

Germination of Wildland Collected Seed by Mark Majerus

Montana Native Plant Society (MNPS) Landscape and Revegetation Committee

The germination of wildland collected seed has been a puzzle to both amateur botanists and professional scientists, as not all species readily germinate after maturity. Germination is regulated by four factors: water, gas exchange, temperature, and light. The seed embryo must imbibe water and inspire air to initiate the germination process. Temperature (both cold and warm) stimulate seed ripening and maturity, while certain warmth is necessary for actual germination. Light stimulates germination of some species while inhibiting germination of others, thus dictating planting depth of seed.

Bewley and Black (1986) described two types of seed dormancy: **embryo dormancy** (physiological) and **seed-coat dormancy** (physical).

Embryo Dormancy: First to consider is after-ripening and secondary dormancy. After-ripening is a protective mechanism to prevent seed from germinating immediately after seed shatter and varies considerably by species. Secondary dormancy can result from extreme hot or cold conditions right after seed shatter. **Stratification** is a process whereby seed is exposed to cold (usually 35°F to 40°F, 2°C to 3°C) for varying time periods (10 to 150 days) to break down inhibitors and stimulate enzymes that are necessary for germination. This simulates a winter cold treatment if seed were to be directly seeded outdoors in the fall. Stratification periods of 90 days or longer may require the use of a fungicide to control mold.

Seed Coat Dormancy: Seed coats can be hard and/or thick restricting the imbibition of water and restricting gas exchange (O₂ and CO₂). Planting seed in the fall will allow for the natural breakdown of the seed coat, but if seeding in the spring or indoors the seed coat must be broken down either physically or chemically (**Scarification**). The most common scarification technique is rubbing the seed with fine-grain sandpaper or pricking the seed coat with a needle. Seed can be soaked in sulfuric acid (H₂SO₄) or hydrogen peroxide (H₂O₂). Soak time is very critical, with a very small margin of error.

Caution: Acid treatment should be only attempted by professionals.

MNPS has attempted to find the seed size (seeds/pound) of all species listed in the following spreadsheet. Seed size of each species varies with ecotype and even by year, so the listed seed size is only a ball-park figure. The relative seed size often dictates what substrate to use in the stratification process. Seed is stratified by combining the seed with a substrate that will retain moisture for the duration of the stratification treatment. The seed may need to be separated (screened) from the substrate following the treatment. Seeds that are small (800,000 seeds/lb. or smaller) usually need to be placed on moist blotter paper or paper towels and put in zip-lock clear plastic bags. Medium size seed is usually treated in sand or a sand/peat mixture. With larger seed, vermiculite, perlite, or a combination of the two can be utilized.

The following spreadsheet is a summary of scarification and stratification techniques that have been developed by amateur plant enthusiasts and professional botanists. Therefore, this is a display of best known practices for the germination of Montana wildland collected seed and serves as a starting point for personal experimentation.

Draft, March 10, 2022

Reference: J. Derek Bewley and Michael Black. 1986. SEEDS: Physiology of Development and Germination. Plenum Press. New York and London.

The Most Common Stratification and Scarification Methods for Germination of Montana Wildland Collected Seed

