1998

Germination Reports of Uncommonly Cultivated Woody Plants from the North Central Regional Plant Introduction Station, 1984-1996

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NORTH AMERICAN REGIONS PLANT PROPAGATOR, SPRING 1998, VOLUME 10, NUMBER 1, PP. 15-19.

RESEARCH REPORTS

82

Germination Reports of Uncommonly Cultivated Woody Plants from the North Central Regional Plant Introduction Station, 1984-1996.

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INTRODUCTION

The North Central Regional Plant Introduction Station's curatorial responsibilities as part of the U.S. National Plant Germplasm System (White et al., 1989) and our coordination of the NC-7 Regional Ornamental Plant Trials (Widrlechner, 1990) have led us to germinate seeds of many unusual woody plants. Attempts to germinate these seeds have been documented since 1984. Many of these records are routine and duplicate information found in widely available references. However, we have successfully germinated the seeds of some species for which little is known about their germination requirements, or such information is absent from standard compendia.

This report summarizes our non-replicated experiences germinating seeds of those woody plants for which little has been reported to date, with the hope that these data will give propagators a starting point for developing reliable germination protocols for these plants.

MATERIALS AND METHODS

We reviewed our woody seed propagation files for records of seedlings produced and transplanted from seedling flats to individual containers. Negative results were omitted here because germination failure could have resulted either from our germination protocols or from seed inviability, and we also omitted all records in which the germination methodology was ambiguous or incomplete.

The remaining records were then sorted according to species to facilitate the search for recommended germination protocols for those species in six references: 1) *Seeds of Woody Plants in the United States* (Schopmeyer, 1974); 2) *Handbook of Seed Technology for Genebanks Volume II. Compendium of Specific Germination Information and Test Recommendations* (Ellis et al., 1985); 3) *The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture* (Dirr and Heuser, 1987); 4) *Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses* (Dirr, 1990); 5) *Seeds of Woody Plants in North America* (Young and Young, 1992); and 6) *Seed Germination, Theory and Practice* (Deno, 1993). In this report, we present data only for those species for which no specific germination protocols were described in the preceding key references.

Data are presented in tabular form, with taxonomic and passport information for the seed samples taken from the Germplasm Resources Information Network (GRIN) database (http://www.ars-grin.gov) (Mowder and Stoner, 1989). Seed age is estimated from records of seed collection dates or, if unavailable, from the dates when the seeds arrived. Seeds generally were stored dry at 3°C and 40% relative humidity until germination was attempted.

All references to stratification refer to moist stratification treatments (see Macdonald, 1986), with cold stratification conducted at ca. 3°C and warm stratification conducted at ca. 20°C. After the completion of stratification treatments, seed flats were held fromJanuary to May in a greenhouse with day temperatures averaging between 23-27°C in January, rising to 28-32°C in May, and night temperatures between 16-21°C in January, rising to 20-24°C in May. Any exceptions to these conditions, such as seeds germinating during the course of stratification treatments, are noted as footnotes to Table 1.

Our results are briefly discussed in relation to germination information presented in the preceding key references and from reports published in the Combined Proceedings of the International Plant Propagators' Society and other sources.

RESULTS

Eight-six records of successful seed germination are included in Table 1, encompassing 66 woody plant taxa from 29 genera.

DISCUSSION

The germination protocols we employed for *Amelanchier*, *Ampelopsis*, *Betula*, *Caragana*, *Celtis*, *Cytisus*, *Exochorda*, *Malus*, *Rhamnus*, *Sorbaria*, *Spiraea*, *Sorbus*, and *Zanthoxylum* are consistent with recommendations made by Dirr and Heuser (1987) for other species of those genera, and those for *Crataegus* and *Rubus* follow information presented in reports for those genera by Brinkman in Schopmeyer (1974). We cold-stratified seeds of *Physocarpus* for 30 days following protocols for *P. malvaceus* (Greene) Kuntze presented by Gill and Pogge in Schopmeyer (1974), and cold-stratified seeds of *Holodiscus* for 90 days, somewhat shorter than the 136 days recommended for *H. discolor* (Pursh) Maxim. by Stickney in Schopmeyer (1974). For *Acer*, *Fraxinus*, *Lonicera*, *Rhus*, *Rosa*, and *Viburnum*, it seemed that no single germination protocol was effective for all species within these genera. In general, *Acer*, *Fraxinus*, *Lonicera*, and *Viburnum* either require cold stratification or an extended period of warm stratification followed by cold stratification (Dirr and Heuser, 1987). *Rhus* generally requires an acid or hot water soak, sometimes followed by cold stratification, and *Rosa* generally requires an acid soak or warm stratification, followed by 90 days of cold stratification (Dirr and Heuser, 1987). Our successful protocols usually were encompassed by the range of these protocols,

Table 1. Seed germination protocols and results.

