BOTANICAL GARDEN
Department of Biology
Faculty of Science
UNIVERSITY OF ZAGREB

DELECTUS SEMINUM 2021

HORTUS BOTANICUS
FACULTATIS SCIENTIARUM NATURALIUM ET MATHEMATICARUM
UNIVERSITATIS ZAGRABIENSIS

Klasea lycopifolia (Vill.) Á.Löve & D.Löve
[*Serratula lycopifolia (Vill.) A. Kern.*]
European endemic and NATURA-2000 species experimental population in the Garden

Please take a look at our article on seed dormancy and germination research of Natura 2000 plant species

B O T A N I C A L   G A R D E N
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Wild bee swarm in a Viburnum bush in the arboretum: wild bees as desirable pollinators are always given a sanctuary. Along with other bee species, hoverflies, butterflies and ants, bees are given plenty of hive space to create a rich pollinator community, by number and diversity quite unusual for a small garden in the centre of the town.

GARDEN AREA: 4.7 ha
NUMBER OF TAXA: approx. 6 000
CLIMATHOLOGICAL DATA (in course of 30 years):
- Abs max. annual temperature: 37.2 °C
- Abs min. annual temperature: -17.2 °C
- Mean annual precipitation: 889.9 mm
- Mean annual sunshine/hrs: 1832.5
- Mean annual days with snow (>/=1 cm): 32.5

The Botanical Garden of the Faculty of Science in Zagreb is member of the International Plant Exchange Network (IPEN).

SYMBOLS

HR-0-ZAVRT-…IPEN code
CW-5738…our identification number
✳ Seed and spores of native plant taxa, collected in natural habitat in Croatia
CW Seed and spores of known wild origin, cultivated in Botanical Garden
G Seed collected in greenhouses
IAS Invasive Alien Species
BG/BV Botanic garden plant origin

LITERATURE

CULLEN, J. et al. (ed.), 1986-2000: The European Garden Flora. Vol. I-VI. Cambridge University Press.

EGGLI, U. (ed.), 2001-2003: Illustrated Handbook of Succulent Plants. Vol. I-II. Springer – Verlag, Berlin, Heidelberg, New York.

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KRÜSSMANN, G., 1984 -1986: Manual of Cultivated Broad-leaved Trees and Shrubs. Vol. I-III. Timber Press, Portland.

TUTIN, T.G. et al. (ed.), 1968-1976: Flora Europaea. Vol. II-V. Cambridge University Press, Cambridge.

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Flora Croatica Database: http://hirc.botanic.hr/fcd/
Euro+Med PlantBase: https://www.emplantbase.org/home.html
World Flora Online: http://www.worldfloraonline.org/

Please note that the seed for exchange is a result of open pollination, therefore we cannot guarantee either its purity or germination. We invite our correspondents to kindly notify us with every mistake found, either in the name or in the dispatch of the species.

Please, **limit your order to 20 taxa** and send your *Desiderata* back by **March 1st this year.**

At its little more than 55.000 km^2, Croatia has little more than 5500 plant taxa!

	IPEN	SEED ORIGIN (BV - plant origin from seeds collected in botanic garden)
P T E R I D O P H Y T A		
a.1. *FILICOPSIDA*		
ASPLENIACEAE		
1. **Asplenium** ceterach L.	HR-0-ZAVRT-*-40	PELJEŠAC 2016 (NEUM)
DRYOPTERIDACEAE		
2. **Dryopteris** filix-mas (L.) Schott.	HR-0-ZAVRT-679	STRAHINJŠČICA
3. **Polystichum** aculeatum (L.) Roth	HR-0-ZAVRT-CW-212E	KAŠINA
4. **Tectaria** zeylanica (Houtt.) Sledge	XX-0-ZAVRT-G-12849	BV BELVEDERE
POLYPODIACEAE		
5. **Phlebodium** aureum (L.) J. Sm. 'Umbellatum'	XX-0-ZAVRT-G-6343	BV ESSEN
6. **Platycerium** bifurcatum (Cav.) C. Chr.	XX-0-ZAVRT-12768	
7. **Polypodium** vulgare L.	HR-0-ZAVRT-CW-645B	VINICA
PTERIDACEAE		
8. **Pteris** cretica L. 'Wimsettii'	XX-0-ZAVRT-G-4097	BV OPEKA
M A G N O L I O P H Y T A		
b.1. ***CONIFEROPHYTINA***		
CYCADACEAE		
9. **Zamia** furfuracea L.f. ex Aiton	XX-0-ZAVRT-7046A	BV BOCHUM
CUPRESSACEAE		
10. **Juniperus** oxycedrus L.	HR-0-ZAVRT-CW-393	LIŠANI
GINKGOACEAE		
11. **Ginkgo** biloba L.	XX-0-ZAVRT-2230	
PODOCARPACEAE		
12. **Podocarpus** neriifolius D.Don	XX-0-ZAVRT-6002	BV ANTIBES
TAXACEAE		
13. **Cephalotaxus** fortunei Hook.	XX-0-ZAVRT-2110	
14. **Taxus** baccata L.	XX-0-ZAVRT-8430	
b.2. ***MAGNOLIOPHYTINA***		
b.2.1. **M A G N O L I O P S I D A**		
ACANTHACEAE		
15. **Elytraria** carolinensis (J.F.Gmel.) Pers.	XX-0-ZAVRT-11340	BV GöTTINGEN
ACERACEAE		
16. **Acer** campestre L.	HR-0-ZAVRT-*-77	GORNJA STUBICA 2020
17. Acer pseudoplatanus L.	XX-0-ZAVRT-890	
18. Acer pseudoplatanus L. 'Purpurascens'	XX-0-ZAVRT-2016	
19. Acer tataricum L.	XX-0-ZAVRT-2035	BV GRAZ
AIZOACEAE		
20. **Glottiphyllum** cruciatum (Haw.) N.E.Br.	XX-0-ZAVRT-G-13030	BV PADUA
21. Glottiphyllum regium N.E.Br.	XX-0-ZAVRT-G-13031A	BV PECS
AMARANTHACEAE		
22. **Aerva** sanguinolenta (L.) Blume	XX-0-ZAVRT-G-4663	
23. **Amaranthus** cruenthus L. 'Rubin'	XX-0-ZAVRT-15078A	BV MINSK
24. Amaranthus cruenthus L. ' Velvet Curtains'	XX-0-ZAVRT-12987	BV WEINHEIM
25. **Celosia** argentea L. 'Flamingo Feather'	XX-0-ZAVRT-2756	BV TABOR
26. **Gomphrena** globosa L. 'Alba'	XX-0-ZAVRT-15083	
27. Gomphrena globosa L. 'Violacea'	XX-0-ZAVRT-15083A	
APIACEAE		
28. **Ammi** visnaga (L.) Lam. 'Blutenball'	XX-0-ZAVRT-12580	BV BESANCON

29.	**Chaerophyllum** hirsutum L.	SLO-0-ZAVRT-CW-8195	KOMNA
30.	**Eryngium** caeruleum M.B.	XX-0-ZAVRT-15192	BV VILNIUS
31.	Eryngium giganteum M.B.	XX-0-ZAVRT-3316	BV MADRID
32.	**Foeniculum** vulgare Mill.	XX-0-ZAVRT-8477	
33.	Foeniculum vulgare Mill.	XX-0-ZAVRT-8477A	
34.	Foeniculum vulgare Mill.	XX-0-ZAVRT-2852	
35.	Foeniculum vulgare Mill. 'Giant Bronze'	XX-0-ZAVRT-15149	BV FENAY
36.	**Levisticum** officinale W.D.J.Koch	XX-0-ZAVRT-8491A	
37.	**Oenanthe** pimpinelloides L.	HR-0-ZAVRT-CW-1082	LOŠINJ
38.	Oenanthe silaifolia M. Bieb.	XX-0-ZAVRT-8549	BV STUTTGART
39.	**Pimpinella** saxifraga L.	XX-0-ZAVRT-8537B	
40.	**Seseli** montanum L. subsp. tommasinii (Rchb.f.) Arcang.	HR-0-ZAVRT-CW-874C	DUGO POLJE, MLJET
	APOCYNACEAE		
41.	**Amsonia** orientalis Decne.	XX-0-ZAVRT-13249A	BV WISLEY
	ARALIACEAE		
42.	**Schefflera** arboricola (Hayata) Merr.	XX-0-ZAVRT-2815	
	ASCLEPIADACEAE		
43.	**Vincetoxicum** hirundinaria Medik.	XX-0-ZAVRT-1990	BV CLUJ-NAPOCA
44.	**Ceropegia** bulbosa Roxb.	XX-0-ZAVRT-2761	BV KAUNAS
	ASTERACEAE		
45.	**Achillea** collina (Becker ex Rchb.f.) Heimerl	XX-0-ZAVRT-1571	
46.	Achillea collina (Becker ex Rchb.f.) Heimerl	XX-0-ZAVRT-1571B	BV BRNO
47.	Achillea filipendulina Lam.	XX-0-ZAVRT-6331	BV DEVON
48.	Achillea filipendulina Lam. ‘Gold Plate’	XX-0-ZAVRT-6930	BV VILNIUS
49.	Achillea filipendulina Lam. ‘Parker’s Variety’	XX-0-ZAVRT-15012	BV GRAZ
50.	Achillea millefolium L.	XX-0-ZAVRT-348C	
51.	Achillea millefolium L. 'Red Beauty'	XX-0-ZAVRT-13159A	JIBOU
52.	Achillea nobilis L.	XX-0-ZAVRT-8572	BV BRNO
53.	Achillea ptarmica L.	XX-0-ZAVRT-2870	
54.	Achillea ptarmica L.	XX-0-ZAVRT-2870A	
55.	**Ageratina** altissima (L.) R.M. King & H. Rob.	XX-0-ZAVRT-12959	BV HALLE
56.	**Antennaria** rosea Greene subsp. pulvinata (Greene) R.J. Bayer	XX-0-ZAVRT-12502	BV WISLEY
57.	**Anthemis** tinctoria L.	XX-0-ZAVRT-1908	BV TÜBINGEN
58.	Anthemis tinctoria L. var. sancti-johannis (Stoj. & Turrill) Govaerts	XX-0-ZAVRT-12690	
59.	**Artemisia** absinthium L.	XX-0-ZAVRT-1088A	
60.	Artemisia annua l.	XX-0-ZAVRT-15087	BV RENNES
61.	Artemisia pancicii Ronniger ex Danihelka & Marhold	XX-0-ZAVRT-13056	BV WIEN
62.	**Aster** alpinus L. ‘Albus’	XX-0-ZAVRT-12168	BV ESSEN
63.	Aster alpinus L. ‘Dunkel Schöne’	XX-0-ZAVRT-6029	BV LUBLIN
64.	Aster alpinus L. ‘Happy End'	XX-0-ZAVRT-12713	BV KRAKOW
65.	Aster amellus L.	XX-0-ZAVRT-1910	
66.	Aster novi-belgii L. *hyb.*	XX-0-ZAVRT-4252C	BV CAEN
67.	**Calendula** officinalis L. *cult.*	XX-0-ZAVRT-12490C	
68.	Calendula officinalis L. 'Geisha Girl'	XX-0-ZAVRT-3103	BV CLUJ-NAPOCA
69.	Calendula officinalis L. 'Orange King'	XX-0-ZAVRT-2548	
70.	Calendula officinalis L. 'Princess Mischung'	XX-0-ZAVRT-13202	BV WEINHWEIM
71.	**Calotis** cuneifolia R. Br.	XX-0-ZAVRT-12671	
72.	**Carlina** corymbosa L.	HR-0-ZAVRT-CW-8521	MURTER
73.	**Centaurea** macrocephala Willd.	XX-0-ZAVRT-7538G	BV SZEGED
74.	Centaurea montana L.	HR-0-ZAVRT-CW-580B	IVANČICA
75.	Centaurea pulcherrima Willd.	XX-0-ZAVRT-4326E	BV LUBLIN
76.	**Coreopsis** lanceolata L. *fl. pl.*	XX-0-ZAVRT-3172	BV BRATISLAVA
77.	Coreopsis pubescens Elliott	XX-0-ZAVRT-4259	BV DEBRECIN
78.	**Cosmos** sulphureus Cav. ‘Life Lemon'	XX-0-ZAVRT-15129	BV COPENHAGEN
79.	**Cynara** cardunculus L.	XX-0-ZAVRT-12600	
80.	**Dittrichia** viscosa (L.) W. Greuter	HR-0-ZAVRT-1067	
81.	**Doronicum** austriacum Jacq.	HR-0-ZAVRT-CW-1286A	MALI RAJINAC
82.	**Echinacea** purpurea (L.) Moench 'Alba'	XX-0-ZAVRT-2850	BV ESSEN
83.	Echinacea purpurea (L.) Moench 'Alba'	XX-0-ZAVRT-2850A	BV POZNAN
84.	Echinacea purpurea (L.) Moench ‘Bright Star’	XX-0-ZAVRT-3656	BV PORRENTRUY
85.	Echinacea purpurea (L.) Moench ‘Hot Lava’	XX-0-ZAVRT-15119	BV KAUNAS
86.	Echinacea purpurea (L.) Moench ‘The King’	XX-0-ZAVRT-4645D	BV POZNAN
87.	**Echinops** bannaticus Rochel ex Schrad.	XX-0-ZAVRT-1466	DELIBLATSKA PJEŠČARA
88.	Echinops ritro L.	XX-0-ZAVRT-1788	
89.	Echinops ritro L.	XX-0-ZAVRT-1788D	BV VACRATOT

90.	**Erigeron** aurantiacus Regel	XX-0-ZAVRT-12676	BV LINZ
91.	Erigeron karvinskianus DC.	XX-0-ZAVRT-12232A	BV TRSTENO
92.	**Gaillardia** × grandiflora Hort. ex Van Houtte 'Burgunder'	XX-0-ZAVRT-11097C	BV PECH
93.	Gaillardia × grandiflora Hort. ex Van Houtte 'Burgunder'	XX-0-ZAVRT-11097B	BV KAUNAS
94.	**Gynura** aurantiaca (Blume) DC.	XX-0-ZAVRT-3145	BV STRASBOURG
95.	**Helenium** autumnale L. 'Red Glory'	XX-0-ZAVRT-2727	BV JIBOU
96.	Helenium autumnale L. 'Clipperfeld Orange'	XX-0-ZAVRT-2817	BV SZEGED
97.	**Helianthus** annuus L. *cult.*	XX-0-ZAVRT-8487	
98.	**Helianthus** annuus L. 'Choco Sun'	XX-0-ZAVRT-2760	BV TÜBINGEN
99.	**Helichrysum** italicum (Roth.) G. Don	XX-0-ZAVRT-516	
100.	Helichrysum italicum (Roth.) G. Don	XX-0-ZAVRT-516A	
101.	Helichrysum italicum (Roth.) G. Don	XX-0-ZAVRT-516B	MURTER
102.	**Inula** chritmoides L.	HR-0-ZAVRT-CW-491	PREVLAKA
103.	Inula helenium L.	XX-0-ZAVRT-8502	
104.	**Leontopodium** souliei Beauverd 'Mignon'	XX-0-ZAVRT-7979	BV ESSEN
105.	**Leucanthemum** adustum Gremli	XX-0-ZAVRT-8194	BV BONN
106.	Leucanthemum maximum (Ram.) DC. 'Beethoven'	XX-0-ZAVRT-2094	BV ESSEN
107.	Leucanthemum maximum (Ram.) DC. 'Mount Kosciuszko'	XX-0-ZAVRT-3326	BV LUBLIN
108.	Leucanthemum vulgare Lam. 'Maikönigin'	XX-0-ZAVRT-11576B	BV ESSEN
109.	**Liatris** pycnostachya Michx.	XX-0-ZAVRT-11030B	BV LINZ
110.	Liatris scariosa (L.) Willd. 'September Glory'	XX-0-ZAVRT-12667	BV LUBLIN
111.	**Ligularia** dentata (A. Gray) Hara 'Desdemona'	XX-0-ZAVRT-7156	BV BRATISLAVA
112.	Ligularia sibirica (L.) Cass.	XX-0-ZAVRT-11930	BV WUPPERTAL
113.	Ligularia stenocephala (Maxim.) Matsum. & Koidz. 'The Rocket'	XX-0-ZAVRT-12507	
114.	**Matricaria** chamomilla L.	XX-0-ZAVRT-13250A	BV SIENNA
115.	Matricaria chamomilla L.	XX-0-ZAVRT-1731	BV AARHUS
116.	**Othonna** capensis L.H.Bailey	XX-0-ZAVRT-3566B	BV BERLIN
117.	**Porophyllum** ruderale (Jacq.) Cass.	XX-0-ZAVRT-2128	BV GACILLY
118.	**Pulicaria** vulgaris Gaertn.	XX-0-ZAVRT-8017	
119.	**Rudbeckia** fulgida Ait. var. sullivantii (Boynton & Beadle) Cronq. 'Goldstrum'	XX-0-ZAVRT-7507	BV GENEVE
120.	Rudbeckia hirta L.	XX-0-ZAVRT-6019	BV MICHIGAN
121.	Rudbeckia hirta L. 'Indian Summer'	XX-0-ZAVRT-2962	BV TORONTO
122.	Rudbeckia nitida Nutt. 'Herbstsonne'	XX-0-ZAVRT-12641	BV TEPLICE
123.	**Senecio** kleinia (L). Less	XX-0-ZAVRT-3782B	BV DUISBURG
124.	Senecio rowleyanus H.Jacobsen	XX-0-ZAVRT-3424C	BV SALASPILS
125.	**Serratula** lycopifolia (Vill.) A.Kern.	HR-0-ZAVRT-CW-1723	BRUVNO, BULJI
126.	**Silybum** marianum Gaertn.	XX-0-ZAVRT-8440	BV TENERIFE
127.	**Sinacalia** tangutica (Maxim.) B.Nord.	XX-0-ZAVRT-2366	BV PRZEMYSL
128.	**Stokesia** laevis (Hill) Greene	XX-0-ZAVRT-7547B	BV KARLSRUHE
129.	**Tagetes** erecta L. 'Mandarin'	XX-0-ZAVRT-2816	BV BLAGOVESHCHENSK
130.	Tagetes patula L.	XX-0-ZAVRT-15090	
131.	**Tanacetum** cinerariifolium (Trevir.) Sch.Bip.	XX-0-ZAVRT-8213	PELJEŠAC
132.	Tanacetum coccineum (Willd.) Grierson	XX-0-ZAVRT-4001K	BV TÜBINGEN
133.	Tanacetum corymbosum (L.) Sch. Bip.	XX-0-ZAVRT-1265B	
134.	Tanacetum corymbosum (L.) Sch. Bip.	HR-0-ZAVRT-CW-1265B	
135.	Tanacetum parthenium (L.) Sch. Bip. 'Aureum'	XX-0-ZAVRT-11248	BV OXFORD
136.	**Telekia** speciosa (Schreb.) Baumg.	HR-0-ZAVRT-*-93	LOKVE 2017
137.	**Zinnia** elegans Jacq. 'Polar Bear'	XX-0-ZAVRT-3102	BV LUBLIN
138.	**Xanthium** strumarium L. subsp. italicum (Moretti) D. Löve	HR-0-ZAVRT-461	
139.	**Xerochrysum** bracteatum (Vent.) Tzvelev 'Chico Red'	XX-0-ZAVRT-12850	BV EDMONTON-ALBERTA