Trees and Shrubs		Seeds/lb	Direct Seed Outdoors	Stratification			Substrate	Scarification		Notes	Vegetative		
Scientific Name	Common Name			Warm	Cold	Duration (days)		Physical Pretreatment	Duration		Propagation	References	
<i>Acer glabrum</i>	Rocky Mountain juniper	12,300	fall	75° F75° F75° F	90	35° F35° F35° F	120	sand/peat	H ₂ O soakH ₂ O soakH ₂ O soak	3-7 days	change water twice daily	X	6
<i>Alnus incana</i>	mountain alder	720,000	spring			none					use fresh seed	X	6
<i>Amelanchier alnifolia</i>	serviceberry	82,000	dormant fall			40° F40° F40° F	120	sand	3:1 H ₂ O:H ₂ O ₂ ---running H ₂ O rinse3:1	10 min--48 hr			6
<i>Artemisia spp.Artemisia spp.Artemisia</i>	sagebrush	1,160,000	winter on wet snow	75° F75° F75° F	21	35° F35° F35° F	14	wet paper towel/zip-lock bag					1, 3
<i>Atriplex x apteraAtriplex x apteraAtriplex</i>	saltbush	52,000	dormant fall/early spring			none							3
<i>Berberis repens</i>	Oregon grape	54,000	fall	70° F70° F70° F	60	35° F35° F35° F	150	sand/peat	H ₂ O soakH ₂ O soakH ₂ O soak	48 hr			6
<i>Betula papyrifera</i>	paper birch	1,400,000	late summer/fall/spring after pre-chill			40° F40° F40° F	75	wet paper towel/zip-lock bag			24 hour soak prior to cold strat	X	1, 6
<i>Ceanothus velutinus</i>	buckbrush	91,000	fall w/ hot water pre-treatment	water190° F water190°	till cool	35° F35° F35° F	30	perlite/vermiculite	3:1 H ₂ O:H ₂ O ₂ ---running H ₂ O rinse3:1	10 min--4 hr	rapid germ after fire		1, 6
<i>Cercocarpus ledifolius</i>	curlleaf mountain mahogany	52,000	dormant fall			35° F35° F35° F	60	perlite/vermiculite			soak in water 48 hrs before pre-chill		1, 6
<i>Cercocarpus montanus</i>	mountain mahogany	59,000	dormant fall			35° F35° F35° F	60	perlite/vermiculite			soak in water overnight		1, 6
<i>Chrysothamnus nauseosus</i>	rubber rabbitbrush	694,000	dormant fall			none					germ reduced after 2 yrs storage		1, 6
<i>Clematis ligusticifolia</i>	virgin's bower	93,000	dormant fall			35° F35° F35° F	60-180	sand/peat				X	1, 6
<i>Cornus stolonifera</i>	red-osier dogwood	18,600	dormant fall, mulched			40° F40° F40° F	60-90	sand				X	1, 6
<i>Crataegus douglasii</i>	Douglas hawthorne	23,000	dormant fall			40° F 40° F	90-120	perlite/vermiculite	acid/abrade with coarse sand	0.5-3 hr			1, 6
<i>Eleagnus commutata</i>	silverberry	3,800	late suumer/fall/spring w/ pre-chill	soak in warm water	2	35° F35° F	60	sand					1
<i>Fraxinus pennsylvanica</i>	green ash	19,000	dormant fall/mulched/spring w/pre-chill	70° F70° F	60	35° F35° F	60-150	perlite/vermiculite					1
<i>Halodiscus discolor</i>	ocean-spray	5,300,000	dormant fall			35° F35° F	120-150	wet paper towel/zip-lock bag					1, 2
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	27,000	fall	70° F70° F	60	40° F40° F	40	sand:peat	H ₂ SO ₄ SO ₄	30-60 min			1, 3, 6
<i>Krascheninnikovia lanata</i>	winterfat	160,000	spring			none					germination good for only 2 yrs		3
<i>Larix occidentalis</i>	western larch	136,000	fall	75° F75° F	21	40° F40° F	21	perlite/vermiculite			soak in water 24 hrs		1, 6