TAXON	ID	ORIGIN	SEED AGE (years)	PRETREATMENTS	STRATIFICATION WARM (days)	STRATIFICATION COLD (days)	# SEEDS	# GERMINATED	% GERMINATION
Acer caudatum A.E. Murray	Ames 10682	Far East, Russian Federation	<1		60	90	33	2	6
Acer mandshuricum Maxim.	Ames 13203	Russian Federation	<1		90	90	8	1	13
Acer monspessulanum L.	PI 560320	Hakkari, Turkey	3		120	90	84	12	14
Acer monspessulanum L.	PI 560321	Hakkari, Turkey	1		120	90	200	2	1
Amelanchier ovalis Medikus	PI 407330	Slovenia	11			120	200	17	9
Amelanchier sanguinea (Pursh) DC.	Ames 4179	Michigan, USA	1			120	17	8	47
Ampelopsis arborea (L.) Koehne	Ames 19055	Louisiana, USA	1			90	46	34	74
Ampelopsis cordata Michaux	PI 495597	Missouri, USA	<1			90	ca. 200	171	85
Ampelopsis cordata Michaux	PI 495598	Nebraska, USA	<1			90	ca. 200	61	30
Ampelopsis japonica (Thunb.) Makino	Ames 21480	Russian Federation	1			90	63	30	48
Atraphaxis spinosa L.	PI 418791	Afghanistan	18			14[1]	200	57	29
Betula costata Trautv. ex Maxim.	Ames 7869	Massachussetts, USA	4			30	200	12	6
Betula humilis Schrank	Ames 7839	Romania	>1			30	100	13	13
Betula occidentalis Hook.	PI 495882	Colorado, USA	4			30	300	138	46
Betula schmidtii Regel	Ames 13833	South Korea	4			30	200	31	16
Betula schmidtii Regel	Ames 20176	South Korea	1			30	200	1	1
Brunnichia cirrhosa (Walter) Shinners	Ames 10216	Illinois, USA	<1			90	10	4	40
Caragana aurantiaca Koehne	Ames 17770	Poland	2			30	35	4	11
Caragana decorticans Hemsley	Ames 10600	Poland	2	sandpaper scarification, 15 hr warm water soak			30	3	10
Caragana densa V. Komarov	Ames 17772	Poland	2	sandpaper scarification		30	7	1	14
Caragana frutex (L.) K. Koch	Ames 13823	Iowa, USA	1&1/2	sandpaper scarification, 15 hr hot water soak		30	100	84	84
Caragana frutex (L.) K. Koch	Ames 17773	Poland	2	15 hr hot water soak		30	19	5	26
Caragana roborovskyi V. Komarov	Ames 19117	Kyrgyzstan	1	15 hr hot water soak		30	200	20	10
Caragana rosea Turcz. ex V. Komarov	Ames 3020	China	>3	sandpaper scarification			18	6	33
Caragana tangutica Maxim. ex V. Komarov	Ames 17774	Poland	2	15 hr hot water soak		30	18	1	6
Caragana tibetica Maxim. ex V. Komarov	Ames 17775	Poland	2	15 hr hot water soak		30	21	14	67
Caragana tragacanthoides (Pallas) Poiret	Ames 17776	Poland	2	15 hr hot water soak		30	16	15	94
Caragana tukestanica V. Komarov	Ames 14220	Hungary	2	sandpaper scarification, 15 hr warm water soak		30	67	7	10
Caragana tukestanica V. Komarov	Ames 17777	Poland	2	15 hr hot water soak		30	10	2	20
Celtis australis L.	Ames 8080	England, United Kingdom	2			90	135	31	23
Celtis australis L.	PI 407331	Croatia	8			90	200	60	30
Celtis bungeana Blume	Ames 3022	China	1&1/2			90	8	3	38
Celtis caucasica Willd.	PI 260881	Russian Federation	28			90	25	3	12
Celtis caucasica Willd.	PI 260881	Russian Federation	27			90	122	6	5
Celtis koraiensis Nakai	Ames 3032	China	2			90	9	2	22

