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THE COLLECTIONS OF GRAMINOIDS AND THEIR POSSIBLE USES – AN EXAMPLE FROM THE BOTANICAL GARDEN AND ARBORETUM (BGA) OF MENDEL UNIVERSITY OF AGRICULTURE AND FORESTRY BRNO

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ABSTRACT

The number of graminoid species grown in central European botanical gardens is rather small. The authors of this contribution point out possible uses of this plant group for garden architecture, bringing results of an investigation of some *Carex* species (*Cyperaceae*) growing in the BGA in Brno.

Their possible uses in a given locality were studied regarding the following features of the species investigated: ecological demands, plant height, duration of leaves, production of rhizomes, texture of clumps or masses, the colour in different seasons, earliness of leaves and flowers.

Species suitable for three different ecological conditions that may occur in a garden (dry, medium-moist and wet sites) are mentioned along with species whose planting failed. Among 76 chosen Czech native Carex species, 67 have been completely evaluated so far (grades used for the evaluation: the best, medium, limited use). The collection of graminoids also plays a role as a gene bank of the taxa protected or threatened in the Czech Republic (these are the following numbers of the taxa in the Czech Republic according to current threat classification: A3: 1, C1: 6, C2: 14, C3: 5, C4: 6).

There is no doubt that any collection of this kind is also a suitable place for students and their practical training in systematic botany, or for any other special studies.

INTRODUCTION

Graminoids are those plants being morphologically similar to grasses (Poaceae), including such families as *Cyperaceae, Juncaceae, Sparganiaceae, Typhaceae* and others. They are present practically in every botanical garden, but usually make up only a small proportion of the garden inventory. Botanical gardens with collection containing a significant proportion of graminoids, or even consisting exclusively of that group of plants are very rare in central European. Example of garden with comparatively rich collection of is include Botanical Garden of PBAI in Bydgoszcz (Poland, the main grass collection in the country – Majtkowski et Majtkowska 2000).

In botanical gardens in Brno (the Czech Republic), the graminoids are represented in the following proportions: Medical Plants Garden at Kraví hora: almost no species, Botanical Garden of Masaryk University: about 13%, Botanical Garden and Arboretum of Mendel University of Agriculture and Forestry Brno: about 10%.

In this paper, special attention is paid to the collections of Botanical Garden and Arboretum of Mendel University of Agriculture and Forestry Brno (BGA). In addition to the rich collection of *Carex* species (109 taxa, all *Cyperaceae* 117 taxa), the collection of BGA contains 20 taxa of family *Juncaceae* and 258 taxa of family *Poaceae* (including 27 taxa of bamboos), altogether 395 taxa, which is about 10% of all herbaceous plants of this collection. The aim of this paper is to show the results of an investigation of Carex species grown in BGA (native in the Czech Republic) aimed at the evaluation of their possible uses in garden and landscape architecture.

Graminoids of BGA are placed in the collection in spiral patches according to botanical

system in two sections including grasses and economic plants. In addition, they form here various garden-architectural components, such as cut lawn, perennial patches, and geographical (communities of North America, eastern Asia and New Zealand) and ecological sections (heath, steppic grassland, ravine with alpine species and petrophyts, miniature garden), and frame water bodies. The collection consists of both natural species and their garden cultivars.

MATERIALS AND METHODS

Single plants of *Carex* species growing in BGA come from different localities in the Czech Republic or have been grown from seeds obtained from other European botanical gardens thanks to the reciprocal exchange of seeds (Index Seminum).

The plants were determined additionally, when it was necessary.

Eight different features of the *Carex* species studied have been investigated and evaluated according to a three-step scale proposed (see Legend to tab. 1). It is important to add that the evaluation is, to some extent, based on the authors' knowledge and therefore may be author-biased, and is of only local applicability.

BGA is situated in subcontinental region with the average annual temperature of 8,4°C and average annual precipitation of 531 mm. The soil is mostly loamy, rich in $CaCO_3$, with high water holding capacity. The locality is a climatically risky region for some species.

The names of plants are given according to Grulich et Řepka (2002).