<i>Lonicera involucrata</i>	twinberry honeysuckle	327,000	fall			35° F35° F	60-90	perlite/vermiculite	---running H ₂ O rinseGA3 soak---running	24 hrs---48 hr		X	1, 6
<i>Philadelphus lewisii</i>	mockorange	5,400,000	fall			35° F35° F	60	wet paper towel/zip-lock bag					1
<i>Physocarpus malvaceus</i>	ninebark	1,000,000	fall			35° F35° F						X	1
<i>Picea engelmannii</i>	Engelman spruce	136,000	spring/mulched			none					some winter damage w/ fall seeding		1
<i>Pinus ponderosa</i>	ponderosa pine	12,000				35° F35° F	45	perlite/vermiculite	O:bleach---H ₂ O soak8:1 H ₂ O:bleach---H ₂	10 min---48 hr	no prechill for fresh seed		1, 6
<i>Pinus contorta</i>	lodgepole pine	135,000				35° F35° F	45	perlite/vermiculite	O:bleach---H ₂ O soak8:1 H ₂ O:bleach---H ₂	10 min---48 hr	alternate hot and cold to open cones		1, 3, 6
<i>Populus tremuloides</i>	quaking aspen	3,500,000	spring/on soil surface			none					hardwood/softwood cuttings	X	1, 6
<i>Populus angustifolia</i>	narrow-leaf cottonwood	1,020,000	spring/on soil surface			none					hardwood/softwood cuttings	X	1
<i>Prunus americana</i>	American plum	870	fall			35° F35° F	90-150	peat/vermiculite	H ₂ O soakH ₂ O soak	48 hr		X	1
<i>Prunus virginiana</i>	chokecherry	4,800	fall			35° F	90	perlite/vermiculite	3:1 H ₂ O:H ₂ O ₂ ---running H ₂ O rinse	10 min---48 hr		X	1, 6
<i>Pseudotsuga menziesii</i>	Douglas fir	36,000	spring			35° F	30-45	perlite/vermiculite	3:1 H ₂ O:H ₂ O ₂ ---running H ₂ O rinse	10 min---48 hr			1, 6
<i>Purshia tridentata</i>	antelope bitterbrush	15,000	fall			35° F	21-28	perlite/vermiculite	H ₂ O soak	24 hrs			1, 6
<i>Quercus macrocarpa</i>	bur oak	75	fall/mulched or spring			35° F	60-90	sand/peat			will start to sprout in cold storage		3, 6
<i>Rhus trilobata</i>	skunkbush sumac	20,000	fall after scarification			35° F	60	sand/peat	10 % H ₂ SO ₄ ---hot H ₂ O bath (95F)	30 min---5 min			1, 3, 6
<i>Ribes cereum</i>	wax currant	250,000	fall/mulched			35° F	120-180	sand/peat					1, 6
<i>Ribes lacustre</i>	gooseberry	510,000	fall/mulched			35° F	90	sand/peat					1, 6
<i>Rosa woodsii</i>	Wood's rose	50,000	fall freshly cleaned seed before they dry	75° F	60	35° F	60	perlite/vermiculite	3:1 H ₂ O:H ₂ O ₂ ---running H ₂ O rinse	10 min---72 hr			1
<i>Rubus parviflorus</i>	thimbleberry	424,000	late summer or fall w/ pre-treatment			35° F	90	sand/peat	1:3 H ₂ O:H ₂ O ₂ ---running H ₂ O rinse	15 min---24 hr			1
<i>Salix exigua</i>	sandbar willow	10,000,000	sown immediately after collection			none						X	1, 6
<i>Sambucus racemosa</i>	elderberry	225,000	fall	80° F	80	35° F	90	perlite/vermiculite					1, 6
<i>Shepherdia argentea</i>	buffaloberry	9,000	fall			35° F	60-90	sand/peat				X	1, 6
<i>Sorbus scopulina</i>	mountain ash	30,000	fall/mulched			35° F	60-90	sand/peat					1, 6
<i>Spiraea betulifolia</i>	birch-leaf spirea	1,750,000	dormant fall			35° F	60	wet paper towel/zip-lock bag					1, 6
<i>Symphoricarpos alba</i>	snowberry	77,000	fall w/ warn treatment	80° F	45-60	35° F	150	sand/peat					1, 6
<i>Yucca glauca</i>	soapweed	23,000	fall			none			rub between sandpaper H ₂ O soak	24 hr			1