TAXON	ID	ORIGIN	SEED AGE	PRETREATMENTS	STRATIFICATION		# SEEDS	# GERMINATED	% GERMINATION
			(years)		WARM	COLD			
					(days)	(days)			
Celtis koraiensis Nakai	Ames 4350	North Korea	<1			90	1	1	100
Celtis tournefortii Lam.	Ames 7846	Poland	3			90	unknown	1	
Celtis tournefortii Lam.	Ames 7846	Poland	3			90	5	2	40
Crataegus erythropoda Ashe	Ames 4204	Colorado, USA	1		90	120	83	2	2
Crataegus orientalis Pallas ex. M. Bieb.	PI 348995	Macedonia	17		60	120	150	1	1
Crataegus pinnatifida Bunge	Ames 4319	Far East, Russian Federation	<1		60	135	unknown	10	
Crataegus pinnatifida Bunge var. *major* N.E. Br.	Ames 4967	South Korea	4		60	135	151	4	3
Crataegus pinnatifida Bunge	PI 254572	Maryland, USA	27		60	135	200	1	1
Crataegus pruinosa (Wendl. f.) K. Koch	Ames 7616	Ontario, Canada	3		90	120	60	1	2
Cytisus commutatus (Willk.) Briq.	PI 315687	Massachusetts, USA	<1	sandpaper scarification, 3 hrs hot water			unknown	4	
Cytisus decumbens (Durande) Spach	PI 315686	Massachusetts, USA	<1	sandpaper scarification, 3 hrs hot water			unknown	4	
Exochorda serratifolia S. Moore	Ames 16103	China	1			60	22	1	5
Fendlera rupicola Engelm. & Gray	PI 495888	Colorado, USA	<1		90	75	200	137	69
Fraxinus anomala Torrey ex S. Watson	Ames 12978	Colorado, USA	1		90	90	11	7	64
Fraxinus anomala Torrey ex S. Watson	PI 495890	Utah, USA	5		90	90	200	84	42
Fraxinus bungeana DC.	Ames 7612	Illinois, USA	<1		120	60	200	39	20
Fraxinus rhynchophylla Hance	Ames 4354	North Korea	5		60	120	11	5	45
Fraxinus rhyncophylla Hance	Ames 22265	China	1		60[2]		32	26	81
Fraxinus rhynchophylla Hance	Ames 22266	China	1		60[2]		200	156	78
Fraxinus rhyncophylla Hance	Ames 22267	China	1		60[2]		200	81	41
Fraxinus raibocarpa Regel	Ames 10183	Pakistan	1			60[3]	200	11	6
Fraxinus xanthoxyloides (G. Don) Wallich	Ames 10185	Pakistan	<1			60[4]	200	51	26
Holodiscus dumosus (Nutt. ex Hook.) A.A. Heller	PI 495893	Colorado, USA	<1			90	ca. 200	10	5
Jamesia americana Torrey & A. Gray	PI 495895	Colorado, USA	5	none (direct sow)			ca. 800	238	30
Jamesia americana Torrey & A. Gray	PI 495896	Colorado, USA	5	none (direct sow)			ca. 800	240	30
Lonicera involucrata (Richardson) Banks ex Sprengel	PI 495898	Colorado, USA	<1		30	120	200	97	49
Malus prunifolia (Willd.) Borkh.	PI 491514	China	3			90	unknown	69	
Microbiota decussata V. Komarov	Ames 19148	Czech Republic	1			90	14	7	50
Microbiota decussata V. Komarov	Ames 21484	Russian Federation	1			90[5]	32	8	25
Physocarpus monogynus (Torrey) Coulter	PI 495901	Colorado, USA	2			30	200	68	34
Physocarpus ribesifolius V. Komarov	Ames 10078	Colorado, USA	6			30	200	175	88
Pteroceltis tatrinowii Maxim.	Ames 3033	China	3			90	10	8	80
Rhamnus imeretina Booth ex Kirchner	Ames 7792	Poland	1			90	38	3	8
Rhus potaninii Maxim.	Ames 15936	Slovakia	1			60	200	24	12
Rosa woodsii Lindley	PI 495909	Colorado, USA	<1			90	200	32	16

