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THOUSAND SEED WEIGHT RECORDS OF SPECIES FROM THE FLORA OF HUNGARY, I. MONOCOTYLEDONOPSIDA

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New thousand seed weight records are reported for 38 members of the Hungarian monocotyledonous flora. Seed samples were harvested from natural populations, kept dry till the end of the vegetation period, then their seed mass were determined. One to three hundred-seed lots were used for measurements with accuracy of 0.1 mg (up to 30 g) and 0.1 g (above 30 g). Most of the new records correspond to already known rules of seed morphology and ecology. In some cases the new records required individual interpretation as they did not support general trends. When thousand seed weight records were plotted against naturalness of species a slight positive correlation occurred indicating that monocots with larger seed mass values often received higher rank of naturalness values. With one table and one figure.

Key words: diaspore weight, Hungarian flora, Monocotyledonopsida, naturalness value, seed weight

INTRODUCTION

The role of seeds and fruits in the dispersal and establishment of species and the recognition of their importance in vegetation restoration resulted an increasing interest on the reproductive propagules of higher plants (HOWE 1986, BAKKER *et al.* 1996, LEVEY *et al.* 2002). Vegetation scientists reported new ecological rules derived from size and shape of seeds and fruits, that requires an extensive database of raw data of species' reproductive propagules. Also for appropriate operations by environment engineers in vegetation restoration projects these databases offer useful information. To serve these challenges seed morphological and seed ecological databases were established in the last decades (GRIME *et al.* 1981, THOMPSON *et al.* 1997, VAN SLAGEREN 2003).

To join the international trend completion of a seed size and shape database of the Hungarian flora was decided (CSONTOS 1998). For filling up the database we used three types of data sources: data published in the literature, measurements of seeds received from botanical gardens and measurements of freshly collected seeds originated from spontaneous populations. Evaluation of the seed weight database with application examples were given by CSONTOS and TAMÁS (2001) and

CSONTOS (2002). In this paper we publish data of 38 monocotyledonous species of the Hungarian flora for what thousand-seed-weights are first reported.

MATERIALS AND METHODS

Seeds or fruits of species were collected in the field at mature stage. For species with easy-to-harvest seeds several hundreds were collected (3 hundreds being the minimum), otherwise at least 100 seeds were taken. Whenever it was possible, attention was paid to collect pooled seed samples from several mother plants of the same stand to avoid bias caused by maternal effects (Kazinczi and Magyar 2003). In case of fleshy fruits the seeds were removed in the lab during the subsequent days then cleaned and dried at room temperature. All seed samples were put in labelled paper bags and stored at room temperature till the end of the vegetation period (late October – early November). For measurements hundred-seed lots (or hundred-diaspore lots) were prepared. Damaged seeds were not considered. Three lots were measured for the majority of species, in some cases two or one. Up to 30 g the accuracy was 0.1 mg (using KERN–410 automatic chemical balance), whereas above 30 g it was 0.1 g (NAGEMA digital weighting machine). Thousand seed weight of a species were calculated from the average weight of the seed lots. In case of six species seeds were collected from spontaneous populations by the Botanical Garden of the Ecological and Botanical Research Institute of the Hungarian Academy of Sciences (Vácrátót). These samples were subjected to the same operations as described above.

As an example for seed mass data application in botanical research a pilot test was made regarding the relationship of seed mass and naturalness values (*sensu* BORHIDI 1993) of the 38 species discussed in this paper. For statistical evaluation the ordinal scale of naturalness values was divided into the following three parts: "low", from –2 to +2; "medium", from +3 to +5; "high", from +6 to +10; then the seed mass data of the "low" and "high" groups were compared in t-test (Sváb 1981).

RESULTS AND DISCUSSION

New thousand seed weight records are given for 38 monocotyledonous species of the Hungarian flora representing the following taxonomic groups: Poaceae: 12 spp., Cyperaceae: 9 spp., Liliaceae (sensu lato): 7 spp., other monocots: 10 spp. (Table 1). Seed samples are stored in the seed collection of the Botanical Department of the Hungarian Natural History Museum (Collectio seminum et fructum, BP).

Most of the new records correspond to already known trends of seed ecology. Seed mass of three rush species (*Juncus atratus*, *J. conglomeratus* and *J. gerardii*) proved to be extreme low (Table 1) similar to most of their congeners. Several small seeded *Juncus* species including *J. conglomeratus* are reported to establish long term persistent seed bank (THOMPSON *et al.* 1997) and *J. gerardii* was already classified as having well developed seed bank with considerable persistence in various European vegetation types (ERKKILA 1998, WOLTERS and BAKKER 2002). Therefore we can assume a similar soil seed bank behaviour for *J. atratus* as well.