BEGONIACEAE

140.	**Begonia** dietrichiana Irmsch.	XX-0-ZAVRT-G-2792	BV STUTTGART
141.	**Begonia** *Semperflorens* 'Carmen'	XX-0-ZAVRT-15093A	BV BRATISLAVA
142.	Begonia *Semperflorens* 'Trophee Rouge'	XX-0-ZAVRT-15093J	BV CLUJ-NAPOCA
143.	Begonia wallichiana Lehm.	XX-0-ZAVRT-G-2790	BV STUTTGART

BERBERIDACEAE

144.	**Nandina** domestica Thunb. ex Murray	XX-0-ZAVRT-5616	BV KYOTO

BETULACEAE

145.	**Alnus** glutinosa (L.) Gartn.	XX-0-ZAVRT-1907	
146.	**Betula** pendula Roth 'Youngii'	XX-0-ZAVRT-2083	
147.	**Corylus** cornuta Marshall	XX-0-ZAVRT-6882	
148.	Corylus maxima Mill.	XX-0-ZAVRT-5213B	BV BESANCON

BIGNONIACEAE

149.	**Incarvillea** delavayi Bureau & Franch. 'Snow Trap'	XX-0-ZAVRT-13052A	

	BORAGINACEAE		
150.	**Anchusa officinalis L.**	XX-0-ZAVRT-875D	BV BAYREUTH
151.	**Cynoglossum** creticum Mill.	HR-0-ZAVRT-8262E	
152.	**Heliotropium** arborescens L. 'Marine'	XX-0-ZAVRT-4491	BV PORRENTRUY
153.	**Lithospermum** purpurocaeruleum L.	MK-0-ZAVRT-CW-617	ŽEDEN
154.	**Pontechium** maculatum (L.) Böhle & Hilger	XX-0-ZAVRT-12550	
	BRASSICACEAE		
155.	**Alyssum** argenteum Vitman	XX-0-ZAVRT-7574	BV REZIA
156.	Alyssum montanum L.	HR-0-ZAVRT-CW-1744	MLJET
157.	Alyssum murale Waldst. & Kit.	HR-0-ZAVRT-CW-8463	VRGORAC
158.	Alyssum repens Baumg.	HR-0-ZAVRT-8576	
159.	**Arabis** blepharophylla Hook. & Arn.	XX-0-ZAVRT-5264D	BV BIELEFELD
160.	Arabis ferdinandi-coburgii Kellerer & Sund. 'Variegata'	XX-0-ZAVRT-3948	
161.	Arabis ferdinandi-coburgii Kellerer & Sund. 'Variegata'	XX-0-ZAVRT-3948A	
162.	Arabis × suendermannii Kell. ex Suenderm.	XX-0-ZAVRT-12076	BV KIEL
163.	Arabis soyeri Reut. & Huet	XX-0-ZAVRT-4528	
164.	Arabis turrita L.	HR-0-ZAVRT-CW-560F	RISNJAK
165.	**Aurinia** saxatilis (L.) Desv. 'Citrina'	XX-0-ZAVRT-3938	BV BELVEDERE
166.	Aurinia sinuata (L.) Griseb.	HR-0-ZAVRT-CW-849F	
167.	**Barbarea** vulgaris R. Br.	XX-0-ZAVRT-8388	
168.	**Biscutella** laevigata L.	HR-0-ZAVRT-*-78	MODRIĆ DOLAC, ZAVIŽAN 2001
169.	**Brassica** juncea (L.) Czern.	XX-0-ZAVRT-3169	
170.	**Bunias** orientalis L.	XX-0-ZAVRT-8556	
171.	**Camelina** sativa (L.) Crantz	XX-0-ZAVRT-2079	BV LUBLIN
172.	**Degenia** velebitica (Degen) Hayek	HR-0-ZAVRT-CW-805D	VELEBIT
173.	**Draba** magellanica Lam.	XX-0-ZAVRT-13193	
174.	**Erysimum** cheiri (L.) Crantz 'Blood Red Convent Garden'	XX-0-ZAVRT-12564	BV STUTTGART
175.	Erysimum cheiri (L.) Crantz 'Golden Gem'	XX-0-ZAVRT-3197	BV GRINSTEAD
176.	Erysimum cheiri (L.) Crantz 'Tom Thumb'	XX-0-ZAVRT-11345	BV IZMIR
177.	**Fibigia** clypeata (L.) Medik.	XX-0-ZAVRT-355B	
178.	Fibigia triquetra (DC.) Boiss. ex Prantl	HR-0-ZAVRT-748	
179.	**Hesperis** matronalis L.	XX-0-ZAVRT-1481B	
180.	Hesperis matronalis L. subsp. candida (Kit.) Hegi&Em.Schmid	XX-0-ZAVRT-13112	BV GOTTINGEN
181.	**Isatis** tinctoria L.	XX-0-ZAVRT-743	BV SION
182.	**Lobularia** 'Carpet of Snow'	XX-0-ZAVRT-12056B	
183.	**Thlaspi** macrophyllum Hoffm.	XX-0-ZAVRT-7580	BV DAHLEM
	CACTACEAE		
184.	**Cereus** peruvianus (L.) Mill.	XX-0-ZAVRT-G-2723	
185.	**Eriocereus** martinii (Labour.) Riccob.	XX-0-ZAVRT-G-2701A	BV LEIPNIZ
186.	**Mammillaria** prolifera (Mill.) Haw.	XX-0-ZAVRT-G-3421C	
187.	Mammillaria prolifera (Mill.) Haw. subsp. haitiensis (K. Schum.) D. R. Hunt	XX-0-ZAVRT-G-11579	BV CLUJ-NAPOCA
188.	Mammillaria prolifera (Mill.) Haw. subsp. texana (Engelm.) D. R. Hunt	XX-0-ZAVRT-G-6885	BV DAHLEM
189.	Mammillaria pygmaea (Britt. & Rose) Berger	XX-0-ZAVRT-G-11339	BV DAHLEM
190.	**Pereskia** aculeata Mill.	XX-0-ZAVRT-G-2040	
191.	**Opuntia** humifusa (Raf.) Raf.	XX-0-ZAVRT-6201A	
	CALYCANTHACEAE		
192.	**Chimonanthus** praecox (L.) Link	XX-0-ZAVRT-2131A	
193.	Chimonanthus praecox (L.) Link	HR-0-ZAVRT-CW-2131B	ZADAR
	CAMPANULACEAE		
194.	**Adenophora** liliifolia (L.) A.DC.	XX-0-ZAVRT-397	
195.	**Campanula** carpatica Jacq. 'Isabel'	XX-0-ZAVRT-6091	BV MEYRIN
196.	Campanula lanata Friv.	XX-0-ZAVRT-3378	BV MEYRIN
197.	Campanula persicifolia L.	HR-0-ZAVRT-CW-97F*	MACELJ
198.	Campanula poscharskyana Degen	XX-0-ZAVRT-572	
199.	Campanula poscharskyana Degen	XX-0-ZAVRT-572A	
200.	Campanula pyramidalis L.	XX-0-ZAVRT-CW-485	
201.	Campanula rapunculoides L.	HR-0-ZAVRT-574	
202.	Campanula trachelium L.	XX-0-ZAVRT-1774I S	BV BERLIN-HUMBOLDT
203.	**Lobelia** cardinalis L.	XX-0-ZAVRT-6678	BV BASEL
204.	Lobelia × gerardii Sauv.	XX-0-ZAVRT-6909A	BV KIEL
205.	**Phyteuma** spicatum L.	HR-0-ZAVRT-CW-633A	STRAHINJŠČICA
206.	**Platycodon** grandiflorus (Jacq.) A. DC. 'Semiplenum'	XX-0-ZAVRT-11819A	BV STUTTGART
	CANNABACEAE		
207.	**Humulus** lupulus L.	HR-0-ZAVRT-*-124	ZAGREB, SAVICA 2017

CAPRIFOLIACEAE		
208. **Kolkwitzia** amabilis Graebn.	XX-0-ZAVRT-5807	
209. **Sambucus** nigra L. 'Eva'	XX-0-ZAVRT-12993	
210. **Viburnum** lantana L.	XX-0-ZAVRT-1783	
211. Viburnum sargentii Koehne	XX-0-ZAVRT-2522A	
212. Viburnum trilobum Marshall	XX-0-ZAVRT-5804	
CARYOPHYLLACEAE		
213. **Agrostemma** githago L.	XX-0-ZAVRT-1811	
214. **Cerastium** glomeratum Thuill.	XX-0-ZAVRT-1473B	
215. **Cucubalus** baccifer L.	HR-0-ZAVRT-*-106	GORNJA STUBICA 2020
216. **Dianthus** × allwoodii 'Alpinus'	XX-0-ZAVRT-4513	BV MANCHESTER
217. Dianthus barbatus L.	XX-0-ZAVRT-2693	BV KIJEV
218. Dianthus caryophyllus L.	XX-0-ZAVRT-1749C	
219. Dianthus deltoides L.	HR-0-ZAVRT-198I	BV BAYREUTH
220. Dianthus deltoides L. 'Brillant'	XX-0-ZAVRT-4334E	BV LUBLIN
221. Dianthus deltoides L. *fl. albo*	XX-0-ZAVRT-7204	BV MEYRIN
222. Dianthus furcatus Balb.	XX-0-ZAVRT-13061	BV TRENTO
223. Dianthus giganteus D'Urv. subsp. croaticus (Borb.) Tutin	HR-0-ZAVRT-CW-184C	ŽUMBERAK
224. Dianthus orientalis Adams.	XX-0-ZAVRT-4466	
225. Dianthus petraeus Waldst. & Kit. subsp. minutiflorus (Halácsy) Greuter & Burdet	XX-0-ZAVRT-12536	BV BERLIN
226. Dianthus plumarius L. subsp. praecox (Kit.) Hayek	XX-0-ZAVRT-8482C	BV MEYRIN
227. Dianthus sternbergii Siebold ex Capelli	XX-0-ZAVRT-309K	BV LJUBLJANA
228. **Gypsophila** bermejoi G. Lopez	XX-0-ZAVRT-15007	BV MADRID
229. Gypsophila paniculata L.	XX-0-ZAVRT-5203	BV LINZ
230. **Lychnis** chalcedonica L.	XX-0-ZAVRT-4400C	BV IASI
231. **Lychnis** coronaria (L.) Desr. 'Atropurpurea'	XX-0-ZAVRT-4211	BV ESSEN
232. Lychnis viscaria L.	XX-0-ZAVRT-878D	
233. Lychnis viscaria L.	HR-0-ZAVRT-CW-878E	MACELJ
234. **Petrorhagia** saxifraga (L.) Link	HR-0-ZAVRT-101M	POLAČNO POLJE
235. **Saponaria** officinalis L.	XX-0-ZAVRT-1274A	
236. **Silene** latifolia Poir. subsp. alba (Mill.) Greuter & Burdet	HR-0-ZAVRT-CW-1406B	VELEBIT (PRPIĆ DULIBA)
237. Silene latifolia Poir. subsp. alba (Mill.) Greuter & Burdet	XX-0-ZAVRT-1406A	
238. Silene nutans L.	XX-0-ZAVRT-1000B	
239. Silene paradoxa L.	HR-0-ZAVRT-CW-355	VRULJA
240. Silene samojedorum (Sambuk) Oxelman	XX-0-ZAVRT-13167	
241. Silene sendtneri Boiss.	XX-0-ZAVRT-194E	
242. Silene vulgaris (Moench) Garcke subsp. angustifolia Hayek	HR-0-ZAVRT-CW-8530	PELJEŠAC
243. Silene vulgaris (Moench.) Garcke subsp. maritima Á. Löve & D. Löve	XX-0-ZAVRT-4501	
CELASTRACEAE		
244. **Euonymus** alatus (Thunb.) Siebold	XX-0-ZAVRT-2195	
CICHORIACEAE		
245. **Cicerbita** alpina (L.) Wallr.	XX-0-ZAVRT-8193E	BV DÜSSELDORF
246. **Hieracium** aurantiacum L.	XX-0-ZAVRT-608A	BV HALLE
247. Hieracium villosum Jacq.	HR-0-ZAVRT-CW-1326A	VELEBIT, ZAVIŽAN
248. **Leontodon** alpinus Hoppe	XX-0-ZAVRT-150A	
249. **Tragopogon** porrifolius L.	HR-0-ZAVRT-CW-1536	PELJEŠAC
CISTACEAE		
250. **Fumana** ericifolia Wallr.	HR-0-ZAVRT-CW-860	
251. **Helianthemum** apenninum (L.) Mill.	XX-0-ZAVRT-6887B	BV KIEL
252. Helianthemum 'Bronzeteppich'	XX-0-ZAVRT-2857	
253. Helianthemum nummularium (L.) Mill.	XX-0-ZAVRT-861C	
CLEOMACEAE		
254. **Cleome** gynandra L.	XX-0-ZAVRT-2082	BV STUTTGART
255. Cleome 'Helen Campbel'	XX-0-ZAVRT-15095	BV SZEGED
256. Cleome 'Rosa Queen'	XX-0-ZAVRT-15095B	BV LUBLIN
257. Cleome spinosa Jacq. *hyb.* mix.	XX-0-ZAVRT-15095D	
258. **Polanisia** dodecandra (L.) DC. subsp. trachysperma (Torr. & A. Gray) Iltis	XX-0-ZAVRT-13049	BV HALLE
CLUSIACEAE		
259. **Hypericum** androsaemum L.	XX-0-ZAVRT-1875C	
260. Hypericum calycinum L.	XX-0-ZAVRT-7761A	BV ULUDAG
261. Hypericum hircinum L.	XX-0-ZAVRT-5761	
262. Hypericum × moserianum André	XX-0-ZAVRT-4929A	BV SLEPČANY

263.	Hypericum olympicum L.	XX-0-ZAVRT-4387E	BV IZMIR
264.	Hypericum patulum Thunb.	XX-0-ZAVRT-6106A	
	CONVOLVULACEAE		
265.	**Ipomoea** alba L.	XX-0-ZAVRT-15122	
266.	Ipomoea coccinea L.	XX-0-ZAVRT-15097	BV RENNES
267.	Ipomoea purpurea (L.) Roth 'Split Personality'	XX-0-ZAVRT-15100B	BV TEPLICE
268.	Ipomoea purpurea (L.) Roth 'Sunrise Serenade'	XX-0-ZAVRT-15190	
269.	Ipomoea tricolor Cav. 'Crimson Rambler'	XX-0-ZAVRT-15163	BV BAYREUTH
	CORNACEAE		
270.	**Aucuba** japonica Thunb. ex Murray	XX-0-ZAVRT-4754	
271.	Aucuba japonica Thunb. ex Murray 'Variegata'	XX-0-ZAVRT-6322	
272.	**Cornus** kousa F. Buerger ex Miq.	XX-0-ZAVRT-4149A	
273.	Cornus mas L.	XX-0-ZAVRT-8363	
274.	Cornus sanguinea L.	HR-0-ZAVRT-*-94	GORNJA STUBICA 2016
	CORYLACEAE		
275.	**Corylus** colurna L.	XX-0-ZAVRT-1876E	
276.	**Ostrya** carpinifolia Scop.	XX-0-ZAVRT-8062	
	CRASSULACEAE		
277.	**Aichryson** punctatum (C.A. Sm.) Webb & Barth.	XX-0-ZAVRT-G-6213*	BV TENERIFE
278.	**Hylotelephium** spectabile (Boreau) H. Ohba 'Iceberg'	XX-0-ZAVRT-4970A	
279.	Hylotelephium telephium (L.) H. Ohba 'Herbstfreude'	XX-0-ZAVRT-4384A	
280.	Hylotelephium telephium (L.) H. Ohba subsp. maximum (L.) H. Ohba	XX-0-ZAVRT-650G	
281.	**Sedum** floriferum Praeg. 'Weihenstephaner Gold'	XX-0-ZAVRT-2564	
282.	Sedum hispanicum L.	XX-0-ZAVRT-166O	GORNJI BRGAT
283.	Sedum hispanicum L.	HR-0-ZAVRT-CW-166O	GORNJI BRGAT
284.	Sedum spectabile Boreau 'Lisa'	HR-0-ZAVRT-*-7207	BUZET
285.	**Sempervivum** tectorum L.	XX-0-ZAVRT-8437J	
	CUCURBITACEAE		
286.	**Cucumis** sativus var. sikkimensis Hook. f.	XX-0-ZAVRT-2848	BV TÜBINGEN
287.	**Cucurbita** maxima Duchesne	XX-0-ZAVRT-1898	BV MARSEILLE
288.	Cucurbita moschata Duchesne,	XX-0-ZAVRT-2837	BV IASI
289.	**Ecballium** elaterium (L.) A. Rich.	XX-0-ZAVRT-827B	BV AACHEN
290.	Ecballium elaterium (L.) A. Rich.	HR-0-ZAVRT-*-254	KLEK, DUBOKA 2016
291.	**Lagenaria** siceraria (Molina) Standl. 'Pilgerflasche'	XX-0-ZAVRT-2839	BV TÜBINGEN
292.	Lagenaria siceraria (Molina) Standl. 'Weinheber'	XX-0-ZAVRT-2840	BV TÜBINGEN
293.	**Luffa** cylindrica (L.) M.Roem.	XX-0-ZAVRT-1899	BV BESANCON
	DIPSACACEAE		
294.	**Cephalaria** leucantha (L.) Roem. & Schult.	HR-0-ZAVRT-CW-8269D	BIOKOVO
295.	Cephalaria leucantha (L.) Roem. & Schult.	HR-0-ZAVRT-8269E	
296.	Cephalaria transylvanica (L.) Schrad. ex Roem. & Schult.	XX-0-ZAVRT-11170A	BV BERLIN-DAHLEM
297.	**Dipsacus** sativus (L.) Honck.	XX-0-ZAVRT-13203	BV RENNES
	EPHEDRACEAE		
298.	**Ephedra** fragilis Desf. subsp. campylopoda (C.A. Mayer) Ascherson & Graebner	HR-0-ZAVRT-CW-755E	VRULJA
	ERICACEAE		
299.	**Arbutus** unedo L.	XX-0-ZAVRT-693A	
	EUPHORBIACEAE		
300.	**Glochidion** wilsonii Hutch.	XX-0-ZAVRT-2229	
301.	**Ricinus** communis L. 'Carmencita Bright Red'	XX-0-ZAVRT-13200	BV JIBOU
302.	Ricinus communis L. 'Carmencita Rot'	XX-0-ZAVRT-2551	0
303.	Ricinus communis L. 'New Zealand Purple''	XX-0-ZAVRT-15152	BV FENAY
	FABACEAE		
304.	**Anthyllis** vulneraria L.	XX-0-ZAVRT-229C	KLEK
305.	Anthyllis vulneraria L. subsp. alpestris (Hegetschw.) Asch. & Graebn.	XX-0-ZAVRT-1519C	
306.	Anthyllis vulneraria L. subsp. carpatica (Pant.) Nyman	XX-0-ZAVRT-1225	
307.	Anthyllis vulneraria L. subsp. maritima (Schweigg.) Corb.	XX-0-ZAVRT-12582	
308.	**Baptisia** australis (L.) R.Br.	XX-0-ZAVRT-4257C	BV HALLE
309.	Baptisia 'Solar Flair'	XX-0-ZAVRT-12958	BV STUTTGART
310.	**Cercis** canadensis L.	XX-0-ZAVRT-2112	
311.	Cercis siliquastrum L.	HR-0-ZAVRT-1923D	VELI LOŠINJ