TAXON	ID	ORIGIN	SEED AGE (years)	PRETREATMENTS	STRATIFICATION WARM (days)	STRATIFICATION COLD (days)	# SEEDS	# GERMINATED	% GERMINATION
Rubus deliciosus Torrey	Ames 8443	Oklahoma, USA	<1		90	90	16	13	81
Sorbaria kirilowii (Regel) Maxim.	Ames 12671	Uzbekistan	7	none (direct sow)			90	1	1
Sorbaria kirilowii (Regel) Maxim.	Ames 14223	Hungary	6	none (direct sow)			ca. 100	1	1
Sorbaria tomentosa (Lindley) Rehder	Ames 10200	Pakistan	<1	none (direct sow)			ca. 1000	216	22
Sorbaria tomentosa (Lindley) Rehder	Ames 10743	Poland	7	none (direct sow)			unknown	196	
Sorbaria tomentosa (Lindley) Rehder	Ames 14222	Hungary	6	none (direct sow)			400	10	3
Sorbaria tomentosa (Lindley) Rehder	PI 586631	Czech Republic	1	none (direct sow)			ca. 1000	4	<1
Sorbus graeca (Karp.) Gabrielian	Ames 7844	Hungary	1			90	19	16	84
Sorbus javorkae (Soo) Karp.	Ames 10325	Hungary	4			90	16	8	50
Sorbus latissima Karp.	Ames 10327	Hungary	4			90	6	4	67
Sorbus reducta Diels	Ames 8371	British Columbia, Canada	1			90	unknown	59	
Spiraea douglasii Hook.	Ames 12800	Washington, USA	1	none (direct sow)			unknown	1	
Spiraea tomentosa L.	PI 578120	Alberta, Canada	<1			60	unknown	107	
Viburnum cotinifolium D. Don	Ames 10201	Pakistan	<1		60	60	39	6	15
Viburnum mongolicum (Pallas) Rehder	Ames 2814	Manitoba, Canada	3		150[6]	60	63	4	6
Zanthoxylum simulans Hance	Ames 2935	Czech Republic	<1			120	149	21	14

[1] seeds placed in 20/30°C germinator after cold stratification
[2] began germinating 26 days into 60-day warm stratification
[3] returned to a second 60-day cold stratification after 60 days in greenhouse; five of the 11 seedlings resulted after doing so
[4] returned to a second 60-day cold stratification after 60 days in greenhouse; 22 of the 51 seedlings resulted after doing so
[5] returned for another 30-day cold stratification after 120 days in greenhouse; five of eight seedlings resulted after doing so
[6] three germinated by end of warm stratification

except that some samples of *Fraxinus* and the sample of *Viburnum mongolicum* required no pretreatment for germination; *Rhus potaninii* germinated without either an acid or hot water soak; and *Rosa woodsii* germinated without an acid soak or warm stratification. It should also be noted that a second cycle of cold stratification may have induced additional germination for samples of *Fraxinus raibocarpa, Fraxinus xanthoxyloides,* and *Microbiota decussata.*

Since 1981, the Combined Proceedings of the International Plant Propagators' Society have reported on germination protocols for six of the species listed in Table 1. Stimart (1982) described a protocol whereby he germinated embryos of *Acer mandshuricum* and noted that germination was accelerated by treating embryos with GA_3. Widrlechner, in Alexander (1990), described the techniques used in the present report to germinate seeds of *Caragana frutex.* Pair (1986) briefly mentioned that combined warm and cold stratification treatments were more effective than acid scarification for inducing the germination of *Crataegus pinnatifida.* Borland (1995) successfully germinated *Fraxinus anomala* after a 90-day cold stratification; perhaps our initial warm stratification (Table 1) was unnecessary. There were numerous references in the Combined Proceedings to the germination of *Rosa woodsii.* The most recent came from Macdonald (1995), who recommended a 90-day warm stratification followed by a 120-day cold stratification. Our sample germinated at 16% with only a 90-day chilling treatment. We successfully followed the recommendations of Macdonald (1988) by treating seeds of *Sorbus reducta* with a 90-day cold stratification prior to germination.

We suspected that our reports of germination protocols for the genera *Atraphaxis, Brunnichia, Fendlera, Jamesia, Microbiota,* and *Pteroceltis* might represent information new to the literature of plant propagation. Protocols for these genera are not described in the six key references nor in any of the Combined Proceedings

of the International Plant Propagators' Society. We then searched the U.S. Department of Agriculture's AGRICOLA database for relevant publications on these six genera, sampling a broad range of horticultural publications for the period 1970-1996. We found that Shaw et al. (1991) successfully germinated samples of *Brunnichia cirrhosa (=B. ovata)* without pretreatment at temperatures between 25 and 40C. Borland (1989) recommended 60 to 90 days of moist stratification at 5C to germinate seeds of *Fendlera rupicola*. And Koller (1977) reported that seedlings of *Pteroceltis tatarinowii* were grown by the Cary Arboretum without the aid of any pretreatment, although Mr. Koller recently mentioned (personal communication) that the Arnold Arboretum had employed a 90-day cold stratification to germinate seeds of this tree.