Table 1. Seed weight records first published to 38 species of the Hungarian flora. SN = number of seeds measured, W = thousand seed weight in grams

Species name	Origin of the seeds	Date	SN	W (g)
POTAMOGETONACEAE				
Potamogeton pectinatus L.	Dinnyés, Dinnyés-Kajtori-csatorna	30.09.2000	100	6.280
LILIACEAE				
Allium rotundum L. subsp. *waldsteinii* (G. Don) Richter	Vácrátót	2000	300	0.574
Allium sphaerocephalon L.	Nagykovácsi, Nagy-Szénás, dry grassland	1995	300	0.766
Hemerocallis lilio-asphodelus L.	Vas county, Nárai	1996	200	52.4
Ornithogalum comosum L.	Csiki Mts, Törökugrató	18.07.1996	300	3.511
Polygonatum latifolium (Jacq.) Desf.	Csiki Mts (KFKI)	20.09.1998	300	23.90
Scilla autumnalis L.	Vácrátót	2000	100	2.090
Scilla vindobonensis Speta	Kup, Kupi-erdő[1]	23.05.1996	300	5.056
AMARYLLIDACEAE				
Galanthus nivalis L.	Kup, Kupi-erdő[1]	23.05.1996	300	6.112
IRIDACEAE				
Crocus heuffelianus Herbert	Kup, Kupi-erdő[1]	10.06.1996	300	5.664
Crocus reticulatus Stev.	Kocs[1]	23.05.1996	200	4.921
Iris sibirica L.	Kőszeg, Alsó-rétek	05.09.1995	60	15.80
JUNCACEAE				
Juncus atratus Krocker	Vácrátót	2000	100	0.032
Juncus conglomeratus L.	Dunaremete, Sorjás pasture	1995	100	0.011
Juncus gerardii Lois.	Sárkeresztúr, Lake Sárkány	22.08.1996	300	0.044
ORCHIDACEAE				
Limodorum abortivum (L.) Sw.	Budapest, Ördög-orom	02.07.2000	100	0.002
Neottia nidus-avis (L.) Rich.	Hollókő, near Földvár	12.09.1998	300	0.008
CYPERACEAE				
Carex alba Scop.[2]	Buda Mts, Kis-Szénás	08.08.1999	200	3.271
Carex cuprina (Sándor) Nendtvich	Százhalombatta, fish-ponds	1995	300	1.218
Carex elata All.	Százhalombatta	1995	300	0.414
Carex hallerana Asso	Vácrátót	2000	200	2.702
Carex liparicarpos Gaud.	Budapest, Tündér-szikla	15.08.1996	300	3.257
Holoschoenus romanus (L.) Fritsch subsp. *holoschoenus* (L.) Greuter	Vácrátót	2000	300	0.090
Schoenoplectus litoralis (Schrad.) Palla	Velence	1995	300	0.974
Schoenoplectus triqueter (L.) Palla	Velence	1995	300	3.012
Scirpus sylvaticus L.	Felsőszölnök, wet meadow	1995	300	0.089
POACEAE				
Bromus ramosus Huds.	Börzsöny Mts	02.07.1998	200	4.36
Calamagrostis epigeios (L.) Roth	near village Nagykovácsi	10.10.1998	200	0.064
Cenchrus incertus M. A. Curtis[3]	Vácrátót	2000	100	44.4
Eleusine indica (L.) Gärtn.	Budapest, IX. district	22.10.1996	300	0.363
Festuca pallens Host	Budapest, Tündér-szikla	20.06.1999	100	1.037

Table 1 (continued)

Species name	Origin of the seeds	Date	SN	W (g)
Hordelymus europaeus (L.) Jessen	Beech forest above Pilisszentlászló	05.08.1998	300	7.32
Phleum phleoides (L.) Karsten	Gerecse Mts, Nagy-Gete	15.08.1998	200	0.075
Poa nemoralis L.	Börzsöny Mts	11.08.1998	100	0.13
Puccinellia limosa (Schur) Holmberg	Hortobágy	1995	300	0.132
Stipa eriocaulis Borb.	Budapest, Széchenyi-hegy	13.06.1999	100	25.30
Tragus racemosus (L.) Desf.	Porpác, railway station	28.08.1998	100	0.429
Triticum monococcum L.	Szombathely, Beithe garden	27.08.1998	150	27.13

1 = collected by S. Barabás; 2 = grain crop with silicle (utriculus); 3 = including spiny grain coat.