312. Cercis siliquastrum L.	XX-0-ZAVRT-1923A	
313. Cercis siliquastrum L. 'Alba'	XX-0-ZAVRT-6365A	BV BRNO
314. **Coronilla** emerus L. subsp. emeroides Boiss. & Spruner	BiH-0-ZAVRT-230	LIŠANI
315. Coronilla emerus L. subsp. emeroides Boiss. & Spruner	HR-0-ZAVRT-*-186	PELJEŠAC 2016
316. **Dorycnium** hirsutum (L.) Ser.	XX-0-ZAVRT-8287E	BV PARIZ
317. **Genista** hispanica L. subsp. occidentalis Rouy	XX-0-ZAVRT-11013	BV MEYRIN
318. **Gleditschia** triacanthus Mill.	XX-0-ZAVRT-2237	
319. **Glycyrrhiza** glabra L.	XX-0-ZAVRT-13060	TABOR
320. **Gymnocladus** dioicus (L.) K. Koch	XX-0-ZAVRT-2233	
321. **Lablab** purpureus (L.) Sweet	XX-0-ZAVRT-15103	BV BONN
322. Lablab purpureus (L.) Sweet 'Ruby Moon'	XX-0-ZAVRT-15161	
323. **Lathyrus** vernus (L.) Bernh.	HR-0-ZAVRT-CW-621C	STRAHINJŠČICA
324. **Lupinus** albus L.	XX-0-ZAVRT-8557	
325. Lupinus angustifolius L.	XX-0-ZAVRT-1642	
326. Lupinus polyphyllus Lindl. 'Schlossfrau'	XX-0-ZAVRT-11096	BV PORRENTRUY
327. Lupinus 'Russel Hybrids'	XX-0-ZAVRT-4399A	BV BUDAPEST
328. **Mimos**a pudica L.	XX-0-ZAVRT-7610A	BV MENTA
329. **Orbexilum** onobrychis (Nutt.) Rydb.	XX-0-ZAVRT-11069	BV STUTTGART
330. **Parkinsonia** aculeata L.	XX-0-ZAVRT-11433B	BV MADRID
331. **Petteria** ramentacea (Sieber) C. Presl	XX-0-ZAVRT-634	
332. Petteria ramentacea (Sieber) C. Presl	BiH-0-ZAVRT-634B	ČVRSNICA
333. **Rhynchosia** densiflora (Roth) DC**.**	XX-0-ZAVRT-G-12152	BV HAREN
334. **Spartium** junceum L.	XX-0-ZAVRT-2469A	
335. **Thermopsis** lanceolata R. Br.	XX-0-ZAVRT-3536	BV GENT
336. **Trifolium** rubens L.	XX-0-ZAVRT-1840A	BV TÜBINGEN
337. Trifolium rubens L.	XX-0-ZAVRT-1840B	BV GöTTINGEN
338. **Ulex** europaeus L.	XX-0-ZAVRT-5153A	BV COIMBRA
339. **Vicia** sativa L.	XX-0-ZAVRT-1988	BV FRANKFURT
FAGACEAE		
340. **Fagus** sylvatica L.	HR-0-ZAVRT-749A	
341. **Quercus** cerris L.	XX-0-ZAVRT-984A	
342. Quercus petraea (Matt.) Liebl.	XX-0-ZAVRT-1289	
GERANIACEAE		
343. **Geranium** dalmaticum (Beck) Rech.f.	HR-0-ZAVRT-1683B	PELJEŠAC
344. Geranium pratense L. f. albiflorum	XX-0-ZAVRT-11392	
345. Geranium sanguineum L.	XX-0-ZAVRT-222D	
346. Geranium sanguineum L. 'Striatum'	XX-0-ZAVRT-4151	BV ESSEN
GESNERIACEAE		
347. **Gloxinella** lindeniana (Regel) Roalson & Boggan	XX-0-ZAVRT-G-13257	BV MAGDEBURG
348. **Streptocarpus** cyaneus S.Moore	XX-0-ZAVRT-G-2819	BV POTSDAM
GLOBULARIACEAE		
349. **Globularia** cordifolia L. subsp. bellidifolia (Ten.) Wettst.	HR-0-ZAVRT-CW-54	GROBNIČKE ALPE
350. Globularia cordifolia L. subsp. bellidifolia (Ten.) Wettst.	HR-0-ZAVRT-54L	BV GöTTINGEN
351. Globularia cordifolia L. subsp. bellidifolia (Ten.) Wettst.	HR-0-ZAVRT-*-181	VELEBIT 2002
352. Globularia punctata Lapeyr.	XX-0-ZAVRT-529E	ČUČERJE
353. Globularia punctata Lapeyr.	XX-0-ZAVRT-529H	BV CHEMNITZ
GROSSULARIACEAE		
354. **Ribes** aureum Pursh	XX-0-ZAVRT-2427	
HIPPOCASTANACEAE		
355. **Aesculus** hippocastanum L.	XX-0-ZAVRT-3285	
356. Aesculus parviflora Walter (*by request in Fall)*	XX-0-ZAVRT-4441	
JUGLANDACEAE		
357. **Carya** cordiformis (Wangenh.) K. Koch	XX-0-ZAVRT-2108A	
358. Carya illinoinensis (Wangenh.) K.Koch	XX-0-ZAVRT-2100	
359. **Pterocarya** fraxinifolia (Lam.) Spach	XX-0-ZAVRT-5570	
360. Pterocarya × rehderiana C.K. Schneid.	XX-0-ZAVRT-5568	
361. Pterocarya stenoptera C. DC.	XX-0-ZAVRT-2398A	
LAMIACEAE		
362. **Agastache** foeniculum (Pursh) Kuntze 'Golden Jubilee'	XX-0-ZAVRT-15191	
363. Agastache rugosa (Fisch. & C.A.Mey.) Kuntze 'Coral'	XX-0-ZAVRT-12571A	BV MINSK

364.	**Ballota** nigra L.	XX-0-ZAVRT-365A	
365.	**Betonica** officinalis L.	XX-0-ZAVRT-701	
366.	Betonica officinalis L. subsp. serotina (Host) Murb.	HR-0-ZAVRT-653	
367.	**Dracocephalum** forrestii W.W.Sm.	XX-0-ZAVRT-4553A	BV LUBLIN
368.	Dracocephalum grandiflorum L. 'Altai Blue'	XX-0-ZAVRT-2603	BV MILANO
369.	Dracocephalum ruyschiana L.	XX-0-ZAVRT-8487	BV LUBLIN
370.	Dracocephalum ruyschiana L.	XX-0-ZAVRT-8487A	
371.	**Horminum** pyrenaicum L.	XX-0-ZAVRT-8518B	BV COL DU POURTALET
372.	**Lamium** album L.	XX-0-ZAVRT-616	
373.	**Lavandula** angustifolia Mill.	XX-0-ZAVRT-1763C	BV BOREDEAUX
374.	Lavandula angustifolia Mill. subsp. pyrenaica (DC.) Guinea	XX-0-ZAVRT-6915B	
375.	Lavandula angustifolia Mill. 'Delphinensis'	XX-0-ZAVRT-7138	BV SZEGED
376.	Lavandula angustifolia Mill. ‘Hidcote Blue’	XX-0-ZAVRT-3747	BV ESSEN
377.	Lavandula angustifolia Mill. ‘Munstead’	XX-0-ZAVRT-4762	BV ESSEN
378.	**Leonurus** sibiricus L.	XX-0-ZAVRT-12912	
379.	**Melissa** officinalis L.	HR-0-ZAVRT-336C	
380.	**Mentha** × piperita L.	XX-0-ZAVRT-1733A	BV RENNES
381.	Mentha × piperita L.	HR-0-ZAVRT-CW-1733B	CRNA MLAKA
382.	**Micromeria** juliana (L.) Benth. ex Rchb.	HR-0-ZAVRT-CW-481	ZABRĐE
383.	**Monarda** didyma L. ’Violacea’	XX-0-ZAVRT-3529	BV DUISBURG
384.	Monarda fistulosa L.	XX-0-ZAVRT-7861	BV PALLANZA
385.	Monarda fistulosa L.	XX-0-ZAVRT-7861A	BV MICHIGAN
386.	**Ocimum** basilicum L. *cult.*	XX-0-ZAVRT-8011	BV TÜBINGEN
387.	Ocimum basilicum L. 'Cinnamon'	XX-0-ZAVRT-1901	BV JIBOU
388.	Ocimum basilicum L. 'Citron'	XX-0-ZAVRT-1902	BV JIBOU
389.	Ocimum basilicum L. 'Dark Opal'	XX-0-ZAVRT-15077A	BV LUBLIN
390.	Ocimum basilicum L. 'Minimum'	XX-0-ZAVRT-2967	BV LUBLIN
391.	Ocimum basilicum L. 'Olive'	XX-0-ZAVRT-2782	BV LUBLIN
392.	Ocimum basilicum L. 'Piperitum'	XX-0-ZAVRT-15077B	BV SIENNA
393.	**Origanum** laevigatum Boiss. 'Harrenhausen'	XX-0-ZAVRT-12533	BV ESSEN
394.	Origanum majorana L.	XX-0-ZAVRT-2822	BV SIENA
395.	Origanum vulgare L.	XX-0-ZAVRT-211B	
396.	Origanum vulgare L.	HR-0-ZAVRT-CW-211F	RAVNA GORA
397.	**Phlomis** fruticosa L.	XX-0-ZAVRT-496	
398.	Phlomis fruticosa L.	XX-0-ZAVRT-496D	
399.	Phlomis herba-venti L. subsp. pungens (Willd.) Maire ex DeFilipps	MK-0-ZAVRT-8573	BV HALLE
400.	Physostegia virginiana (L.) Benth. ‘Summer Snow’	XX-0-ZAVRT-5432A	BV ESSEN
401.	**Prasium** majus L.	HR-0-ZAVRT-*-29	PALAGRUŽA 2019
402.	**Prunella** grandiflora (L.) Scholler 'Alba'	XX-0-ZAVRT-13251B	
403.	Prunella grandiflora (L.) Scholler 'Carminea'	XX-0-ZAVRT-13251A	
404.	**Pycnanthemum** virginianum (L.) T.Durand & B.D.Jacks. ex B.L.Rob. & Fernald	XX-0-ZAVRT-12855	BV SEATTLE
405.	**Salvia** argentea L.	XX-0-ZAVRT-12517	
406.	Salvia × superba (Silva Tar. & C.K.Schneid.) Stapf 'Blue Queen'	XX-0-ZAVRT-13117	
407.	Salvia coccinea Buc'hoz ex Etl. 'Cherry Blossom'	XX-0-ZAVRT-6504	
408.	Salvia fruticosa Mill. *fl.albo*	XX-0-ZAVRT-12545	BV TRST
409.	Salvia indica L.	XX-0-ZAVRT-12915A	BV JARUSALEM
410.	Salvia jurisicii Kosanin	XX-0-ZAVRT-12542	BV WARSZAWA
411.	Salvia napifolia Jacq.	XX-0-ZAVRT-12549	BV TRST
412.	Salvia nemorosa L. 'Rose Queen'	XX-0-ZAVRT-15199	BV TEPLICE
413.	Salvia nemorosa L. 'Sensation Deep Blue'	XX-0-ZAVRT-13078	
414.	Salvia officinalis L.	HR-0-ZAVRT-CW-156D	KRK
415.	Salvia officinalis L.	HR-0-ZAVRT-CW-156F	BIOKOVO 2011
416.	Salvia pratensis L. subsp. vulgaris (Rchb.) Briq. var. vulgaris Rchb. f. rubicunda (Wend.) Voss-Vilmorin	HR-0-ZAVRT-CW-1620	PODGORA
417.	Salvia ringens Sibth. & Sm.	XX-0-ZAVRT-6184A	BV IASI
418.	Salvia roemeriana Scheele	XX-0-ZAVRT-3527A	BV WISLEY
419.	Salvia tiliifolia Vahl	XX-0-ZAVRT-1743	BV TRIESTE
420.	Salvia verticillata L. ‘Purple Rain’	XX-0-ZAVRT-3515	BV TRIESTE
421.	**Satureja** montana L.	HR-0-ZAVRT-18	
422.	Satureja montana L.	HR-0-ZAVRT-18x	
423.	Scutellaria altissima L.	XX-0-ZAVRT-237B	BV GöTTINGEN
424.	**Stachys** byzantina Juss. ex Steud. 'Silver Carpet'	XX-0-ZAVRT-15047	
425.	Stachys officinalis (L.) Trevis.	XX-0-ZAVRT-701	
426.	Stachys officinalis (L.) Trevis. subsp. serotina (Host) Hayek	HR-0-ZAVRT-CW-653	UČKA
427.	**Teucrium** chamaedrys L.	HR-0-ZAVRT-CW-102A	MAKARSKA
428.	Teucrium chamaedrys L.	HR-0-ZAVRT-102T	
429.	Teucrium flavum L.	HR-0-ZAVRT-CW-8270	PELJEŠAC
430.	Teucrium hircanicum L.	XX-0-ZAVRT-15202	BV VILNIUS
431.	**Thymus** serpyllum L.	XX-0-ZAVRT-8035	

	LARDIZABALACEAE		
432.	**Akebia** trifoliata (Thunb.) Koidz.	XX-0-ZAVRT-5624	
	LINACEAE		
433.	**Linum** alpinum Jacq. subsp. julicum (Hayek) Hegi	XX-0-ZAVRT-153	
434.	Linum grandiflorum Desf.	XX-0-ZAVRT-2106	BV BRNO
435.	Linum grandiflorum Desf. 'Rubrum'	XX-0-ZAVRT-15108	BV LUBLIN
436.	Linum perenne L.	XX-0-ZAVRT-1377	BV COIMBRA
437.	Linum perenne L.	HR-0-ZAVRT-CW-1377B	BV LEIPZIG
438.	Linum usitatissimum L.	XX-0-ZAVRT-8004C	BV STRASBOURG
	LYTHRACEAE		
439.	**Lythrum** salicaria L.	XX-0-ZAVRT-1941	
	MALVACEAE		
440.	**Abelmoschus** esculentus (L.) Moench	XX-0-ZAVRT-2777	BV MANE
441.	Abelmoschus manihot (L.) Medik.	HR-0-ZAVRT-*-129	GORNJA STUBICA 2020
442.	**Abutilon** arboreum (L. f.) Sweet	XX-0-ZAVRT-G-5941A	BV BARCELONA
443.	**Alcea** rosea L.	XX-0-ZAVRT-15204	
444.	**Althaea** officinalis L.	XX-0-ZAVRT-2762	
445.	**Callirhoe** involucrata (Torr. & A. Gray) A. Gray	XX-0-ZAVRT-7504B	BV STUTTGART
446.	**Gossypium** herbaceaum L.	XX-0-ZAVRT-4927B	BV MARBURG
447.	**Hibiscus** cannabinus L.	XX-0-ZAVRT-13210	BV ROSTOCK
448.	Hibiscus coccineus Walter	XX-0-ZAVRT-1959	
449.	Hibiscus esculentus L. 'Star of David'	XX-0-ZAVRT-125963	BV CLUJ-NAPOCA
450.	Hibiscus trionum L.	XX-0-ZAVRT-1752 S	BV BRISTOL
451.	**Lavatera** trimestris L.	XX-0-ZAVRT-4435A	BV GRAZ
452.	Lavatera trimestris L.	XX-0-ZAVRT-4435	BV MÜNCHEN
453.	**Sparmannia** africana L. f.	XX-0-ZAVRT-6286A	BV COIMBRA
	MORACEAE		
454.	**Dorstenia** contrajerva L.	XX-0-ZAVRT-6227	
455.	**Maclura** pomifera (Rafin.) C. K. Schneid.	XX-0-ZAVRT-2333	
	MYRTACEAE		
456.	**Psidium** araca Raddi	XX-0-ZAVRT-11619	
457.	**Syzygium** jambos (L.) Alston	XX-0-ZAVRT-G-4924	
	NELUMBONACEAE		
458.	**Nelumbo** nucifera Gaertn.	XX-0-ZAVRT-7468F	BV ATENA
	NYCTAGINACEAE		
459.	**Mirabilis** jalapa L.	XX-0-ZAVRT-8008	
	NYSSACEAE		
460.	**Davidia** involucrata Baill. var. vilmoriniana (Dode) Wangerin	XX-0-ZAVRT-5725	BV VOLČJI POTOK
	OLEACEAE		
461.	**Fraxinus** excelsior L. 'Diversifolia'	XX-0-ZAVRT-7907	
462.	Fraxinus excelsior L. 'Pendula'	XX-0-ZAVRT-5739	
463.	Fraxinus ornus L.	HR-0-ZAVRT-CW-8061B	OGULIN
464.	**Jasminum** floridum Bunge	XX-0-ZAVRT-13050A	BV HAMBURG
465.	**Ligustrum** japonicum Thunb. 'Rotundifolium'	XX-0-ZAVRT-4947	
466.	Ligustrum vulgare L.	HR-0-ZAVRT-*-29	GORNJA STUBICA 2020
	ONAGRACEAE		
467.	**Epilobium** hirsutum L.	XX-0-ZAVRT-399A	
468.	**Gaura** lindheimeri Engelm. & A. Gray 'Whirling Butterflies'	XX-0-ZAVRT-12514	
469.	**Oenothera** biennis L.	XX-0-ZAVRT-205A	
470.	Oenothera fruticosa L.	XX-0-ZAVRT-7869	BERLIN, 03
471.	Oenothera fruticosa L.	XX-0-ZAVRT-7869B	BV WISLEY
472.	Oenothera fruticosa L.	XX-0-ZAVRT-7869C	BV ESSEN
473.	Oenothera fruticosa L.	XX-0-ZAVRT-7869D	BV VACRATOT
474.	Oenothera odorata Jacq. 'Sulphurea'	XX-0-ZAVRT-7831B	BV WIEN
475.	Oenothera speciosa Nutt.	XX-0-ZAVRT-11807	BV WISLEY
	PAEONIACEAE		
476.	**Paeonia × lactiflora Pall. 'Kastys'**	XX-0-ZAVRT-12609B	BV KAUNAS

