of the flowers makes seeds, and the rest remains in various bud stages). Partly, it is a consequence of not perfect condition for cultivation of *S. porcii*, and partly - the result of the impact of weather conditions, and a certain lack of pollinators. In any case, it's an interesting question, and it requires additional and parallel studies, both in nature and cultivation.

In June and July at the base of the shoots, virginal and generative individuals are formed, from 3 to 7 resumptions buds. The growing season lasts an average about 200 days,

and finishes with the start of frost in late October – early November. Maximum seed germination was 83% in the autumn, sowing in boxes with a soil mix of deoxidized peat, leaf soil and sand. More than 70% of the seedlings in their second year become the generative phase of development.

Conclusions

We have introduced in the culture the endangered Eastern Carpathians endemic species of *Saussurea porcii* Degen. In accordance with our program of restore the nature populations of endangered plant species, we have created a field bank of *S. porcii*. To restore the disturbed populations should only correctly collect seeds and sow it, and through a growing season will have a representative genetic planting material. And that is important – without the high financial costs. Implementation of this program in the CHNU Botanic Garden is our contribution to the conservation of plant diversity and compliance with international obligations of Ukraine in the Global Strategy for Plant Conservation.

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Tab. 1. *Saussurea porcii* Degen rhythm of development in the collection of CHNU Botanic Garden

Year/ statistics	Beginning of grows	Formation of flower stalk	Efflorescence	Mass flowering	End of flowering	Beginning of ripening	Full ripening of seeds	End of vegetation	Duration of vegetation
2007	-	27. V	24. VI	5. VII	13.VIII	9.VIII	21.VIII	3.XII	-
2008	11.IV	19.V	30.VI	7. VII	26. VII	10. VIII	27. VIII	22.X	194
2009	1.IV	21.IV	2.VI	23.VI	15.VII	7.VIII	28.VIII	27.X	209
2010	4.IV	5.V	11.VII	15.VII	28.VII	15.VIII	30. VIII	18.X	197
2011	30.III	21.V	16.VII	19.VII	10. VIII	13. VIII	31. VIII	25.X	209
M±2m	3.IV±5,7	12.V±13,1	27.VI±15,4	6.VII±9,0	31.VII±10,5	11.VIII±2,8	28.VIII±3,7	31.X±16,6	202,3±7,9
V	6.1	11.0	9.6	5.3	5.5	1.4	1.7	6.1	3.9

Tab. 2. Climatic data during the *Saussurea porcii* Degen flowering in the collection of CHNU Botanic Garden

Year/ statistics	Number of days before flowering	Flowering period			T ºC of air during the flowering			The number of days with precipitation	Σ precipitation (mm)
		Efflorescence	End of flowering	Duration	Max	Min	M ± m		
2007	-	24.VI	13.VIII	51	36.9	10.0	20.8±0.5	15	86.1
2008	81	30.VI	26.VII	27	32.3	9.9	19.5±0.5	20	185.8
2009	63	2.VI	15.VII	44	31.7	8.2	19.4±0.5	22	103.8
2010	99	11.VII	28.VII	18	32.6	12.9	23.2±0.7	7	53.7
2011	109	16.VII	10. VIII	26	33.1	10.3	20.4±0.5	17	123.6
M±m	88 ± 10.2			33.2 ± 6,1	33.3 ± 0.9	10.3 ± 0.8	20.7 ± 0.7	16.2 ± 2.6	110.6 ± 22.0
M±2m		27.VI ± 15,4	31.VII ± 10.5						
V	23.1	9.6	5.5	41.4	6.2	16.5	7.5	35.8	44.5

Fig. 1. The population of *Saussurea porcii* Degen on the polonyna Glystuvata (foto by Vacyl Budjac)

Fig. 2. *Saussurea porcii* Degen *in situ* (foto by Vacyl Budjac)

Fig. 3. *Saussurea porcii* Degen *ex situ* (in CHNU Botanic Garden)

Fig. 4. The inflorescens of *Saussurea porcii* Degen *in situ*
(foto by Vacyl Budjac)