The two *Scilla* species can be mentioned as good example for seed mass difference of congeners preferring habitats with contrasting light climate (CSONTOS 1998). In accordance with earlier observations, here again the heliophilous member (*Scilla autumnalis*) has the smaller seed mass.

Some of the new records do not support the general rules and require special interpretation. The relatively large seed mass of the small-sized sedge, *Carex liparicarpos* contradict to the sunny habitats where this species is a member of several plant communities: *Asplenio rutae-murariae-Melicetum ciliatae*, *Cleistogeno-Festucetum rupicolae*, *Astragalo austriacae-Festucetum sulcatae*, *Stipo eriocauli-Festucetum pallentis*, *Seseli leucospermi-Festucetum pallentis* (PENKSZA *et al.* 1995, BORHIDI and SÁNTA 1999). This can probably be explained by extreme high level of abiotic stress – mainly drought – in these habitats, that may support larger seed mass governed by higher rate of seedling survival. Weedy species are known to have relatively small seeds that are produced in large numbers to serve the "colonisation strategy" of their seed dispersal behaviour (*cf.* HOWE 1986). In this paper we report considerable diaspore mass for *Cenchrus incertus* (see Table 1) an alien graminoid weed of the Hungarian flora. A possible interpretation of it is the epizoochorous dispersal of *Cenchrus* what may permit heavy diaspores, while ability for long distance dispersal is still retained.

Finally, we made a pilot test on the relationship of seed mass and nature conservation status of the 38 species treated in the paper.

The ranking system of BORHIDI (1993) was used for classifying species according to their naturalness values. In Borhidi's system the lowest ranked "aggressive alien species" (invadors) score –3, whereas the highest score, +10, was given to rare specialist species that are represented in the Hungarian flora with 1 to 5 populations only. (In our case the naturalness values varied between –2 and +10.) The seed mass records were log-transformed to ensure normal distribution of data.

When the logarithm of thousand seed weight data were plotted against naturalness values (Fig. 1), a slight positive correlation occurred between the two vari-

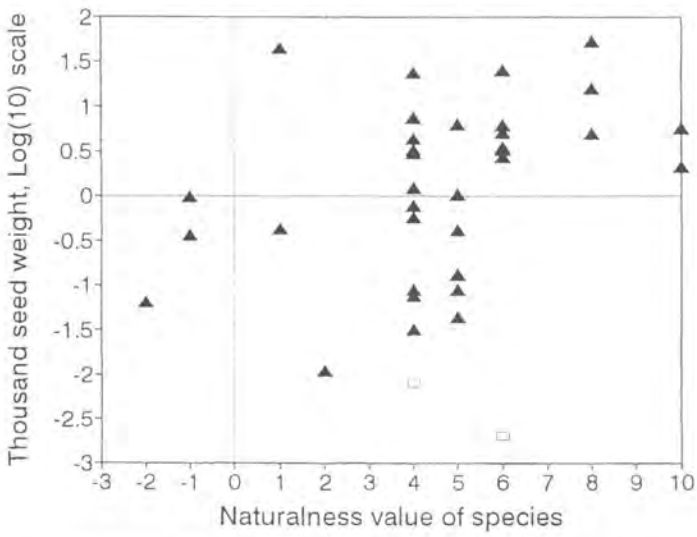


Fig. 1. Seed mass and naturalness value of 38 monocotyledonous species of the Hungarian flora. Empty squares indicate posititions of Orchidaceae species.

ables. (Orchids, though indicated, were not encountered because their seeds have different anatomy with lack of endosperm, thus they should not be discussed together with the "normal" seeded species.) The statistical evaluation by *t*-test confirmed a significantly higher seed mass of species with "high" naturalness values compared to that of "low" naturalness values ($n_{(low)} = 6$; $n_{(high)} = 11$; $p < 0.1$; critical *t*'-value = 2.006; calculated *t*-value = 2.358). We found the results of the pilot test interesting and thought provoking, that may reflect to both underlying ecological phenomena and human attitude in evaluating species. Larger seed size indicate more pronounced K-strategist behaviour of a species and it is often linked with higher sensitivity to habitat disturbances that may cause the rarity of those species thus involving a higher value given by botanists. For better interpretation of the relationship between seed mass, naturalness and rarity of a species further studies are required using larger set of species with a detailed analysis of their function in the Hungarian vegetation.

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