477.	Paeonia × lactiflora Pall. 'Maironis'	XX-0-ZAVRT-12609K	BV KAUNAS
478.	Paeonia × lactiflora Pall. 'Regina'	XX-0-ZAVRT-12609F	BV KAUNAS
479.	Paeonia × lactiflora Pall. 'Tadas'	XX-0-ZAVRT-12609I	BV KAUNAS
480.	Paeonia × lactiflora Pall. 'Virgilijus'	XX-0-ZAVRT-12609H	BV KAUNAS
481.	Paeonia mascula (L.) Mill.	XX-0-ZAVRT-632	
482.	Paeonia mascula (L.) Mill.	XX-0-ZAVRT-632C	
483.	Paeonia × suffruticosa Andrews	XX-0-ZAVRT-4409I	BV TARTU
	PAPAVERACEAE		
484.	**Argemone** platyceras Link & Otto	XX-0-ZAVRT-12602A	BV BRNO
485.	**Chelidonium** majus L.	XX-0-ZAVRT-1676A	
486.	**Dicentra** spectabilis (L.) Lem. 'Alba'	XX-0-ZAVRT-4182	BV MEYRIN
487.	**Glaucium** flavum Crantz	XX-0-ZAVRT-8493	
488.	**Meconopsis** cambrica (L.) Vig. 'Frances Perry'	XX-0-ZAVRT-12972	BV BRATISLAVA
489.	**Papaver** nudicaule L. 'Gelbes Wunder'	XX-0-ZAVRT-3322	BV BRATISLAVA
490.	Papaver orientale L. 'Feuerrise'	XX-0-ZAVRT-4413	BV BADENWEILER
491.	Papaver orientale L. 'Rosenpokal'	XX-0-ZAVRT-12607	BV PORRENTRUY
492.	Papaver popovii Sipliv.	XX-0-ZAVRT-1684	BV PLZEN
493.	Papaver rhoeas L.	XX-0-ZAVRT-2764	BV AMIENS
494.	Papaver rupifragum Boiss. & Reut.	XX-0-ZAVRT-6603A	BV AKUREYRI
495.	Papaver rupifragum Boiss. & Reut.	XX-0-ZAVRT-6603B	BV LUBLIN
	PEDALIACEAE		
496.	**Ceratotheca** triloba (Bernh.) E. Mey. ex Hook. f.	XX-0-ZAVRT-12386	BV AMIENS
497.	**Sesamum** indicum L.	XX-0-ZAVRT-2088	BV SIENA
	PHYTOLACCACEAE		
498.	**Phytolacca** americana L.	XX-0-ZAVRT-8015	
499.	**Rivina** humilis L.	XX-0-ZAVRT-7392A	BV GIESEN
	PITTOSPORACEAE		
500.	**Pittosporum** crassifolium Banks & Sul ex A. Cunn.	XX-0-ZAVRT-G-5421A	BV CHRISTCHURCH
501.	Pittosporum crassifolium Banks & Sul ex A. Cunn.	XX-0-ZAVRT-G-5421B	BV BASEL
502.	Pittosporum undulatum Vent.	XX-0-ZAVRT-G-5893A	BV BARCELONA
503.	Pittosporum undulatum Vent.	XX-0-ZAVRT-G-5893C	BV PORTO
	PLANTAGINACEAE		
504.	**Collinsia** heterophylla Graham	XX-0-ZAVRT-1635	BV COPENHAGEN
505.	**Plantago** lanceolata L. *s. l.*	SLO-0-ZAVRT-313H	TRIGLAV
	PLATANACEAE		
506.	**Platanus** × hispanica Mill. ex Münchh.	XX-0-ZAVRT-2773	
	PLUMBAGINACEAE		
507.	**Armeria** berlengensis Daveau	XX-0-ZAVRT-3363	BV LISBOA
508.	Armeria maritima (Mill.) Willd. 'Alba'	XX-0-ZAVRT-15029	BV GORIZIA
509.	Armeria maritima (Mill.) Willd. 'Rosea Compacta'	XX-0-ZAVRT-6744E	
510.	Armeria maritima (Mill.) Willd. 'Rosea Compacta'	XX-0-ZAVRT-6744F	BV BRATISLAVA
511.	Armeria pseudoarmeria Brot.	XX-0-ZAVRT-12865	MEISE
512.	Armeria rumelica Boiss. f. rhodopaea (Vel.) Beck	XX-0-ZAVRT-4228A	BV BIELEFELD
513.	**Psylliostachys** suworowii (Regel) Roshkova	XX-0-ZAVRT-1774	BV CHEMNITZ
	POLEMONIACEAE		
514.	**Polemonium** caeruleum L.	XX-0-ZAVRT-8436E	BV CLUJ-NAPOCA
515.	Polemonium pauciflorum S. Wats.	XX-0-ZAVRT-12577	BV WISLEY
	POLYGONACEAE		
516.	**Persicaria** affinis (D. Don) Ronse Decr.	XX-0-ZAVRT-11351	
517.	Persicaria tinctoria (Aiton) H.Gross	XX-0-ZAVRT-3984A	BV TARTU
518.	Persicaria tinctoria (Aiton) H.Gros	XX-0-ZAVRT-13057	BV OBERHOLZ
519.	**Polygonum** capitatum Buch.-Ham. ex D. Don.	XX-0-ZAVRT-3984	
520.	Polygonum filiforme Thunb.	XX-0-ZAVRT-4222	BV BADENWEILER
521.	**Rumex** aquaticus L.	XX-0-ZAVRT-8424	
522.	Rumex sanguineus L.	XX-0-ZAVRT-1109	
523.	Rumex scutatus L.	XX-0-ZAVRT-371	
	PRIMULACEAE		
524.	**Primula** auricula L.	HR-0-ZAVRT-CW-501E	BV STUDENZEN
525.	Primula halleri J.F. Gmel.	XX-0-ZAVRT-729C	BV FRANKFURT

526.	Primula japonica A. Gray ‘Miller's Crimson’	XX-0-ZAVRT-11275A	
	PUNICACEAE		
527.	**Punica** granatum L. ‘Nana’	XX-0-ZAVRT-12158	BV JALTA
	RANUNCULACEAE		
528.	**Aconitum** lycoctonum L. subsp. vulparia (Reich.) Nym.	HR-0-ZAVRT-552	
529.	Aconitum variegatum L.	XX-0-ZAVRT-1636	BV VARŠAVA
530.	**Anemone** hupehensis Lem. var. japonica (Thunb.) Bowles & Stearn.	XX-0-ZAVRT-4330	
531.	Anemone 'Queen Charlotte’	XX-0-ZAVRT-7713	BV MANCHESTER
532.	Anemone virginiana L.	XX-0-ZAVRT-11838C	BV QUEBEC
533.	**Aquilegia** atrata Koch	XX-0-ZAVRT-4335C	BV CHAMPEX
534.	Aquilegia atrata Koch	XX-0-ZAVRT-4335J	BV MARBURG
535.	Aquilegia atrata Koch	XX-0-ZAVRT-4335R	BV BELVEDERE
536.	Aquilegia aurantiaca 'Sweet Rainbows'	XX-0-ZAVRT-12918	
537.	Aquilegia canadensis L.	XX-0-ZAVRT-4155K	BV NANTES
538.	Aquilegia canadensis L.	XX-0-ZAVRT-4155L	BV BRATISLAVA
539.	Aquilegia chrysantha A. Gray	XX-0-ZAVRT-4346C	BV DNJEPROPETROVSK
540.	Aquilegia flabellata Siebold & Zucc. var. pumila Kudo	XX-0-ZAVRT-2650	BV LAUSANNE
541.	Aquilegia flabellata Siebold & Zucc. var. pumila Kudo	XX-0-ZAVRT-2650A	BV LAUSANNE
542.	Aquilegia nigricans Baumg.	XX-0-ZAVRT-8337G	LJUBLJANA
543.	Aquilegia 'Spring Magic Blue & White'	XX-0-ZAVRT-12948	
544.	Aquilegia viridiflora Pall. 'Chocolate Soldier'	XX-0-ZAVRT-12521	BV TARTU
545.	Aquilegia vulgaris L.	HR-0-ZAVRT-CW-147	RISNJAK
546.	Aquilegia vulgaris L.	HR-0-ZAVRT-CW-147B	ZAVIŽAN
547.	Aquilegia vulgaris L.	SLO-0-ZAVRT-147D	NANOS
548.	Aquilegia vulgaris L.	XX-0-ZAVRT-147G	BV FENAY
549.	**Clematis** integrifolia L.	XX-0-ZAVRT-1772A	
550.	Clematis integrifolia L. 'Hendersonii'	XX-0-ZAVRT-6920	BV EDMONTON
551.	Clematis ispahanica Boiss.	XX-0-ZAVRT-12578	
552.	Clematis recta L.	HR-0-ZAVRT-160A	
553.	Clematis recta L.	HR-0-ZAVRT-CW-160B	RISNJAK
554.	Clematis tangutica (Maxim.) Korsh.	XX-0-ZAVRT-12585A	
555.	**Delphinium** ‘Berghimmel’	XX-0-ZAVRT-11282D	BV BUDAPEST
556.	Delphinium caucasicum C.A.Mey.	XX-0-ZAVRT-7095A	BV REZIA
557.	Delphinium 'Giant Pacific'	XX-0-ZAVRT-6944	
558.	Delphinium ‘Giant Pacific Mixed’	XX-0-ZAVRT-12668	BV MANCHESTER
559.	Delphinium ‘Pacific’	XX-0-ZAVRT-4457	BV JIBOU
560.	Delphinium 'Ritterspom Mix'	XX-0-ZAVRT-15043	BV GRAZ
561.	Delphinium ‘Simone’	XX-0-ZAVRT-6668	BV SUAMER
562.	**Eranthis** hyemalis (L.) Salisb.	HR-0-ZAVRT-672	
563.	**Helleborus** niger L. subsp. macranthus (Freyn) Schiffn.	HR-0-ZAVRT-676	
564.	Helleborus odorus Waldst. & Kit. ex Willd.	XX-O-ZAVRT-1856	
565.	**Nigella** damascena L.	HR-0-ZAVRT-CW-312E	PELJEŠAC
566.	Nigella damascena L.	XX-0-ZAVRT-321D	
567.	**Pulsatilla** ambigua (Turcz. ex Hayek) Juz.	XX-0-ZAVRT-7461A	BV OSLO
568.	Pulsatilla montana (Hoppe) Reichenb.	XX-0-ZAVRT-1837J	
569.	Pulsatilla rubra (Lam.) Delarbre	XX-0-ZAVRT-4311	BV WROCLAW
570.	**Thalictrum** minus L. *s.l.*	BiH-0-ZAVRT-CW-414B	BORAČKO JEZERO
	RHAMNACEAE		
571.	**Hovenia** dulcis Thunb.	XX-0-ZAVRT-2246A	
572.	**Ziziphus** jujuba Mill.	XX-0-ZAVRT-7117B	
	ROSACEAE		
573.	**Alchemilla** cinerea Buser	XX-0-ZAVRT-8428	BV MÜNCHEN-NYMPHENBURG
574.	**Aruncus** aethusifolius Nakai	XX-0-ZAVRT-12267	
575.	**Chaenomeles** japonica Spach ‘Gaujardii’	XX-0-ZAVRT-2152	
576.	**Cotoneaster** acutifolius Turcz.	XX-0-ZAVRT-5827	
577.	Cotoneaster horizontalis Recne.	XX-0-ZAVRT-2142	
578.	Cotoneaster microphyllus Wall. ex Lindl 'Cochleatus'	XX-0-ZAVRT-7787	
579.	**Crataegus** collina Chapm.	XX-0-ZAVRT-2149	
580.	Crataegus punctata Jacq.	XX-0-ZAVRT-5716	
581.	Crataegus turkestanica A. Pojark.	XX-0-ZAVRT-5319	BV ALMA-ATA
582.	**Fallugia** paradoxa (D.Don) Endl. ex Torr.	XX-0-ZAVRT-2550	BV GöTTINGEN
583.	Fallugia paradoxa (D.Don) Endl. ex Torr.	XX-0-ZAVRT-2550A	BV SEATLE
584.	**Filipendula** rubra (Hill) Robinson	XX-0-ZAVRT-6032	
585.	Filipendula vulgaris Moench	XX-0-ZAVRT-206C	
586.	Filipendula vulgaris Moench	HR-0-ZAVRT-CW-206D	LAZ

587.	Filipendula vulgaris Moench	XX-0-ZAVRT-206E	
588.	**Geum** coccineum Sibth. & Sm.	XX-0-ZAVRT-1874E	BV NEUCHATEL
589.	Geum coccineum Sibth. & Sm.	XX-0-ZAVRT-1874F	BV LJUBLJANA
590.	Geum coccineum Sibth. & Sm.	XX-0-ZAVRT-1874G	BV HALLE
591.	Geum pyrenaicum Mill.	XX-0-ZAVRT-7359	BV NEUCHATEL
592.	Geum pyrenaicum Mill.	XX-0-ZAVRT-7359B	BV BERN
593.	Geum rivale L.	SLO-0-ZAVRT-CW-257F	KRANJSKA GORA
594.	Geum urbanum L.	HR-0-ZAVRT-CW-59	SVILAJA
595.	Geum urbanum L.	HR-0-ZAVRT-*-226	GORNJA STUBICA 2009
596.	Geum × heldreichii cult .	XX-0-ZAVRT-12592	
597.	**Osteomeles** schwerinae C.K.Schneid.	XX-0-ZAVRT-4291	BV BARCELONA
598.	**Mespilus** germanica L.	XX-0-ZAVRT-5986	BV BUKUREŠT
599.	**Potentilla** argyrophylla Wall. ex Lehm.	XX-0-ZAVRT-12732	BV PETROZAVODSK
600.	Potentilla inclinata Vill.	XX-0-ZAVRT-1261A	
601.	Potentilla nepalensis Hook. 'Roxana'	XX-0-ZAVRT-12504	BV SALASPILS
602.	Potentilla purpurea (Royle) Hook. f.	XX-0-ZAVRT-12594	
603.	Potentilla recta L.	XX-0-ZAVRT-264A	MURTER
604.	Potentilla rupestris L.	XX-0-ZAVRT-1792A	BV CHEMNITZ
605.	Potentilla 'White Beauty'	XX-0-ZAVRT-12225	BV RIGA
606.	**Prunus** avium L. var. juliana (L.) Thuill.	MK-0-ZAVRT-12541A	SV. NAUM
607.	Prunus cerasifera Ehrh. var. divaricata (Ledeb.) Bailey	XX-0-ZAVRT-8460A	
608.	**Pyracantha** coccinea M. J. Roem.	XX-0-ZAVRT-5662	
609.	**Rhodotypos** scandens (Thunb.) Makino	XX-0-ZAVRT-5638	
610.	**Rosa** canina L.	XX-0-ZAVRT-5638	BV GRAZ
611.	Rosa canina L.	HR-0-ZAVRT-*-62	GORNJA STUBICA 2020
612.	**Sanguisorba** minor Scop.	HR-0-ZAVRT-1887A	
613.	Sanguisorba minor Scop. subsp. muricata (Gremli) Briq.	HR-0-ZAVRT-*-273	VRGORAC
614.	Sanguisorba officinalis L.	HR-0-ZAVRT-CW-8540	LIKA
615.	**Sorbus** aria (L.) Crantz	HR-0-ZAVRT-CW-8422C	ŠTIROVAC
	RUBIACEAE		
616.	**Phuopsis** stylosa (Trin.) Hook. F. ex B.D. Jacks.	XX-0-ZAVRT-2983	BV MÜNCHEN
	RUTACEAE		
617.	**Poncirus** trifoliata (L.) Raf.	XX-0-ZAVRT-6022	
618.	**Ruta** graveolens L.	XX-0-ZAVRT-1985	
	SAPINDACEAE		
619.	**Cardiospermum** halicacabum L.	XX-0-ZAVRT-12459	
	SAXIFRAGACEAE		
620.	**Astilbe** × arendsii H.R.Wehrh. 'Ceres'	XX-0-ZAVRT-4437	
621.	Astilbe × arendsii H.R.Wehrh. 'Deutschland'	XX-0-ZAVRT-6931	
622.	Astilbe × arendsii H.R.Wehrh. 'Gertrude Brix'	XX-0-ZAVRT-2618	
623.	Astilbe chinensis (Maxim.) Franch. & Sav.	XX-0-ZAVRT-3381	BV MÜNCHEN
624.	Astilbe chinensis (Maxim.) Franch. & Sav.	XX-0-ZAVRT-3381A	BV TÜBINGEN
625.	**Heuchera** americana L.	XX-0-ZAVRT-11562A	BV ZÜRICH
626.	Heuchera americana L. 'Palace Purple'	XX-0-ZAVRT-7069	BV TRST
627.	Heuchera × brizoides 'Firefly'	XX-0-ZAVRT-1300	BV ULM
628.	Heuchera sanguinea Engelm. 'Purpurglockchen'	XX-0-ZAVRT-5943	BV ESSEN
629.	Heuchera sanguinea Engelm. 'Splendens'	XX-0-ZAVRT-4298	BV OSLO
630.	**Saxifraga** stolonifera Curtis	XX-0-ZAVRT-12345A	
631.	**Tiarella** cordifolia L.	XX-0-ZAVRT-12604	
	SCROPHULARIACEAE		
632.	**Antirrhinum** majus L. 'Flamme'	XX-0-ZAVRT-15127B	BV IZMIR
633.	**Digitalis** 'Excelsior Hybrids'	XX-0-ZAVRT-2660A	BV HARROGATE
634.	Digitalis ferruginea L.	HR-0-ZAVRT-CW-8030D	KRASNO
635.	Digitalis grandiflora Mill.	HR-0-ZAVRT-CW-65	MEDAK
636.	Digitalis grandiflora Mill.	XX-0-ZAVRT-65F	BV REZIA
637.	Digitalis lanata Ehrh.	XX-0-ZAVRT-4370	BV LAUSANNE
638.	Digitalis lutea L.	XX-0-ZAVRT-12599	
639.	Digitalis lutea L.	XX-0-ZAVRT-2820	
640.	Digitalis purpurea L.	XX-0-ZAVRT-1735J	BV CLUJ-NAPOCA
641.	Digitalis purpurea L. *hyb.*	XX-0-ZAVRT-15128B	
642.	**Erinus** alpinus L. 'Mrs. Charles Boyle'	XX-0-ZAVRT-3165	BV WIEN
643.	**Mimulus** cardinalis Douglas ex Benth.	XX-0-ZAVRT-15187	
644.	Mimulus luteus L.	XX-0-ZAVRT-2713	
645.	**Paulownia** tomentosa (Thunb. ex Murray) Steud.	XX-0-ZAVRT-2366A*	