Wildflowers/Forbs		Seeds/lb	Direct Seed Outdoors	Stratification			Substrate	Scarification		Notes	Vegetative		
Scientific Name	Common Name			Warm	Cold	Duration (days)		Physical Pretreatment	Duration		Propagation	References	
<i>Achillea millefolium</i>	western yarrow	2,740,000	spring seed (shallow)			none							3, 6
<i>Agastache urticifolia</i>	horsemint	1,400,000	early spring			35° F35° F35° F35° F35° F35° F	30	wet paper towel/zip-lock bag	soak in GA3 solution	24 hr	needs light/seed on surface		5, 6
<i>Agoseris glauca</i>	yellow agoseris	296,000	fall or early spring			35° F35° F35° F35° F35° F35° F	42	sand/peat					4, 6
<i>Allium cernuum</i>	nodding onion	138,000	fall			35° F35° F35° F35° F35° F35° F	60-90	vermiculite					4, 6
<i>Amorpha canescens</i>	leadplant	256,000	fall			35° F35° F35° F35° F35° F35° F	100	sand	rub between sandpaper		inoculate <i>Amorpha</i> spec. 1inoculate <i>Amorpha</i> spec. 1inoc		5
<i>Anaphalis margaritacea</i>	pearly-everlasting	3,500,000	spring (do not cover)	7/0° Falt 35° F/0° Falt	35° F/0° Falt 35° F/0° Falt	35° F/0° Falt 35° F/0° Falt	24/24 hr 8 days	perlite/zip-lock bag			alternate refrig/freezer	X	5, 6
<i>Androsace lehmanniana</i>	rock jasmine		fall or spring			35° F35° F35° F35° F35° F35° F	60	sand/peat					4, 6