RESULTS AND DISCUSSION

Carex – sedge is the largest genus of the *Magnoliophyta*. Species of this genus grow in all floristic regions of the Earth. They participate in most plant communities of both temperate and boreal zone. The total number of *Carex* species exceeds 2,000, about 180 taxa of this number occur in Europe and 81 in the Czech Republic. Their cultivation in a garden may be quite problematic because of special demands (ecological specialization) of most species which are difficult to create in garden conditions (e.g. rocks of subalpine and alpine zones, moors or ocean coast etc.). So, the list of the species available for using in landscape architecture or creating specialised graminoid collections is rather limited. On the other hand, there are some species with wide ecological amplitude whose cultivation is possible without any difficulties in gardens of central Europe (extreme examples in BGA: *Carex firma, C. sempervirens*).

Altogether 76 *Carex* species have been investigated, 67 of them completely evaluated so far. The results of this investigation are summarised in tab. 1.

An overview of some Czech *Carex* species suitable for different situations in a garden (sorted according to their growth character and habitat):

1. Low sedges suitable as groundcover for (partly) shady places:
Among species evaluated, *C. digitata* (tolerates also full sunshine), *C. ornithopoda, C. pediformis, C. muricata* agg., *C. caryophyllea, C. michelii* and *C. pilosa* are the most suitable ones, thriving also in dry conditions. The use of *C. montana*, especially in spring very decorative sedge, is also suitable, however its leaves get dry during winter.

2. Low sedges suitable for moist soils:
C. remota is very suitable and attractive for its fine texture of leaves, other possible species are: *C. otrubae* of semi-coarse texture; *C. aterrima* of semi-coarse to coarse texture and dark green to blue-green leaves.

3. Low sedges suitable for sunny places:
C. hordeistichos, C. distans and *C. secalina*, species of slightly salty habitats, proved suitable in places with heavy soil. This group also includes sedges of steppic grasslands (*C. humilis*).

4. Middle-high sedges framing water bodies or growing in inundated places:
C. acutiformis seemed to be best among the species evaluated. This sedge, unlike similar *C. acuta*, is not lodged during winter.

List of the Czech *Carex* species whose use garden and landscape architecture is limited due to some undesirable characters:

C. bohemica: short living, *C. ericetorum*: needs porous soils, very slow growth, *C. hirta*: ruderal species expanding quickly, *C. melanostachya*: too long stolonate, *C. pallescens*: needs porous soils, *C. rupestris*: small sedge, only for rock garden, *C. stenophylla* and *C. supina*: sparse masses.

TABLE 1
Legend to the tab.1:

(1) Plant height
(2) Duration of leaves: 1 dying before winter, 2 semi-evergreen, 3 evergreen
(3) Type of growth (type of rhizomes): 1 tuft (tussock), 2 short rhizomatous, 3 long rhizomatous
(4) Texture of tufts or overgrowth: 1 fine, 2 semi-coarse, 3 coarse
(5) Colour in different seasons (in parentheses is expressive autumn colouring leaf): 1 in autumn and winter brown, 2 in autumn markedly coloured (yellow, orange etc.) then braun or whithish, 3 green, end of leaves dead (whitish, brown)
(6) Earliness of flowers: according to Dierschke (1995) – using only periods 2–6: period 2 – Acer platanoides-Anemone nemorosa, period 3 – Prunus avium-Ranunculus auricomus, period 4 – Fagus-Galeobdolon, period 5 – Sorbus aucuparia-Galium odoratum, period 6 – Cornus sanguinea-Melica uniflora
(7) Grades used for the evaluation (general usability): +++ – the best, ++ – medium, + – limited use, x – not evaluated yet