646.	**Penstemon** alpinus Torr.	XX-0-ZAVRT-6354C	BV GöTTINGEN
647.	Penstemon azureus Benth.	XX-0-ZAVRT-12004C	BV KIEL
648.	Penstemon cardinalis Wooton & Standl.	XX-0-ZAVRT-15011	BV CLUJ-NAPOCA
649.	Penstemon cardinalis Wooton & Standl.	XX-0-ZAVRT-15011A	
650.	Penstemon cobaea Nutt.	XX-0-ZAVRT-5955	BV VACRATOT
651.	Penstemon confertus Douglas ex Lindl.	XX-0-ZAVRT-6377C	
652.	Penstemon digitalis Nutt. ex Sims 'Husker Red'	XX-0-ZAVRT-6560	BV YEOMIJI
653.	Penstemon digitalis Nutt. ex Sims 'Mystica'	XX-0-ZAVRT-6560A	BV KAUNAS
654.	Penstemon heterophyllus Lindl.	XX-0-ZAVRT-5451	BV CHEMNITZ
655.	Penstemon nanus D.D. Keck	XX-0-ZAVRT-13419	BV ŠIAULIAI
656.	Penstemon procerus Douglas ex Graham	XX-0-ZAVRT-12949	BV KIEL
657.	Penstemon whippleanus A. Gray	XX-0-ZAVRT-12995	BV TÜBINGEN
658.	**Pseudolysimachion** spicatum (L.) Opiz 'Blauriesin'	XX-0-ZAVRT-2687	BV PORRENTRUY
659.	Pseudolysimachion spicatum (L.) Opiz subsp. incanum	XX-0-ZAVRT-6190	
660.	**Scrophularia** canina L. *s.l.*	HR-0-ZAVRT-*-245	UČKA 2002
661.	**Veronica** chamaedrys L.	HR-0-ZAVRT-665B	
662.	Veronica gentianoides Vahl	XX-0-ZAVRT-12500	BV NANTES
663.	Veronica gentianoides Vahl	XX-0-ZAVRT-12500A	BV BIELEFELD
664.	Veronica gentianoides Vahl 'Nana'	XX-0-ZAVRT-13073	BV MEISE
665.	Veronica urticifolia Jacq.	HR-0-ZAVRT-*-247	VELEBIT 2002

SOLANACEAE

666.	**Alkekengi** officinarum Moench (syn. Physalis alkakengi)	XX-0-ZAVRT-3982	
667.	**Capsicum** annuum L. 'Black Cuban'	XX-0-ZAVRT-2772	BV ROUEN
668.	Capsicum annuum L. 'Cherry Hot'	XX-0-ZAVRT-15130D	BV ULM
669.	Capsicum annuum L. 'Peruvian Purple'	XX-0-ZAVRT-15130A	
670.	**Datura** inoxia Mill. 'Inka'	XX-0-ZAVRT-12491	BV SZEGED
671.	Datura quercifolia Kunth	XX-0-ZAVRT-12335A	BV POZNAN
672.	Datura stramonium L.	XX-0-ZAVRT-1970A	BV POZNAN
673.	Datura wrightii Regel.	XX-0-ZAVRT-2770	BV JIBOU
674.	**Hyoscyamus** niger L.	XX-0-ZAVRT-2122	BV LUBLIN
675.	**Lycium** chinense Mill.	XX-0-ZAVRT-5790	
676.	Nicandra physalodes (L.) Gaertn.	XX-0-ZAVRT-15134B	BV RENNES
677.	Nicotiana alata Link et Otto	XX-0-ZAVRT-2123	BV BRAUNSCHWEIG
678.	Nicotiana langsdorffii Weinm.	XX-0-ZAVRT-2124	BV BRNO
679.	**Nicotiana** rustica L.	XX-0-ZAVRT-15171	BV CLUJ-NAPOCA
680.	Nicotiana sylvestris Speg.	XX-0-ZAVRT-2126	BV BRNO
681.	Nicotiana rustica L. 'San Pedro'	XX-0-ZAVRT-2125	BV LA GACILLY
682.	Nicotiana tabacum L.	XX-0-ZAVRT-2746	BV BAYREUTH
683.	Nicotiana tabacum L. 'Orient Tabac'	XX-0-ZAVRT-3929B	
684.	**Nolana** humifusa (Gouan) I.M.Johnst	XX-0-ZAVRT-2107	BV BRAUNSCHWEIG
685.	**Physalis** alkekengi L.	XX-0-ZAVRT-1079	BV KARLSRUHE
686.	**Solanum** aethiopicum Jacq.	XX-0-ZAVRT-15096BA	BV BERN
687.	Solanum aethiopicum Jacq.	XX-0-ZAVRT-15096B	BV DRESDEN
688.	Solanum scabrum Mill. 'Mrs. B.'s Nonbitter'	XX-0-ZAVRT-1757	BV BONN
689.	Solanum citrullifolium A.Braun	DE-0-ZAVRT-1747	BV BERN
690.	Solanum dulcamara L.	HR-0-ZAVRT-*-184	ZAGREB, MIROGOJ 2016
691.	Solanum lycopersicum L. 'Beefsteack'	XX-0-ZAVRT-2768	BV FENAY
692.	Solanum lycopersicum L. 'Coeur de Boeuf'	XX-0-ZAVRT-2767	BV FENAY
693.	Solanum lycopersicum L. 'Lemmon Tree'	XX-0-ZAVRT-1748	BV MARSEILLE
694.	Solanum lycopersicum L. 'Orange Banana'	XX-0-ZAVRT-2769	BV FENAY
695.	Solanum lycopersicum L. 'Reisetomate'	XX-0-ZAVRT-1751	BV MARSEILLE
696.	Solanum lycopersicum L. 'Tip Lamaie'	XX-0-ZAVRT-1752	BV MARSEILLE
697.	Solanum melongena L. 'Evrou'	XX-0-ZAVRT-1756	BV ATENA
698.	Solanum melongena L. 'Thai White Ribbed'	XX-0-ZAVRT-15030A	BV NANTES
699.	Solanum sisymbrifolium Lam.	XX-0-ZAVRT-2786	BV AMIENS

STAPHYLEACEAE

700.	**Staphylea** pinnata L.	XX-0-ZAVRT-652	
701.	Staphylea pinnata L.	XX-0-ZAVRT-652A	

STYRACACEAE

702.	**Styrax** officinalis L.	XX-0-ZAVRT-5780A	BV TRST

TILIACEAE

703.	**Tilia** americana L.	XX-0-ZAVRT-5017	
704.	Tilia cordata Mill.	XX-0-ZAVRT-895	
705.	Tilia × flavescens A. Braun	XX-0-ZAVRT-5811	
706.	Tilia petiolaris DC.	XX-0-ZAVRT-5779	

707.	Tilia platyphyllos Scop.	XX-0-ZAVRT-894	
	VALERIANACEAE		
708.	**Centranthus** ruber (L.) DC	XX-0-ZAVRT-1496	
709.	**Valeriana** alliariifolia Vahl	XX-0-ZAVRT-1770	BV BERLIN
	VERBENACEAE		
710.	**Callicarpa** bodinieri Lev. var. giraldii (Hesse ex Rehder) Rehder	XX-0-ZAVRT-2091B	BV FRANKFURT
711.	Callicarpa japonica Thunb. 'Leucocarpa'	XX-0-ZAVRT-5736	
712.	Callicarpa mollis Siebold & Zucc.	XX-0-ZAVRT-6617	
713.	**Phyla** nodiflora L.	XX-0-ZAVRT-6524A	
714.	**Verbena** rigida Spreng.	XX-0-ZAVRT-6757B	BV HARROGATE
	ZYGOPHYLLACEAE		
715.	**Peganum** harmala L.	XX-0-ZAVRT-11548	BV SEATTLE
	b.2.2. **L I L I O P S I D A**		
	AGAVACEAE		
716.	**Cordyline** stricta Hook. f.	XX-0-ZAVRT-G-3901	
	ALISMATACEAE		
717.	**Alisma** plantago-aquatica L.	HR-0-ZAVRT-CW-1767	KRAPJE ĐOL
718.	Alisma plantago-aquatica L.	HR-0-ZAVRT-*-251	PISAROVINA 2004
	ALLIACEAE		
719.	**Allium** ampeloprasum L.	HR-0-ZAVRT-CW-1648	PELJEŠAC 2010
720.	Allium commutatum Guss.	HR-0-ZAVRT-350	
721.	Allium ledebourianum Roem. & Schult.	XX-0-ZAVRT-6472A	BV NOVOSIBIRSK
722.	Allium moly L. 'Jeannine'	XX-0-ZAVRT-29718	
723.	Allium pskemense B.Fedtsch.	XX-0-ZAVRT-13022	BV LEIPZIG
724.	Allium ramosum L.	XX-0-ZAVRT-6316B	BV BESANCON
725.	Allium schoenoprasum L.	XX-0-ZAVRT-1900	
726.	Allium senescens L. subsp. senescens	HR-0-ZAVRT-7F	
727.	Allium subhirsutum L.	HR-0-ZAVRT-*-253	BRAČ 2008
728.	Allium ursinum L.	HR-0-ZAVRT-1293	
	AMARYLLIDACEAE		
729.	**Agapanthus** campanulatus Leight. subsp. patens (Leight.) Leight.	XX-0-ZAVRT-6873	
730.	Agapanthus africanus (L.) Hoffmanns.	XX-0-ZAVRT-7265B	BV AMSTERDAM
731.	**Clivia** nobilis Lindl.	XX-0-ZAVRT-G-2801	
732.	**Zephyranthes** rosea Lindl.	XX-0-ZAVRT-G-7403	BV BESANCON
	ARACEAE		
733.	**Disporum** cantoniense (Lour.) Merr. 'Night Heron'	XX-0-ZAVRT-12540	
734.	**Spathiphyllum** 'Domino'	XX-0-ZAVRT-3787	
	ASPARAGACEAE		
735.	**Asparagus** densiflorus Jessop.	XX-0-ZAVRT-G-11995	BV ROTTERDAM
736.	Asparagus tenuifolius Lam.	HR-0-ZAVRT-505	
737.	**Cordyline** fruticosa (L.) A.Chev.	XX-0-ZAVRT-2818 S	BV UTRECHT
738.	Cordyline fruticosa (L.) A.Chev. 'Red Edge'	XX-0-ZAVRT-7913A	BV BESANCON
739.	**Polygonatum** multiflorum (L.) All.	XX-0-ZAVRT-643	
740.	**Sansevieria** grandicuspis Haw.	XX-0-ZAVRT-3711	BV GOETEBORG
	ASPHODELACEAE		
741.	**Asphodeline** lutea (L.) Rchb.	HR-0-ZAVRT-CW-351	BAŠKA
742.	Asphodeline lutea (L.) Rchb	HR-0-ZAVRT-CW-351C	GROMAČA,03
743.	**Asphodelus** aestivus Brot.	XX-0-ZAVRT-353F	
744.	Asphodelus fistulosus L.	XX-0-ZAVRT-3169B	
745.	Asphodelus fistulosus L.	HR-0-ZAVRT-CW-8301D	PELJEŠAC, GORNJI BRGAT
	BROMELIACEAE		
746.	**Aechmea** bracteata (Sw.) Griseb.	XX-0-ZAVRT-G-3636	BV FRANKFURT AM MAIN
747.	Aechmea bromeliifolia (Rudge) Bak.	XX-0-ZAVRT-G-3837B	BV MARBURG
748.	Aechmea comata (Gaudich.) Baker 'Variegata'	XX-0-ZAVRT-3841	BV BRISEL
749.	Aechmea sphaerocephala Baker	XX-0-ZAVRT-G-3845	BV DAHLEM
750.	**Billbergia** brasiliensis L.B.Sm.	XX-0-ZAVRT-G-5930	BV CLUJ-NAPOCA
751.	Billbergia kuhlmannii L.B.Sm.	XX-0-ZAVRT-12824	BV VACRATOT
752.	Billbergia macrolepis L.B.Sm.	XX-0-ZAVRT-6938	

753.	Billbergia porteana Brong. ex Beer	XX-0-ZAVRT-G-2675	BV BASEL
754.	**Catopsis** morreniana Mez	XX-0-ZAVRT-13296	
755.	**Hechtia** argentea Baker	XX-0-ZAVRT-G-5198	
	BUTOMACEAE		
756.	**Butomus** umbellatus L.	XX-0-ZAVRT-1912	
	CANNACEAE		
757.	**Canna** flaccida Salisb.	XX-0-ZAVRT-6030	BV RIGA
758.	Canna 'Sunrise' series (orange)	XX-0-ZAVRT-13255	
759.	Canna tuerckheimii Kraenzl.	XX-0-ZAVRT-15185	
	COMMELINACEAE		
760.	**Callisia** navicularis (Ortgies) D.R.Hunt	XX-0-ZAVRT-3797A	BV LUBLIN
761.	**Tradescantia** spathacea Sw.	XX-0-ZAVRT-G-4083	
762.	Tradescantia virginiana L.	XX-0-ZAVRT-G-4240	
	CONVALLARIACEAE		
763.	**Polygonatum** multiflorum (L.) Allioni	XX-0-ZAVRT-643/1	
764.	**Smilacina** racemosa (L.) Desf.	XX-0-ZAVRT-4862C	BV TORONTO
	CYPERACEAE		
765.	**Carex** acuta L.	HR-0-ZAVRT-*-306	MUTILIĆ 2015
766.	**Carex** dipsacea Berggr.	XX-0-ZAVRT-12625	BV WISLEY
767.	Carex distans L.	HR-0-ZAVRT-*-320	LAPAČKO POLJE 2015
768.	Carex flava L.	HR-0-ZAVRT-*-113	LIČKO POLJE, TRNOVAC 2015
769.	Carex flava L.	XX-0-ZAVRT--8564	BV POZNAN
770.	Carex grayi Carey	XX-0-ZAVRT-2555	BV NANTES
771.	Carex morrowii Boott	XX-0-ZAVRT-3876	
772.	Carex ornithopoda Willd.	SLO-0-ZAVRT-30A	VELIKA PLANINA
773.	Carex otrubae Podp.	HR-0-ZAVRT-*-132	LIČKO POLJE, TRNOVAC 2015
774.	Carex pendula Huds.	HR-0-ZAVRT-CW-1058A	STRAHINJŠČICA
775.	Carex pendula Huds.	HR-0-ZAVRT-CW-1058B	G. BISTRA
776.	Carex spicata Huds.	HR-0-ZAVRT-*-134	BRAJKOVIĆI, GACKO POLJE 2015
777.	**Cyperus** textilis Thunb.	XX-0-ZAVRT-11329B	BV TORINO
	DIOSCOREACEAE		
778.	**Tamus** communis L.	HR-0-ZAVRT-375	
	HEMEROCALLIDACEAE		
779.	**Hemerocallis** citrina Baroni	XX-0-ZAVRT-4382	BV BONN
780.	Hemerocallis minor Mill.	XX-0-ZAVRT-11751C	BV BONN
	HYACINTHACEAE		
781.	**Muscari** armeniacum Leichtlin ex Baker	HR-0-ZAVRT-CW-1681E	MLJET, VELIKI GRAD
782.	**Ornithogalum** longibracteatum Jacq.	XX-0-ZAVRT-G-7377	
783.	**Scilla** bifolia L.	XX-0-ZAVRT-1167	
	IRIDACEAE		
784.	**Crocosmia** 'Lucifer'	XX-0-ZAVRT-2889	TRIGLAV, POKLJUKA
785.	Crocosmia 'Lucifer'	XX-0-ZAVRT-2889A	BV MANCHESTER
786.	**Gladiolus** Nanus 'Charm'	HR-0-ZAVRT-12962E	
787.	**Iris** Barbata Elatior 'Foxfire'	XX-0-ZAVRT-3027	BV HAMILTON
788.	Iris Barbata Elatior 'Fuji's Mantle'	XX-0-ZAVRT-12553	BV HAMILTON
789.	Iris Barbata Elatior 'Pink Plume'	XX-0-ZAVRT-4262	BV PRUHONICE
790.	Iris domestica (L.) Goldblatt & Mabb. (syn. Belamcanda chinensis (L.) Redouté)	XX-0-ZAVRT-2443	BV CHEMNITZ
791.	Iris domestica (L.) Goldblatt & Mabb.	XX-0-ZAVRT-11348	
792.	Iris domestica (L.) Goldblatt & Mabb.	XX-0-ZAVRT-11348C	BV STUTTGART
793.	Iris domestica (L.) Goldblatt & Mabb.	XX-0-ZAVRT-11348D	BV MARBURG
794.	Iris × germanica L. (syn. I. × croatica Horvat & M.D.Horvat)	XX-0-ZAVRT-8002	
795.	Iris pallida Lam. subsp. illyrica (Tomm. ex Vis.) K.Richt. (syn. I. illyrica Tomm. ex. Vis)	XX-0-ZAVRT-228	
796.	Iris pseudacorus L.	XX-0-ZAVRT-1769	
797.	Iris reticulata M.Bieb.	XX-0-ZAVRT-5117	
798.	Iris reticulata M.Bieb.	XX-0-ZAVRT-5117B	BV WUPPERTAL
799.	Iris sanguinea Donn ex Hornem. ‘Snow Queen’	XX-0-ZAVRT-2615A	BV SOFIA
800.	Iris sibirica L.	XX-0-ZAVRT-419B	
801.	Iris sibirica L. 'Phosporflamme'	XX-0-ZAVRT-3509	BV RIGA
802.	Iris spuria L. subsp. halophila (Pallas) D. A. Webb & Chater	XX-0-ZAVRT-11909B	BV TALIN
803.	Iris spuria L. subsp. ochroleuca (L.) Dykes	XX-0-ZAVRT-4207	BV IZMIR