In the sharing spirit of the IPPS, we urge all members with experience germinating the seeds of woody plants unreported in the literature to join us in communicating your experiences through the publications and meetings of our Society.

Acknowledgments. Journal Paper No. J-17321 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa, Project No. 1018, and supported by Hatch Act and State of Iowa funds. We appreciate the help of Peter Bretting, Richard Faltonson, Allen Knapp, and Loren Stephens in reviewing this paper; Lisa Burke and Gary Koller in providing additional information; and Charles Heuser for originally suggesting this project.

LITERATURE CITED

Alexander, J. 1990. New plant forum.Combined Proc. Intl. Plant Prop. Soc. 40:628-636.

Borland, J. 1989. *Fendlera rupicola*. American Nurseryman 169(5):146.

Borland, J. 1995. Cuttings, clippings, and miscellany. Combined Proc. Intl. Plant Prop. Soc. 45:276-278.

Deno, N.C. 1993. Seed Germination, Theory and Practice. 2nd ed. Published by the author, State College, PA. 242 pp.

Dirr, M.A. 1990. Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Propagation and Uses. 4th ed. Stipes Publ. Co., Champaign, IL. 1007 pp.

Dirr, M.A. and C.W. Heuser, Jr. 1987. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Varsity Press, Athens, GA. 239 pp.

Ellis, R.H., T.D. Hong, and E.H. Roberts. 1985. Handbook of Seed Technology for Genebanks Volume II. Compendium of Specific Germination Information and Test Recommendations. International Board for Plant Genetic Resources, Rome. 667 pp.

Koller, G.L. 1977. Observations on a neglected species - *Pteroceltis tatarinowii*.Yearbook International Dendrology Society (London) 1976:54-56.

Macdonald, B. 1986. Practical Woody Plant Propagation for Nursery Growers. Timber Press, Portland, OR. 669 pp.

Macdonald, B. 1988. Introducing new and recommended plants - the British Columbia way. Combined Proc. Intl. Plant Prop. Soc. 38:413-416.

Macdonald, B. 1995. The propagation of some British Columbian native plants. Combined Proc. Intl. Plant Prop. Soc. 45:196-199.

Mowder, J.D. and A.K. Stoner. 1989. Information systems. Plant Breeding Rev. 7:57-65.

Pair, J.C. 1986. New plant introductions with stress tolerance to conditions in the southern Great Plains. Combined Proc. Intl. Plant Prop. Soc. 36:351-355.

Schopmeyer, C.S. 1974. Seeds of Woody Plants in the United States. Agric. Handbook 450. U.S.D.A. - Forest Service, Washington, DC.

Shaw, D.R., R.E. Mack, and C.A. Smith. 1991. Redvine (*Brunnichia ovata*) germination and emergence. Weed Science 39:33-36.

Stimart, D.P. 1982. Propagation of trifoliate maples by seed. Combined Proc. Intl. Plant Prop. Soc. 32:489-494.

White, G.A., H.L. Shands, and G.R. Lovell. 1989. History and operations of the National Plant Germplasm System. Plant Breeding Rev. 7:5-56.

Widrlechner, M.P. 1990. NC-7 regional ornamental trials: Evaluation of new woody plants. METRIA Proceedings 7:41-47.

Young, J.A. and C.G. Young. 1992. Seeds of Woody Plants in North America. Rev. ed. Dioscorides Press, Portland, OR.

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A Common Sense Approach to Disease Control and Increased Rooting Percentages of Specific Woody Ornamentals from a Propagating Bench

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For over forty two years I have been involved with propagating various woody ornamentals, first with my father's nursery, then in college both in New Jersey and California, then finally within my own company in North Carolina. Every season was a struggle with various problems, but one problem that was consistent in every year and every situation was disease control in the propagating area, and the resultant effect on rooting percentages. For the commercial nursery, consistent quantities of strong healthy liners is essential for continued profitability, whether produced on site or purchased either from liner nurseries or tissue culture laboratories. As we produce over two thirds of our liners on site, the problems of disease control are very important.

Starting in 1991, we evaluated and tested ideas for the control of disease in the propagation bench with the least amount of chemicals. Thus it was critical for us to establish not only what problem or problems we had on site, but what would be the various control methods available. Careful laboratory analysis showed that we had a tremen-

Continued on page 20