Table. 1. Evaluation of selected Czech native species of the genus *Carex*

Carex	(1)	(2)	(3)	(4)	(5)	(6)	(7)
acuta	30–140	1	3	1	1	4	++
acutiformis	30–120	1–2	3	2	2 (conspicous yellow-orange)	4	+++
alba	10–30	2	2	1	1–2 (beige-brown)	2	++
appropinquata	30–80	2	1	1	1–2 (green-orange)	3	++
atrata	15–30	1–2	1	2	3	5	++
aterrima	30–60	1–2	1	1–2	3	5	++
bigelowii	10–30	2(3)	2	2	3	6	x
bohemica	5–30	1	1	1	1 (yellow-brown to brown)	5-latter	+
brizoides	20–50	1	3	1	1	5	++
buekii	50–120	1	3	2–3	2 (yellow-green to brown)	4	++
buxbaumii	30–70	1	3	1–2	2	5	x
hartmanii	30–70	1	3	1–2	2 (yellow-orange)	5	++
canescens	20–50	1(2)	1	1	2 (grey-yellow-brown)	4	++
capillaris	5–25	1	1	1	1	5	+
caryophyllea	10–50	2	2	1	1 (copper-brown)	3	++(+)
cespitosa	30–60	1	1	2	1 (yellow-brown)	3	++
curvata	20–50	1	3	1	1	4	x
davalliana	10–40	2–3	1	1	2 (brown-green)	3	++(+)
diandra	30–60	1–2	2	1	1 (yellow-brown)	5	++
digitata	10–30	3	1	2	3	2	+++
distans	20–80	2–3	1	2	3	5	++(+)
disticha	30–70	1	3	1	2 (yellow-orange-brown)	4	++
echinata	10–30	2	1	1	2 (red-bronze)	5	++
elata	40–120	1–2	1	2	2 (green-brown to light brown)	4	++
elongata	30–70	1–2	1	2	2 (yellow-brown-green to brown)	3	++
ericetorum	10–30	3	2	2	3	3	+
flacca	10–50	2–3	2+3	2	3	4	+++
flava agg.							
demissa	10–40	2	1	1	3	5	+
flava	20–80	2	1	2	3 (yellow-brown)	5	++
lepidocarpa	20–70	2	1	2	3	5	++
viridula	5–25	1–2	1	1	2 (yellow-green to light brown)	5	+
fritschii	20–60	1	1+2	1	2 (orange yellow-green to light brown)	3	x
hirta	20–80	1	3	1	1	4	+
hordeistichos	20–50	2–3	1	2	3	5	++(+)
hostiana	20–60	1–2	2	1	3	3	+
humilis	5–20	2	1	1	3	2	+++
lasiocarpa	40-100	1	3	1	1	5	+
limosa	10–50	1	3	1	1 (copper-brown)	4	+

Carex	(1)	(2)	(3)	(4)	(5)	(6)	(7)
melanostachya	20–60	1–2	3	2	2 (yellow-orange to brown)	4	+
michelii	20–40	2	2	2	2 (yellow-green, tips yellow-orange)	4	+++
montana	10–40	1	1	1	2 (bronze, then brown)	2	+++
muricata agg.							
chabertii	30–120	2	1	1	3	4	+++
divulsa	30–90	2	1	1	3	4	+++
leersiana	30–100	2	1	1	3	4	+++
muricata	30–110	2	1	1	2 (yellow-orange-green)	3–4	+++
pairae	20–80	2	1	1	2 (yellow-orange-green)	5	+++
contigua	10–100	2	1	1	3	4	+++
nigra	10–80	1–2	2+3	1	2 (copper-brown)	4	++
ornithopoda	5–15	3	1	1	3	3	+++
otrubae	20–80	2	1	2	3	5	++(+)
ovalis	5–70	2	1	1	2 (yellow-brown to grey-brown)	6	++(+)
pallescens	10–60	1	1	2	1	5	+
panicea	10–40	2	2	1	2–3 (yellow-grey to brown-grey)	4	+++
paniculata	40–100	2	1	1	2 (yellow-green-orange to brown)	4	++(+)
paupercula	10–40	2–3	2	2	3	6	+
pediformis s.l.	15–40	2–3	1+2+3	2	3 (yellow-brown)	4	+++
pendula	50–150	3	1	3	3 (yellow-brown)	5	+++
pilosa	30–50	3	3	2	3	2	+++
pilulifera	10–40	3	1	1	3	4	++
praecox	5–40	1	3	1	1	4	+
pseudobrizoides	30–60	1	3	1	1	5	x
pseudocyperus	40–100	1–2	1	2–3	2 (yellow-green to copper-brown)	6	+++
remota	20–50	2	1	1	3	6	++(+)
riparia	(30–) 60–200	1	3	2	1	4	++
rostrata	30–100	2–3	3	1+2	2 (grey-yellow-green to brown-whitish)	4	+
rupestris	10–20	1–2	1+2	1	1 (copper-brown)	6	+
secalina	10–40	2	1	1–2	3	5	++(+)
sylvatica	30–100	3	1	2	3	4	+++
stenophylla	5–20	1	3	1	1	4	+
strigosa	30–100	2–3	1+2	2	3	4	x
supina	5–20	1	1+2+3	1	1	3	+(+)
tomentosa	20–50	1	3	1	1–2 (orange tinge)	4	++
umbrosa	20–50	3	1	2	3	3	+(+)
vaginata	10–40	1	2	2	3–1	4–5	x
vesicaria	30–120	1	2	2	2 (green copper-brown)	4	++
vulpina	30–90	1	1	2	2 (yellow-green-brown)	4	++