804.	Iris unguicularis Poir.	XX-0-ZAVRT-4508	BV MARIMURTRA
805.	**Libertia** grandiflora (R.Br.) Sweet	XX-0-ZAVRT-13021	BV BERN
806.	**Phalocallis** coelestis (Lehm.) Ravenna	XX-0-ZAVRT-1881	BV CHEMNITZ
	JUNCACEAE		
807.	**Juncus** effusus L.	XX-0-ZAVRT-1014A	
	LILIACEAE		
808.	**Fritillaria** meleagris L.	HR-0-ZAVRT-CW-1287	ZAPREŠIĆ (NOVI DVORI)
809.	Fritillaria montana Hoppe ex W.D.J.Koch	XX-0-ZAVRT-288	
810.	**Ophiopogon** planiscapus Nakai 'Nigrescens'	XX-0-ZAVRT-3964	
811.	**Smilacina** racemosa (L.) Desf.	XX-0-ZAVRT-4862C	BV TORONTO
812.	**Urginea** maritima (L.) Baker	HR-0-ZAVRT-CW-1322B	VIS
	MARANTACEAE		
813.	**Thalia** dealbata Fraser ex Roscoe	XX-0-ZAVRT-4693	BV LINZ
	MELANTHIACEAE		
814.	**Veratrum** nigrum L.	XX-0-ZAVRT-1524*	BV BELVEDERE
	POACEAE		
815.	**Aegilops** geniculata Roth	XX-0-ZAVRT-787	
816.	**Arrhenatherum** elatius (L.) P.Beauv. ex J. Presl & C. Presl	XX-0-ZAVRT-8347	
817.	**Brachypodium** retusum (Pers.) P.Beauv.	HR-0-ZAVRT-CW-923A	MLJET
818.	**Briza** maxima L.	HR-0-ZAVRT-CW-1566	KONAVLE
819.	Briza media L.	HR-0-ZAVRT-CW-122D	GORNJA STUBICA
820.	**Bromus** erectus Huds.	HR-0-ZAVRT-CW-123	GORNJE JELENJE
821.	Bromus madritensis L.	HR-0-ZAVRT-CW-8584	PELJEŠAC
822.	**Chasmanthium** latifolium (Michx.) H.O. Yates	XX-0-ZAVRT-12507	BV IASI
823.	**Festuca** amethystina L.	XX-0-ZAVRT-1738	BV TÜBINGEN
824.	Festuca glauca Vill. 'Elijah Blue'	XX-0-ZAVRT-12425	BV EAST GRINSTEAD
825.	Festuca heterophylla Lam.	HR-0-ZAVRT-CW-1787	BURNJAK
826.	Festuca tenuifolia Schrad. 'Herms'	XX-0-ZAVRT-12785	
827.	**Melica** ciliata L.	HR-0-ZAVRT-973	
828.	**Nassella** tenuissima (Trin.) Barkworth 'Pony Tails'	XX-0-ZAVRT-12954	BV TEPLICE
829.	**Pennisetum** orientale L. C. Rich.	XX-0-ZAVRT-3177	BV POTSDAM
830.	**Poa** badensis Haenke ex Willd.	XX-0-ZAVRT-8509	
831.	Poa bulbosa L.	XX-0-ZAVRT-778	
832.	Poa compressa L.	XX-0-ZAVRT-8499	
833.	Poa nemoralis L.	HR-0-ZAVRT-CW-1243B	VELEBIT
834.	**Sesleria** tenuifolia Schrader	HR-0-ZAVRT-CW-26A	J. VELEBIT
835.	Sesleria tenuifolia Schrader	HR-0-ZAVRT-CW-26B	BRAČ, VIDOVA GORA
836.	Sesleria tenuifolia Schrader	HR-0-ZAVRT-CW-26C	KONAVLE
837.	Sesleria tenuifolia Schrader	HR-0-ZAVRT-CW-26G	VELA UČKA
838.	**Stipa** barbata Desf.	XX-0-ZAVRT-12626	BV BIELEFELD
839.	**Zea** mays L. 'Brotmais'	XX-0-ZAVRT-2758	BV LA GACILLY
840.	Zea mays L. 'Strawberry Corn'	XX-0-ZAVRT-15175	BV VILNIUS
	RUSCACEAE		
841.	**Ruscus** aculeatus L.	HR-0-ZAVRT-6	
842.	Ruscus aculeatus L.	HR-0-ZAVRT-6D	
843.	Ruscus hypoglossum L.	HR-0-ZAVRT-640	
844.	Ruscus hypoglossum L.	HR-0-ZAVRT-640A	
	TYPHACEAE		
845.	**Typha** angustifolia L.	XX-0-ZAVRT-8514	
846.	Typha shuttleworthii W.D.J.Koch & Sond.	XX-0-ZAVRT-8581	
	XANTHORRHOEACEAE		
847.	**Haworthia** fasciata (Willd.) Haw.	XX-0-ZAVRT-2752	BV MONACO
848.	Haworthia rigida (Lam.) Haw.	XX-0-ZAVRT-3169B	BV WAGENINGEN
	ZINGIBERACEAE		
849.	**Alpinia** officinarum Hance.	XX-0-ZAVRT-2818	BV ROSTOCK
850.	Alpinia zerumbet (Pers.) B.L.Burtt & R.M.Sm.	XX-0-ZAVRT-3832A	BV MENTON

Agreement

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The Botanic Garden is dedicated to the conservation, sustainable use and research of biological diversity. With regard to the acquisition, maintenance and supply of plant material, the Garden therefore expects its partners to act in a manner that is consistent to the letter and spirit of the Convention on Biological Diversity (Rio de Janeiro, 1992), the Convention on International Trade in Endangered Species (CITES) and in compliance with all relevant conventions and laws relating to the protection of biological diversity.
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e.g. 11		

Your address:

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Seed dormancy and germination of five selected NATURA-2000 plant species from Croatia showing different germination strategies

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ABSTRACT
NATURA-2000, the ecological network of protected areas in the European Union that has been included in the Croatian legislation, defines Community important plant species with imperative on their conservation *ex/in situ*. In the Botanical Garden of the Faculty of Science, University of Zagreb, five NATURA-species have been selected as research subjects for germination study to shed light on the topic of their seed ecology and consequently advance their conservation efforts: *Degenia velebitica*, *Scilla litardierei, Klasea lycopifolia*, *Ligularia sibirica* and *Genista holopetala*. The freshly matured seeds of each species were exposed to cold or warm stratification in duration of four to sixteen weeks, and their germination was investigated through different regimes of incubation parameters, i.e. illumination (light/dark) and temperature (5, 15/6, 23 °C). All species had higher germination values after cold stratification, with the exception of *G. holopetala*. We concluded that *D. velebitica, K. lycopifolia* and presumably *L. sibirica* seeds has non-deep physiological dormancy while *S. litardierei* has deep complex morphophysiological dormancy and *G. holopetala* has physical dormancy. The observed patterns in seeds' behaviour are consistent with the conditions in their natural habitats in Croatia and the knowledge of these patterns is vital for successful conservation strategies in the future.

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Degenia velebitica; *Genista holopetala*; *Klasea lycopifolia*; *Ligularia sibirica*; *Scilla litardierei*; seed ecology; *ex situ* conservation; endemic species

Introduction

Among the vast Croatian flora of more than 5000 species and subspecies, 390 taxa are considered to be endemic (Nikolić et al. 2015; Nikolić 2019). The species of Community interest found in the Croatian territory have been listed in the Habitats Directive (European Commission 2018), the European legal document whose Annexes are transferred to the Croatian legislative within the *Regulation of Ecological Network NATURA 2000 Croatia* (NATURA 2000 Croatia 2013, 2015) and *Ordinance on Strictly Protected Species* (2013, 2016). According to the *List of wildlife species (except birds) of interest to European Union* within the *Regulation* (NATURA 2000 Croatia 2015), Croatian flora has 17 vascular plants, one fern and three mosses enlisted as the 'Natura-species' of special interest to the European Union. The majority of vascular plants listed in the Ordinance (Ordinance on Strictly Protected Species 2016) have been grown for a long time in the collections of the Botanical Garden of the Faculty of Science, University of Zagreb (Sandev et al. 2013; Kovačić et al. 2014). On the other hand, most of these plants have not been thoroughly researched from the perspective of their seed ecology, while questions of their seed viability and germination requirements remain unanswered. Therefore, we selected five 'Natura-species' to conduct the seed germination ecology research.

A single endemic plant species added to the *List of wildlife species (except birds) of interest to European Union* within the *Regulation* (NATURA 2000 Croatia 2015), after Croatian accession to EU in 2013 is *Degenia velebitica* (Degen) Hayek (Brassicaceae), one of two Croatian plant species listed under Annex II to the Habitats Directive (European Commission 2018) as 'priority taxa for biodiversity conservation'. This monotypic heliophyte grows in the karstic scree and rock crevices of three known wild localities, all in Croatia (Nikolić 2015): two in Mt. Velebit, among *Peltarion alliaceae* Horvatić in Domac 1957 Alliance (Class *Drypidetea spinosae* Quézel 1964 with a single Order, *Drypidetalia spinosae* Quézel 1964), and a single at the lower slopes of Mt. Velika Kapela, among *Saturejion subspicatae* Tomić-Stanković 1970 Alliance (*Scorzoneretalia villosae* Kovačević 1959 Order of the *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947 Class). *Degenia velebitica* was included as vulnerable (VU) in the European (IUCN 1991) and global Red Lists (Walter and Gillett 1998). More recently, it was not globally re-assessed, while in the Croatian Red Data Book (Šegulja et al. 2005) it is assessed as endangered (EN). *Degenia velebitica* is one of the few Croatian endemics that meets all three European criteria needed to proclaim its natural habitat as an Important Plant Area (Alegro et al. 2010) and the first native species introduced to the Programme of cultivation and *ex situ* protection of Croatian threatened species in the Botanical Garden of the Faculty of

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Science, University of Zagreb (Naumovski and Stamenković 2004; Naumovski 2005).

The distribution of Illyrian-Balkan endemic *Scilla litardierei* Breistr. (Hyacinthaceae) includes the wet meadows in the intermittently flooded areas and damp habitats of Dinarid Mts, from Slovenia to Albania (Seliškar 2004; Jasprica 2015a). This species is currently listed as critically endangered (CR) for EU27 (Bilz et al. 2011), since it thrives only on a single locality in Slovenia and it is probably extinct in Italy (Čušin 2004; Jogan et al. 2011; Caković et al. 2018). However, *S. litardierei* is rather frequent in Croatia (Kovačić et al. 2014, 2015) and assessed as nearly threatened (NT) in the Red Book (Nikolić and Topić 2005). It is abundant in the periodically flooded karst fields ('krško polje') of the mainland and northern-Adriatic islands, where it grows in various communities of the *Molinio-Arrhenatheretea* Tx. 1937 Class, within the Orders *Trifolio-Hordeetalia* Horvatić 1963, *Molinietalia caeruleae* Koch 1926, *Arrhenatheretalia elatioris* Tx. 1931 and *Potentillo-Polygonetalia avicularis* Tx. 1947, even at salty grounds (Alegro 2013).

The European endemic *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve (Asteraceae) is another species of the Croatian flora considered to be a 'priority for biodiversity conservation' under Annex II to the Habitats Directive (European Commission 2018). Scattered across the mountain ranges from western to eastern Europe and southern Russia, its distribution centre is in SE Europe (Meusel and Jäger 1992). *Klasea lycopifolia* is statutorily protected and Red-listed in several European countries (cp. Cieślak 2013 and references within), while there are also some data on its extinction (Škodová 1999) and re-discovery (Conti and Manzi 1997). Although it does not fall under any of the threatened thresholds (Bilz 2011), the populations of *K. lycopifolia* are in most of its range small and declining, with several reported threats (Abdulhak 2010; Perzanowska 2015). *Klasea lycopifolia* is considered to be rare in Croatia, with only several recently confirmed localities in the dry steppic sub-Mediterranean grasslands of *Scorzoneretalia villosae* Kovačević 1959 Order (Vitasović Kosić et al. 2014). Nevertheless, it is still assessed as data deficient (DD) in Croatian Red Data Book (Nikolić and Topić 2005).

Ligularia sibirica (L.) Cass. (Asteraceae) is a boreal Euro-Asian species which colonizes a wide range of habitats from East Asia, along southern Siberia, to European parts of Russia, Belarus and Ukraine (Bernhardt et al. 2011; Mânzu et al. 2013). In the southwestern-most parts of its areal it is very rare, found mostly in small, scattered and isolated mountainous populations with decreasing population trends (Hendrych 2003; Kukk 2003; Ilves et al. 2013; Mânzu et al. 2013). In Croatia, *L. sibirica* has its single and isolated locality (Šegulja 2005; Stančić et al. 2010) in the wet meadows of sub-Mediterranean *Molinio-Hordeion secalini* H-ić (1934) 1958 Alliance (Class *Molinio-Arrhenatheretea* Tx. 1937 and Order *Trifolio-Hordeetalia* Horvatić 1963). Part of the locality was semi-shaded by spreading of species belonging to *Salicion albae* Soó 1951 and *Phragmition communis* Koch 1926 Alliances, but today it is well-maintained as an important part of this NATURA-site (Kovačić et al. 2015). *Ligularia sibirica* is assessed as critically endangered (CR) in Croatian Red Book (Šegulja and Štefan 2005).

The Illyrian endemic and tertiary relic *Genista holopetala* (Koch) Bald. (Fabaceae), rare in Slovenia and Italy (Surina 2004; Gargano et al. 2011), is considered vulnerable (VU) for EU27 (Bilz et al. 2011) and it was assessed as data deficient (DD) in Croatia (Nikolić and Topić 2005). This species is still fairly abundant in NW Croatia, where its southern-most localities are found on the southern slopes of Velebit Mt (Jasprica 2015b). In Croatia, *G. holopeala* inhabits the wind-exposed calcareous dry grasslands (Surina 2004) of *Elyno-Seslerietea* Br.-Bl. 1948 Class, within the *Seslerietalia tenuifoliae* Horvat 1930 Order, as well as *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947 Class, within the Orders *Brachypodietalia pinnati* Korneck 1974 nom. conserv. propos. and *Scorzoneretalia villosae* Kovačević 1959 (where it forms an endemic *Genisto holopetalae-Caricetum mucronatae* Horvat 1956 association).

Considering the importance of conserving these selected 'Natura-species', the aim of this study was to assess (i) the existence and type of seed dormancy and (ii) the effect of temperature and light regimes on germination. The data were then related to the natural habitat in Croatia and ecological factors these five species utilize to ensure their reproduction by seeds.

The nomenclature of taxa follows Euro + Med Plantbase (Euro + Med 2006), while syntaxonomical nomenclature follows the EuroVegChecklist (Mucina et al. 2016), ammended for Croatia by Škvorc et al. (2017).

Materials and methods

We conducted the laboratory experiments with freshly matured seeds collected in the wild at the time of their natural dispersal (Table 1) in accordance with special permits from the national authorities, as the species are also statutorily strictly protected in the Croatian territory according to the Anonymous (2013). The seeds were stored at room temperature for two weeks until they were used in the experiment.

Table 1. Sampling localities of seed material used in the experiment.

Species	Natura-site NO	Coordinates (WGS84)	Altitude (m)	Date of sampling	Locality of sampling
Degenia velebitica	HR2000856 inside HR5000019	45°03′78″N 14°53′2″E	433	June 11th 2016	Tomišina draga, Velika Kapela Mt
Genista holopetala	HR2000707 inside HR5000019	45°24′4.1″N 14°32′54.6″E	851	September 7th 2016	Jazvina Hill slopes, Mali Platak Mt
Klasea lycopifolia	HR2001255	44°25′3.3″N 15°54′50″E	752	September 30th 2016	Bruvno-Bulji plateau, Lika Karst field
Ligularia sibirica	HR5000020	44°46′40″N 15°40′55″E	681	August 12th 2015	Rudanovac, Plitvička jezera National park
Scilla litardierei	HR2001012	44°30′60″N 15°17′49″E	560	August 1st 2015	Trnovac, Lika Karst field

Experiment design and stratification test

The total number of seeds in the experiment was 2850 for each species, except for *G. holopetala* and *S. litardierei*. A total of 1710 seeds was used for *G. holopetala* due to the low number of seeds available, and a total of 2925 seeds was used for *S. litardierei* to conduct one additional test which was specific for that species. The seeds of each species were divided by a random choice into groups of 25 (15 for *G. holopetala*) and then placed into a 9-cm-diameter plastic Petri dishes, on top of sterilized white quartz sand damped with distilled water. The experiment was divided into two phases. The first phase was designed to expose seeds to cold or warm stratification. The second phase, the actual germination test, was designed to provide data on the conducted stratification test, while also testing the effect of the incubation temperature and illumination on germination. In the first phase, all of the prepared experimental units (Petri dishes) were grouped as triplicates and then divided into three groups (warm, cold and control groups) with consideration to the number of treatments in the following phase. Both stratification treatments lasted for 4, 8, 12 and 16 weeks at constant 5 °C (refrigerator) in the case of cold stratification and constant 23 °C (growth chamber) in the case of warm stratification. The experimental units in the control groups were not exposed to any stratification period; they were immediately introduced to the germination test. The stratified seeds followed the same procedure after their stratification period ended. All dampened dishes were wrapped with *Parafilm M* (Bemis, Neenah WI 54956) to prevent the loss of water and distilled water was added as needed, to keep the quartz sand damp.

Germination test

In the second phase of the experiment, the seeds were incubated under three different temperature regimes (from here onwards referred to as thermoperiods), each in two different illumination regimes: light (constant photoperiod of light 16 h/dark 8 h; cool white fluorescent light, 35 μmol m^{-2} s^{-1}) and dark (complete absence of photoperiod; dark 24 h). The Petri dishes in the dark illumination regime were wrapped with two layers of aluminium foil. The three thermoperiods were controlled: constant 23 °C (growth chamber), alternating 15/6 °C (Kambič RK 105 CH, climatic chamber) and constant 5 °C (refrigerator). The seeds for each species in the second phase of the experiment were incubated and monitored in all treatments for one month in the case of the species *D. velebitica, L. sibirica* and *S. litardierei* or two months in the case of the remaining two species. The seeds exposed to light were counted and removed twice a week, while those incubated in the darkness were not exposed to the light for at least 15 days. Every two weeks, the seeds in the darkness were exposed to about 3–30 seconds of very dimmed room light to check and replant the new seedlings, minimizing the change of photoperiod. The single exception was made for *S. litardierei*, whose seeds were counted three times per day. We expected that *S. litardierei* would have a very rapid rate of germination based on the previous experience with this species. Furthermore, for *S. litardierei* we placed three extra replicates (25 seeds each) in the same condition (23 °C, in light) as a control group, with the difference being that the quartz sand in these additional replicates was dampened with a solution of 1000 mg L^{-1} of gibberellic acid (GA_3) and distilled water. The extra treatment for this species was specifically introduced since we predicted that it would contribute to the conclusion about this species type of dormancy. The seeds were considered to have germinated when the radicle had reached the length of 1–2 mm (acc. to Association of Official Seed Analysts 1986).

Statistical analysis and data visualization

The germination percentage (%) was calculated as $n/N \times 100$ where n is the number of germinated seeds after 30 or 60 days depending on the species (30 days for *D. velebitica, L. sibirica* and *S. litardierei*; 60 days for *G. holopetala* and *K. lycopifolia*) and N is the total number of seeds of one experimental unit. The results are shown as calculated means of germination percentages from each unit in triplicates with their respective standard errors. The Levane's tests were carried out to check homogeneity of variances and since the tests were not significant ($p > 0.05$), no data transformation was needed. The variances were analyzed with one-way analysis of variance (ANOVA) and post hoc test was performed with Duncan's Multiple Range test. All analyses were conducted in R version 3.0.0 (R Core Team 2013) and Microsoft Excel 2016 was used for processing data. The differences between means were considered statistically significant at $p \leq 0.05$. The results are presented as bar charts. To visualize and present the data in the most concise way, we used data input composed of all the germination data acquired from cold or warm stratified group of seeds in the analysis of variance for each species. In other words, the letters indicating the different means on the figure with the germination data can be referred as the differences inside and between the thermoperiod treatment, the illumination regime treatment and the duration of stratification. The only species that needed representation with two graphs (cold and warm stratification) is *G. holopetala*, while for the rest of the studied species the second graph was omitted since the germination on one of the stratification temperature excluded the germination on the other.

Results

Degenia velebitica

The *Degenia velebitica* seeds germinated after cold stratification when incubated at 15/6 °C and 23 °C (Figure 1(A)). The seeds exposed to warm stratification did not germinate throughout all of the treatments. The only seeds that germinated in the control group were those incubated at 23 °C (18.2% ± 1.6 in light and 3.1% ± 0.4 in darkness). The maximum germination was noted after 12 weeks of cold

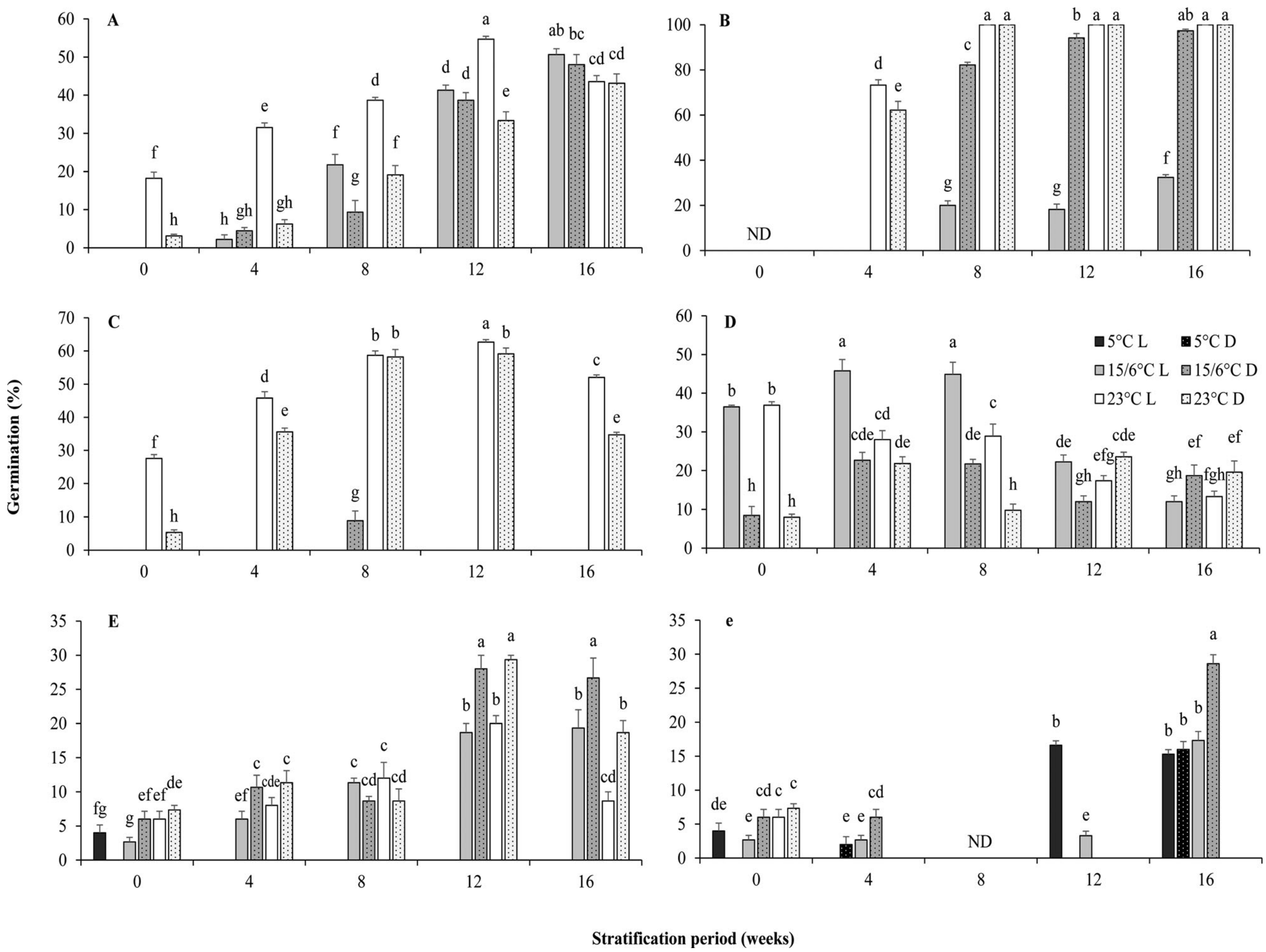

Figure 1. The germination of seeds from five Croatian Natura-species incubated under different regimes of illumination (L: light, non-patterned bars; D: dark, dotted bars) and temperature (5, 15/6, 23 °C) after different duration of cold (5 °C; uppercase) or warm (23 °C; lowercase) stratification. A) *Degenia velebitica*; B) *Scilla litardierei*; C) *Klasea lycopifolia*; D) *Ligularia sibirica*; E,e) *Genista holopetala*. The bar plots intervals represent + SE, $n = 3$, while statistically different means are marked with different letter (one-way ANOVA, Duncan test, $p \leq 0.05$). The periods where germination was not noted are marked with ND; not detected.

stratification at 23 °C in light regime (54.6% ± 0.8) and 16 weeks of cold stratification at 15/6 °C in both light (50.6% ± 1.6) and dark (48.0% ± 2.7) illumination regime. Furthermore, from the data acquired after cold stratification in duration of 0–12 weeks the statistically highest means were noted for seeds incubated on 23 °C in light regime. All treatments had improved germination rates from longer period of cold stratification, with the exception of three cases where the means were not statistically different (between 23 °C dark at 0 and 4 weeks; 15/6 °C dark at 4 and 8 weeks; 23 °C light at 12 and 16 weeks). The change of germination percentage per change of stratification period at 15/6 °C was higher than the ratio for treatments at 23 °C. Germination noted after 4–12 weeks of cold stratification was lower in the darkness than in the light for the seeds incubated at 23 °C. In contrast, the germination in light regime was not statistically different from the germination in the dark for seeds incubated at 15/6 °C, even though the trend in which the light regime yields higher germination is noticeable from the means. The only exception with statistically distinct means between seeds incubated in the light and dark at 15/6 °C were observed for germination after 8 weeks of cold stratification (21.7 ± 2.7 in light and 9.3 ± 3.1 in darkness).

Scilla litardierei

The *Scilla litardierei* seeds without stratification did not germinate at all. However, cold stratification had a positive influence on germination as we recorded high percentages in these treatments (Figure 1(B)). In contrast, warm stratification did not show any influence on germination (0.0% ± 0.0 germination across all treatments). As the duration of the cold stratification increased till 8 weeks, so did the percentage of germination for seeds incubated at 23 °C in both light and darkness (incr. ∼27–38%). The maximum germination (100.0% ± 0.0) was noted for the cold stratified seeds (8, 12 and 16 weeks) incubated at 23 °C in both illumination regimes and for the seeds incubated at 15/6 °C in darkness. After 4 weeks of stratification, the germination percentage of seeds was 0.0% ± 0.0 at 15/6 °C in light and darkness. However, as stratification increased from 8 to 16 weeks, the final germination percentage at 15/6 °C also increased (32.4 ± 1.2 light; 97.3% ± 0.8 dark). In all treatments, the cold stratified seeds germinated in higher percentage at 23 °C then at 15/6 °C, with the exception being in the treatments where seeds were stratified for 16 weeks—Duncan post hoc test grouped seeds germinated at 15/6 °C in the dark as statistically not different from those germinated at 23 °C in both illumination regimes. The light illumination regime at 23 °C of cold stratified seeds yielded higher germination percentages then in the dark regime, or there was no statistical difference in the means between light and dark incubated seeds. However, this relationship was opposite in the group of seeds that germinated at 15/6 °C—seeds germinating in the darkness had significantly higher germination percentages than those germinating in the light (62–76% diff.). The seeds exposed to the gibberellic acid did not germinate at all (data not shown).

Klasea lycopifolia

The non-stratified seeds of *K. lycopifolia* reached germination percentage of 27.5% ± 1.2 in the light and 5.3% ± 1.8 in the dark at 23 °C, but cold stratification improved the germination in all treatments for averagely two times in light illumination and ~8.8 times in dark regime (Figure 1(C)). On the other hand, warm stratification did not break seed dormancy in *K. lycopifolia*. The largest yield of germination (~35%) in comparison to the control group in the light regime was noted for the seeds that were cold stratified for 12 weeks and incubated in light conditions at 23 °C. This value (62.6% ± 0.8) also represents germination maximum for our dataset of *K. lycopifolia*. The seeds stratified at cold temperatures for 4, 12 and 16 weeks and then incubated in light had higher germination percentages in comparison to the same treatments in dark illumination. Not even one seed of *K. lycopifolia* germinated at 5 °C and 15/6 °C, except seeds that were treated 8 weeks with cold stratification and incubated in the darkness at 15/6 °C. This value represents the minimal germination percentage (8.8% ± 2.9) acquired for cold stratified seeds of this species.

Ligularia sibirica

The germination in the control group was the same between seeds germinating at 15/6 °C and 23 °C (Figure 1(D)); the treatments incubated in the light (36.4% ± 0.4; 36.8% ± 0.9, respectively) and those incubated in the darkness (8.4% ± 2.4; 8.0% ± 0.8) were not statistically different. The seeds stratified with warm stratification did not show any germination at all. The germination ceiling for this species was registered after 4 and 8 weeks of cold stratification at 15/6 °C in the light. There was no continuous trend of increasing germination with the duration of cold stratification period. Moreover, the germination decreased or remained in a similar range as values in the control group exposed to light if the stratification period was longer than 8 weeks. On the other hand, the seeds incubated in the darkness exhibited more or less constant values across different stratification periods that are higher than the values in the control group, with the exception of seeds that were stratified for 8 weeks and incubated at 23 °C and where seeds were stratified for 12 weeks incubated at 15/6 °C.

Genista holopetala

The seeds in the control group germinated with low percentages (< 7.3%). Germination data was acquired for both cold (Figure 1(E)) and warm stratification (Figure 1(E)), with more treatments germinating after cold stratification. A gradual trend in rise of germination due to the prolonged cold stratification was not noticed, rather the seeds germinated suddenly with relatively higher germination percentages after 12 and 16 weeks of stratification. The maximum value of germination was noted in three cases; the first two were seeds that were exposed to 12 weeks of cold stratification and then incubated in the darkness at 15/6 °C (28.0% ± 2.0) and 23 °C (29.3% ± 0.7) and in the third one, the seeds were exposed to 16 weeks of cold stratification and then incubated in darkness at 15/6 °C (26.6% ± 2.9). Regarding the warm stratified seeds, higher germination percentages were noted for the seeds that were exposed to longer periods of stratification with the same suddenness that was noticed for the cold stratified seeds, only at temperatures of 5 °C and 15/6 °C. The maximal recorded value for the warm stratified seeds was registered after 16 weeks of stratification at 15/6 °C in the dark (28.6% ± 1.3).

Discussion

Degenia velebitica

The seeds of *D. velebitica* that were not treated with any type of stratification (control group), after being adequately exposed to moisture, germinated exclusively at 23 °C. This is in coherence with the known ecology of the species—the dispersal of *D. velebitica* seeds in the wild begins in June and at that time of the year some of the seeds are non-dormant. These non-dormant seeds have the possibility to sprout if the conditions during the early summer in the natural habitat are favorable. However, immediate sprouting during the summer for this species is a rare sight; it is most likely that these non-dormant seeds will be prevented from germinating since the soil is not thoroughly dampened and such ecological parameters in the natural habitat of *D. velebitica* are usually held up until the late summer (Naumovski 2005). Overall, it seems that the results from the control group corroborate the more general premise of successful germination in seed ecology—warmer temperatures and adequate levels of moisture in the soil are one of the main environmental factors controlling the germination of non-dormant seeds of *D. velebitica*.

The considerable percentage (roughly 80%) of non-germinated seeds in the control group indicates the presence of dormancy in the mature seeds. Since in our study *D. velebitica* prefers germinating at spring (15/6 °C) and predominantly early summer temperatures (23 °C) after cold stratification, it seems that *D. velebitica* regulates germination under favorable habitat conditions through annual non-dormancy–dormancy cycle (ND-D cycle), with dormancy loss occurring in late winter. As *D. velebitica* grows in highly unpredictable habitat conditions with extreme seasonal changes, a great deal of potential fitness can be gained by preventing germination in unfavorable times of the year—avoiding summer droughts and low temperatures during the winter. That is to say, low temperatures are the absolute requirement for breakage of dormancy in *D. velebitica* since the highest germination percentages were noted for cold stratified seeds while warm stratification was completely ineffective in breaking dormancy. From the ratio of germination increase per duration of stratification we can deduce that longer stratification period enhances the germination percentage at both tested temperatures (15/6 °C and 23 °C). This indicates at the observance of negative correlation between strength of dormancy and range of temperatures on which seeds of *D. velebitica* can germinate previously described in the study by Courtney (1968). Likewise, Hyatt et al. (1999) described this relation in the perennial plant *Lesquerella fendleri* (A. Gray) S. Watson. The genus *Lesquerella* is morphologically very similar to the *D. velebitica,* so much so that these two were initially grouped into the same genus (*Lesquerella*) after *D. velebitica* was discovered in 1907 (Matijević et al. 1999). According to Baskin and Baskin (2014) this observed pattern of change in physiological response to temperature is one of the features that determine the affiliation of species to one of the five classes of seed dormancy, i.e. non-deep physiological dormancy (PD). This affiliation is further supported by the study conducted by Naumovski (2005)—seeds of *D. velebitica* are water permeable with fully developed bent embryos. Moreover, non-deep PD is the dominant type of dormancy in Brassicaceae family (Finch-Savage and Leubner-Metzger 2006; Baskin and Baskin 2014). In the light of more recent categorization of non-deep PD by Soltani et al. (2017), *D. velebitica* could belong to the Type 2, since in our experiment it firstly germinated at higher temperature and as dormancy level was lowered, it germinated at 15/6 °C as well. Based on all of the data provided here, we conclude that *D. velebitica* has non-deep physiological dormancy. To conclude with a higher degree of certainty on the affiliation of *D. velebitica* within the Type 2 categorization of non-deep PD, more research should be conducted in the future.

Temperature and moisture levels are the most prominent factors in seed germination and they moderate the depth of dormancy, but also the sensitivity to other signals, such as illumination (Bouwmeester and Karssen 1993; Derkx and Karssen 1993; Botto et al. 1998). The role of light on germination of *D. velebitica* seeds is not clear. Naumovski (2005) studied the effects of darkness on germination and concluded that light was not strictly required for germination, but seeds germinated much better in the light than in the darkness. Our data lead to the same conclusion, but also reveal that longer periods of cold stratification lead to the gradual increase of germination in the darkness. The reason behind this observation could be due to the potential cessation of light as a restricting factor for the germination, as concluded in some previous studies (Corbineau et al. 1992; Baskin and Baskin 2014). *Degenia velebitica* is growing in screes, rocky habitats where soil is deep below the layer of gravel and the seeds in this habitat are likely to survive in cracks and crevices between rocks and boulders, where there are often just small traces of light. The capability of the seeds to germinate without light in such instances could prove beneficial for higher fitness of the species. Similar results, with high germination percentages in the darkness, were recently found in the study of alpine scree species *Cerastium dinaricum* G. Beck et Szysz. (Fišer Pečnikar et al. 2018). On the other hand, observation of gradual increase of germination in the darkness of *D. velebitica* could also be explained through the intensification of seeds' sensitivity to illumination, meaning that even the smallest amounts of light were sufficient to initiate germination. This explanation is supported by the more general idea of *D. velebitica* seeds adjusting their dormancy levels in the natural habitat—entering deep dormancy during wintertime when days are shorter and gradual break of dormancy as the temperature gets warmer and the amount of daylight increases.

Our studies were limited by the small amount of *D. velebitica* seeds which we were able to collect in compliance with the permission from the national authorities. Further studies are necessary to broaden the knowledge of germination ecology and *ex situ* conservation of this narrow endemic Croatian species.