Uses of graminoids in BGA

– cultivating protected and threatened taxa
– forming plant collections and demonstrating diversity of this plant group
– collecting cultivars for ornamental uses
– special garden purposes: agricultural and ornamental species, garden and landscape architecture (components of perennial patches, groundcover of woody formations, watersides)
– didactic purposes for all studying graminoids (systematic botany).

Conclusion

In this paper the results of the investigation of 76 *Carex* species grown in Botanical Garden and Arboretum of Mendel University of Agriculture and Forestry Brno (the Czech Republic) are presented. Of them, 67 have been completely evaluated so far. Selected characters of every species (a) tolerance to different ecological conditions, (b) ecological demands, (c) plant height, (d) duration of leaves, (e) production of rhizomes, (f) texture of clumps or

masses, (g) colour in different seasons, (h) earliness of leaves and flowers, were evaluated (one of this according to a 3-step scale).

The results of evaluating *Carex* species from two different points of view: 1) suitability for garden use with respect to the growth character and habitat demands (four groups), 2) general usability and value of species investigated for uses in garden and landscape architecture.

The most suitable *Carex* species for garden purposes are the following: *Carex acutiformis, C. digitata, C. distans, C. flacca, C. michelii, C. montana, C. muricata* agg., *C. ornithopoda, C. pediformis* s. l., *C. pendula, C. pilosa, C. pseudocyperus, C. secalina, C. sylvatica*.

As to the gene pool of the threatened taxa of the Czech Republic, the list includes 2 extinct, 6 critically threatened, 15 strongly threatened species and 6 species requiring further study all of which, are cultivated in BGA.

To sum up, graminoids are, along with grasses, very attractive plants for their decorative growth, suitable for different ecological situations in gardens. It is necessary to support their wide uses in garden and landscape architecture by specialised evaluation of their growth/ecological characters in botanical gardens.

Appendix l

Threatened taxa of native graminoids (*Cyperaceae, Juncaceae, Sparganiaceae* and *Typhaceae*) cultivated in BGA (according to Holub et Procházka 2000):

A1 – definitely extinct taxa: *Typha minima*

A3 – uncertain cases of extinct or missing taxa: *Carex brevicollis*

C1 – critically threatened taxa: *Carex alba, C. atrata* s.s., *C. capillaris, C. hordeistichos, C. rupestris, C. stenophylla*

C2 – strongly threatened taxa: *Carex appropinquata, C. aterrima, C. davalliana, C. diandra, C. distans, C. divulsa, C. hostiana, C. lasiocarpa, C. lepidocarpa, C. limosa, C. melanostachya, C. ornithopoda, C. secalina, C. strigosa, Luzula luzulina*

C3 – threatened taxa: *Carex bigelowii, C. ericetorum, C. hartmanii, C. michelii, C. supina*

C4 – rare or scattered taxa, requiring further study and monitoring: *Carex cespitosa, C. flava, C. humilis, C. pendula, C. pseudocyperus, C. riparia*.

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