Scilla litardierei

To stimulate the germination of freshly collected seeds of *Scilla litardierei*, cold stratification pre-treatment was required and it was the only stratification type influencing the initiation of germination. Moreover, the cold stratification was also the restrictive factor for germination to occur at both temperatures (23 °C; 15/6 °C) and illumination regimes. Freshly matured seeds that exhibit such specificity for stratification have morphophysiological dormancy (MPD) (Baskin and Baskin 2014). The seeds with MPD have an underdeveloped embryo which must grow to a specific critical size under the appropriate stratification conditions for germination to occur (Baskin and Baskin 2004). *Scilla litardierei* belongs to the monocotyledons and Martin (1946) states that various monocotyledon seeds are characterized by an underdeveloped linear embryo. There are eight known levels of MPD that could be roughly grouped into two categories: simple and complex (Nikolaeva 1969; Baskin and Baskin 2004). According to Nikolaeva (1969, 1977), the seeds with intermediate and deep complex MPD require only cold stratification to break dormancy, and affiliation of one of these two MPD levels to the plant species can be concluded based on the seeds' response to the gibberellic acid (GA_3). Since germination of the seeds from *S. litardierei* was not promoted by gibberellic acid, the seeds of *S. litardierei* have a deep complex type of MPD where embryos grow during the dormancy breaking treatment in cold conditions (0–10 °C). The combination of temperature at 23 °C and at least 8 weeks of cold stratification was effective in interrupting the seeds' dormancy, promoting embryos growth and germination in this species. Other examples of monocotyledon genera with complex MPD are *Erythronium* (Baskin and Baskin 1985; Baskin et al. 1995), *Lilium* (Patterson and Givnish 2002) and *Fritillaria* (Carasso et al. 2011).

Similar to the seeds' germination at 23 °C, the incubation temperature at 15/6 °C, i.e. spring temperature also had encouraging effect for seeds to germinate with high percentages after cold stratification, especially in the darkness. To illustrate the reason behind this, we have to look into the ecology of *S. literdierei* in its natural habitat. In its wild populations in Croatia, *S. litardierei* flowers in dependence of the altitude (ca. 30–1000 m a.s.l.) and climatological conditions. Flowering happens from April to June, which is followed by seed dispersal from mid-June to August. After the dispersal in a dry period of mid-summer, the seeds of *S. litardierei* survive through the winter in a gradually weakening dormant state. Simultaneously, this is the period when embryos maturation occurs. Afterwards, the transition from wet grasslands (even periodically flooded in the karst fields) in the early spring to semidry and dry grasslands toward the mid- and late summer takes place. According to Hölzel and Otte (2004) the majority of flood-meadow species are able to germinate, under outdoor conditions, in early spring. However, successful germination and seedling establishment will often depend on the extent of flood periods. These 'temporal lakes' that can happen during springtime will consequently bury the seeds of *S. litardierei* in a lot of organic material and soil, limiting the influence of light on seeds. Thus, the observed high germination at alternating temperature (15/6 °C) in the dark after prolonged period of cold stratification is an adaptation to ensure sprouting in conditions of unpredictable duration of winter and flood period. Several studies further support this observation—Thompson and Grime (1983) report that alternating temperature can override a light requirement for germination in wetland species, and Milberg et al. (2000) report that light requirement for germination is confined to small-seeded wetland species (acc. to Martin 1946, *S. litardierei* is considered large-seeded). In addition to that, the same behaviour in germination as *S. litardierei* was described for the wetland species *Parnassia grandifolia* DC. (Albrecht and Long 2014).

Finally, the preference of *S. litardierei* for germination at 23 °C is logical, in view of its natural habitat—if the floods are absent and temperatures are high after the overwintering period, there is a good chance for successful establishment of seedlings and abundant growth. This temperature is probably closer to the optimal germination and growth temperature for this species and as such it triggers the signal in the seed for rapid germination.

Klasea lycopifolia

The seeds of *Klasea lycopifolia* in their natural habitat in the Croatian territory ripe between July and August and many seeds can remain on senescent capitula for several months, especially if there is no precipitation. The dry steppic sub-Mediterranean grasslands, which represent this species natural habitat in Croatia, is characterized by a scarce, non-continuous precipitation throughout the year and constant high temperatures, especially during the summer (Tryfon 2016). This habitat has two major rainfall peaks—during November and May (Tryfon 2016), and those periods are the most suitable for seedlings' establishment. In such a small margin of opportunity for a good fitness of species, *K. lycopifolia* needs to ensure some degree of plasticity to have a quick adaptive response to the eventual rainfall during the summer. This was registered in a form of seed behaviour of *K. lycopifolia* in our experiment in several ways. First, the results from the control group illustrates that some of the matured seeds were not dormant, which means that some seeds are capable of germinating when released from capitula if precipitation is present. Second, we found out that seeds of *K. lycopifolia* need just two days after exposure to moisture to start germinating. This would certainly be a beneficial trait in the case of mid-summer rainfall. Additionally, the seeds in the control group germinated only at 23 °C and this underlines the observed traits as adaptations for the described habitat conditions during the summer.

From the perspective of the entire experiment, seeds germinated entirely at 23 °C (with a single exception). This is consistent with the warm conditions in the Croatian habitat of this species. Furthermore, this specificity for temperature even after the cold stratification pre-treatment is consistent with the definition of conditional dormancy (CD)—a period where seeds have the ability to germinate only over a narrow range of conditions (Baskin and Baskin 2014). When considering the results from the control group, we concluded that the seeds of *K. lycopifolia* are conditionally dormant at maturity. The CD at maturity was also reported for another species of the Asteraceae family, *Boltonia decurrens* (Baskin and Baskin 2002). Furthermore, the seeds of *K. lycopifolia* most possibly cycle back and forth between CD and non-dormancy (ND) and this represents the main adaptation mechanism to ensure plasticity in the context of environmental conditions in the natural habitat during the summer. Another observation that backs up the ND as a following state after the CD is the observation noticed after the time frame of the experiment (data not shown)—seeds were gradually germinating on other temperatures besides 23 °C (e.g. 15/6 °C).

The requirement for cold stratification for enhanced germination, CD/ND cycle, freshly matured seeds with pronounced CD and water permeable seed coat are all reasons to conclude with a sufficient certainty that the seeds of *K. lycopifolia* have non-deep physiological dormancy. Through perspective of the classification discussed by Soltani et al. (2017) we group *K. lycopifolia* into sublevel of the non-deep physiological dormancy characterized by seeds that exhibit a dormancy continuum, i.e. Type 2. In this subgroup, matured seeds germinate first at high temperatures and once the ND state takes place, they have the ability to germinate at lower temperatures. The Type 2 categorization for *K. lycopifolia* is especially supported by the only case of germination at lower temperature than 23 °C, being recorded after 8 weeks of cold stratification.

The effect of light in our study had positive influence on germination, especially since the highest germination percentage was observed in seeds exposed to the light. This is reasonable since the conditions in the natural habitat have abundant amounts of light—grasslands are not shaded by dense or tall shrubs/trees. Atwater (1980) supports our data with conclusion that light can affect the germination of *K. lycopifolia,* and this effect is also present in many other species of Asteraceae family (Baskin and Baskin 2014; Valletta et al. 2016). However, Lermyte (2004) concluded that *K. lycopifolia* seeds do not need light for germination. That is somewhat true for our data as well, since all of our treatments germinated in the dark, but in our study Lermyte's observation is more relevant for the cold stratified seeds. Here we noticed that germination was more prominent in the dark when compared to the control group and we assume that this is due to the restriction of light being a decisive factor for germination in this species. The main combination of factors to stimulate germination in the summer during CD state is warm temperature, humidity and light as noted in the control group, but the most important trigger is the presence of humidity. After overwintering period, there is sufficient precipitation for seed establishment, but there might not be the same levels of illumination as those in the summer, so it is only logical for *K. lycopifolia* to moderate its dormancy state, i.e. the influence of illumination factor after cold stratification to maximally benefit from the presence of water; the factor whose deficit will later be a restriction for its survival and fitness.

Even though our studied sample displayed rather high germination (~60%), it is important to consider that complete absence of germination in a random group of seeds is common in the Asteraceae family and several factors may affect this loss: the maternal tissues surrounding the embryos i.e. differences in the seed coats (Roach and Wulff 1987); seed size (Vaughton and Ramsey 1998; Parciak 2002); the condition of the seeds, the level of maturity and the absence of embryos (Bombo et al. 2015). According to Cury et al. (2010), high percentages of seeds without embryo were discovered in the species with a strong tendency for vegetative propagation, e.g. through root buds. Several studies have shown that *K. lycopifolia* could be quite successfully propagated through rhizomes (Lermyte 2004; Abdulhak 2010). We confirm these findings as we noticed that our *K. lycopifolia* samples in the collection of the Botanical Garden quite often strive to propagate vegetatively. Moreover, we notice the same prevalence of vegetative distribution of *K. lycopifolia* on the sampling site. This indicates that many of the seeds of *K. lycopifolia* in our research could have lacked embryos and this might have influenced the success of germination. With this in mind, we recommend performing the 'cut-test' on ungerminated seeds for any future experimental research on *K. lycopifolia*.

Ligularia sibirica

In our research, many seeds of *Ligularia sibirica* in the control group germinated immediately in a wide range of tested conditions and did not exhibit dormancy at all. This indicates that most seeds are germinable as soon as they are released from capitula (Figure 1(D)). The soil in the humid meadow by the stream which is the habitat of this species in Croatia is most of the year well saturated with enough water. As such it can provide a well-resourced niche for seedling establishment after the dispersal in the late summer. Additionally, these mostly open grasslands have an abundant amount of light that can potentially have a positive effect on germination and this is reflected in our data for non-stratified seeds. When mature, some of the seeds of *L. sibirica* are non-dormant and they have the ability to germinate even in the early autumn if the conditions in the habitat are favorable and winter is postponed. This is supported by the fact that seeds germinated in the control group with relatively high percentage at 15/6 °C—alternating temperature that is most similar to spring and autumn conditions. *Ligularia sibirica* is a perennial hemicryptophyte with ground rosettes of leaves and a short rhizome (Cîşlariu et al. 2018), and as such it is debatable if the newborn plants of *L. sibirica* in Croatia could develop perennating rhizomes and sufficient protection with ground leaves before winter.

The cold stratification mildly boosts the germination rates of *L. sibirica*, but after prolonged periods of cold stratification, the overall germination levels diminish in comparison to the non-stratified seeds. *Ligularia sibirica* has a semi-dormant behaviour (Puchalski et al. 2014), meaning that it has a potential to grow during the winter if the conditions are favorable. It is possible that the seeds of this species also follow the same pattern as the mother plant—some of them have weak dormancy which is broken by cold winter temperatures or they do not develop dormancy at all. These non-dormant seeds could be more prone to rotting if favorable conditions are not met in a certain time frame. This could explain the diminishing germination trend of seeds exposed to the prolonged cold stratification. Cîşlariu et al. (2018) in their study of *L. sibirica* acquired similar results after cold stratification pre-treatment. Since the seeds of *L. sibirica* could have randomly distributed ratios of non-dormant and dormant seeds, we cannot conclude the type of dormancy present in this species with certainty. Baskin and Baskin (2014) reported that species in a variety of families originating from boreal zones are characterized by physiological dormancy. This statement, water permeability of testa and cold stratification as the exclusive factor for the rise of germination levels are well consistent with the conclusion that, if the dormancy is present, the seeds of *L. sibirica* could have non-deep PD. However, more research and data is required in order to reach a definitive conclusion on this matter.

Ligularia sibirica in Croatia is a mesophilic plant (Šegulja and Krga 1990) and this is in coherence with our data since this species germinated at both 15/6 and 23 °C throughout the whole experiment. Furthermore, it is noticeable that seeds are internally well calibrated to the conditions in their natural habitat—after 4–8 weeks of cold stratification they germinate better at spring temperature (15/6 °C).

The seeds exposed to light in the control group did germinate substantially better than those in the dark, but this sharp line of differentiation is somewhat blurred in other treatments where cold stratification was applied. The only noticeable effect of the prolonged cold stratification would be in a certain increase of germination in darkness in comparison to the non-stratified seeds, which could be due the fact that *L. sibirica* is a wetland species and it is expected that in conditions of unpredictable water levels in the habitat, the seeds could precipitate in the soil to a certain level where light is absent. In other words, light requirement for germination of *L. sibirica* after longer periods of cold stratification seems to be inhibited or even irrelevant.

It has been reported that different populations of *L. sibirica* have a pronounced variation in maximal germination rates, even in laboratory conditions. *Ligularia sibirica* from Estonian populations had value of 50% (Kukk 2003) and values from 41–73% (Ilves et al. 2013); Kļaviņa et al. (2004) reported 67% for Latvian population and Cîşlariu et al. (2018) registered 18.96% for Romanian populations. These results are mostly considered low and results from our study are consistent with them as we recorded germination maximum at ∼45%. In contrast, according to Fomina (2016), populations of *L. sibirica* from Siberia reached 100% after cold stratification. *Ligularia sibirica* is considered a postglacial relict, occurring in isolated localities in many European countries (Hegi 1987; Cîşlariu et al. 2018). Ilves et al. (2013) concluded that low genetic diversity and inbreeding depression in small populations of *L. sibirica* can influence seed production and germination ability of this species. Very similar situation is with the Croatian population of *L. sibirica*, where overall individual number is less than 500. In addition to that, this single population is geographically divided into several localities relatively close to each other (Stančić et al. 2010). Such genetically impoverished populations of *L. sibirica* consequently have low fitness, with inbreeding as one of the main contributing factor, and therefore special attention is needed. As stated by Edmands (2006) and Ilves et al. (2013), the introduction of new genotypes may be unavoidable to conserve this species in its current habitats. This situation could be due to the substantial isolation in or between populations that is more or less enhanced because of the inefficient seed dispersal mechanisms or environmental changes in the past. The seeds of *L. sibirica* are dispersed from mid-August and they have a pappus adapted for potential dispersal by wind. However, most of the seeds of this species do not travel long distances and they are mostly distributed by flowing water and they land close to the parent plant (Kobiv 2005; Šmídová et al. 2011). Thus, it is possible that natural barriers in Croatian habitat of *L. sibirica* (e.g. surrounding tree and shrub-like species belonging to *Salicion albae* and *Phragmition communis* Alliances) have been efficiently preventing seed migration even between geographically closer localities on the same river system. Moreover, analyses of extinction probabilities in small populations of *L. sibirica* in Czech Republic showed that there is a very low expectancy for long or complete life span of this species (Šmídová and Münzbergová 2012), therefore careful management, including appropriate *ex situ* and *in situ* conservation programs, are necessary for this small population of *L. sibirica* in Croatia to survive.

Genista holopetala

Most of the seeds in Fabaceae family have physical dormancy, as a consequence to impermeability of water and gas into their seed coat (Stewart 1926; Riggio Bevilacqua et al. 1989). In our study, non-stratified seeds of *Genista holopetala* germinated immediately at all three temperatures in both illumination regimes but at the relatively low rate (Figure 1(E; e)). This could only be registered if some of the seeds' coat impermeability did not develop. This is possible if there weren't any abiding dryness in the natural habitat, as noted by Long et al. (2012) and Baskin and Baskin (2014). This was presumably the case with some of the seeds of *G. holopetala* we collected. On the other hand, the low germination percentage indicates that the majority of seeds are in fact impermeable to water, and subsequently with well-defined physical dormancy (PY). This is consistent with the evidence supplied by López et al. (1999) where it is stated that species from the tribe *Genisteae* have the hard seed coat.

The majority of species from Fabaceae family with physical dormancy have non-dormant embryo, which means that when the water enters the seed, they will germinate immediately (Baskin and Baskin 2014). However, some of the species with PY could also have another type of dormancy—most usually physiological dormancy, and both PY and PD needs to be broken in order for a species to germinate (Baskin and Baskin 2014). On the first glance, our results indicate that there is an underlying PD in the seeds of *G. holopetala* since we recorded higher germination values after 12 and 16 weeks of cold stratification (Figure 1(E)) and 16 weeks of warm stratification (Figure 1(e)). However, it is more probable that they are PY with ND embryos because the raise of germination is not gradual with the prolongment of both cold and warm stratification. This is supported by López et al. (1999)—nine species from the genus *Genista* did not require stratification as they germinated in high percentages (some of them to ∼90%) immediately after scarification. This rise of germination acquired in our study after long stratification periods could be due to the breakage of the physical barrier, rather than the stratification itself. In the case of cold stratification, Baskin and Baskin (2014) said that it is possible for seeds chilled at 5 °C for over 30 days to exhibit breakdown of cells in the palisade layer of seed coat, even though the mechanism of this observation is unknown. Secondly, the prolonged warm stratification in our experiment could promote softening of the testa by microbial activity and consequently the breakage of PY. In the natural habitat of *G. holopetala* in Croatia, the seeds with physical dormancy that endured winter conditions could start sprouting because of a disrupted hardness of the seed's coat caused by mechanical abrasion from soil particles or after decomposition of the seed's coat by microbial activity. López et al. (1999) stated that the most suitable scarifying treatment for the species in the *Genista* genera is acid treatment—this points out the possible degrading action of the soil's microbial flora having the most important effect on softening of the *G. holopetala* seeds' coat.

In both warm and cold stratification pre-treatments between the seeds that managed to break PY, maximal germination values were noted for seeds that were incubated in the darkness. Moreover, seeds germinated better (or at least equally) in the darkness than in the light throughout all of the treatments conducted. The reason behind this could be in the fact that *G. holopetala* grows in sloped rocky grasslands where seeds presumably overwinter in crevices with limited light. The study conducted by Serrano-Bernardo et al. (2007) on the species *Genista versicolor* Boiss. is consistent with our observations—they also noted that darkness had a positive impact on germination. On the other hand, López et al. (1999) examined nine *Genista* species and only two of them required darkness for better germination, three species did not germinate in darkness at all, and the rest of them germinated better in the light. This indicates that the influence of darkness on seeds' germination in *Genista* is species specific, not genus and this factor is possibly more or less relevant according to the respective conditions in the natural habitat.

From the obtained data we can notice almost the same percentage of germination at both 15/6 °C and 23 °C. In its natural habitat in Croatia, *G. holopetala* grows on cold grasslands that are quite dry because of the bora; katabatic wind that blows from the higher elevations in the direction of Adriatic Sea. The sampled habitat where *G. holopetala* grows have the intermediate climate between two types as classified by Köppen: Cfb; temperate humid climate with warm summers and Df; humid boreal climate (Filipčić 1998). The winter periods in the habitat might be prolonged because of the influence of boreal climate. This mixture of climates and ecological conditions in the habitat implies that our population of *G. holopetala* could be adapted to the mildly cooler temperatures in the summer, and to both alternating and constant temperatures since night and day temperatures are distanced throughout the year. The germination of sampled *G. holopetala* could occur mid-spring or even early summer on temperatures that range from 15–20 °C and this was backed up by our results.

All things considered, for further research endeavors we suggest the continuation of the germination study with stratified seeds, on the same Croatian population of *G. holopetala*, if possible. The relatively small number of seeds that were available for this research presented a limitation that prevented us from further investigating this specific sample and impaired our efforts to provide additional information for conservation of this rare species.

Disclosure statement

Authors whose names are listed on this scientific article certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this article.

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