<i>Angelica arguta</i>	white angelica	175,000	fall		35° F35° F35°	F35° F35° F35° F35°	90	perolite/vermiculite	soakactivated charcoal/H ₂ O soakactiv	24 hr		5, 6
<i>Antennaria microphylla</i>	rosy pussy-toes	8,000,000	fall in pots		35° F35° F35°	F35° F35° F35° F35°	42	sand/perolite			do not overwater	4, 6
<i>Aquilegia flavescens</i>	yellow columbine	400,000	fall		35° F35° F35°	F35° F35° F35° F35°	60	wet paper towel/zip-lock bag	soak in GA3 solution	24 hr		4, 6
<i>Aquilegia formosa</i>	red columbine	248,000	fall			35 F	90	wet paper towel/zip-lock bag	soak in GA3 solution	24 hr		4, 6
<i>Arabis holboellii</i>	Holboell's rockcress		spring shallow		35° F35° F35°	F35° F35° F35° F35°	30	wet paper towel/zip-lock bag			short lived	4, 6
<i>Arctostaphylos uva-ursi</i>	kinnikinnik	41,000	fall - may be 2 yrs before emergence	5° F75° F75° F75° F75°	60-90	F40° F40° F40° F40°	60-90	perolite/vermiculite	akpour boiling H ₂ O over seed-let soakp	24 hr	X	2, 6
<i>Arenaria capillaris</i>	mountain sandwort	3,800,000	fall		35° F35° F35°	F35° F35° F35° F35°	60	wet paper towel/zip-lock bag				5, 6
<i>Arnica cordifolia</i>	heart-leaf arnica	220,000	spring		35° F35°	F35° F35° F35° F35°	60	sand/peat	k in H ₂ Osoak in H ₂ Osoak in H ₂ Osoak in H	4 hr		3, 6
<i>Arnica latifolia</i>	mountain arnica	450,000	spring			none						3
<i>Artemisia frigida</i>	fringed sagewort	4,300,000	winter on wet snow or spring		35° F35° F35°	F35° F35° F35° F35°	10	wet paper towel/zip-lock bag			may be an after-ripening period	3, 4, 6
<i>Asclepias speciosa</i>	showy milkweed	72,000	early spring		35° F35° F35°	F35° F35° F35° F35°	30	sand/peat				5
<i>Astragalus bisulcatus</i>	two-groove milkvetch	400,000	early spring		35° F35° F35°	F35° F35° F35° F35°	10	sand/peat	rub between sandpaper		inoculate Type <i>Astragalus</i> spec. 1.inoculate	type <i>Astragalu</i> 5
<i>Astragalus canadensis</i>	Canada milvetch	300,000	early spring		35° F35° F35°	F35° F35° F35° F35°	10	sand/peat	rub between sandpaper		inoculate Type <i>Astragalus</i> spec. 1.inoculate	type <i>Astragalu</i> 3, 5, 6
<i>Astragalus crassicaulus</i>	ground plum	83,200	early spring		35° F35° F35°	F35° F35° F35° F35°	10	sand/peat	rub between sandpaper		inoculate Type <i>Astragalus</i> spec. 1.inoculate	type <i>Astragalu</i> 3, 5, 6
<i>Astragalus drummondii</i>	wooly milkvetch	220,000	early spring		35° F35° F35°	F35° F35° F35° F35°	10	sand/peat	rub between sandpaper		inoculate Type <i>Astragalus</i> spec. 1.inoculate	type <i>Astragalu</i> 5
<i>Astragalus kentrophyta</i>	mat milkvetch		fall		35° F35° F35°	F35° F35° F35° F35°	10	sand/peat	rub between sandpaper		inoculate Type <i>Astragalus</i> spec. 1.inoculate	type <i>Astragalu</i> 4
<i>Balsamorhiza sagittata</i>	balsamroot	79,000	spring or fall		35° F35° F35°	F35° F35° F35° F35°	60-90	sand/peat				3, 6
<i>Besseyia rubra</i>	tall kittentail		fall		35° F35° F35°	F35° F35° F35° F35°	90-120	wet paper towel/zip-lock bag				4
<i>Brickellia grandiflora</i>	large-flowered brickellia		fall		35° F35° F35°	F35° F35° F35° F35°	60-90	wet paper towel/zip-lock bag				4
<i>Brodiaea douglasii</i>	wild hyacinth		fall		35° F35° F35°	F35° F35° F35° F35°	90	wet paper towel/zip-lock bag				4
<i>Calochortus eurycarpus</i>	big-pod mariposa	165,000	fall		35° F35° F35°	F35° F35° F35° F35°	40-60	sand/peat				4, 6
<i>Calochortus nuttalli</i>	sego lily	190,000	fall		35° F35° F35°	F35° F35° F35° F35°	40-60	sand/peat				4, 6
<i>Caltha leptosepala</i>	marsh marigold	400,000	fall	75° F75° F75° F75° F75°	90	35° F35° F35° F35°	60-90	sand/peat				5, 6
<i>Camassia quamash</i>	camas	65,000	fall or early winter		35° F35° F35°	F35° F35° F35° F35°	90-120	sand/peat				5, 6
<i>Campanula rotundifolia</i>	harebell	1,200,000	spring		35° F35° F35°	F35° F35° F35° F35°	30	wet paper towel/zip-lock bag				5, 6
<i>Castilleja linarifolia</i>	wyoming paintbrush	4,086,000	spring		35° F35° F35°	F35° F35° F35° F35°	30	wet paper towel/zip-lock bag				6
<i>Castilleja miniata</i>	scarlet paintbrush	325,000	fall		35° F35° F35°	F35° F35° F35° F35°	90	wet paper towel/zip-lock bag				6
<i>Chamerion angustifolium</i>	fireweed	7,125,000	fall		35° F35° F35°	F35° F35° F35° F35°	30-60	sand/peat			needs light/plant on soil surface	5, 6
<i>Chaenactis douglasii</i>	dusty maiden	350,000	fall		35° F35° F35°	F35° F35° F35° F35°	60	sand/peat				4
<i>Clarkia pulchella</i>	clarkia	1,790,000	fall			none						4, 6
<i>Cleome serrulata</i>	Rocky Mountain beeplant	74,300	spring or fall		35° F35° F35°	F35° F35° F35° F35°	30	sand/peat				5
<i>Cornus canadensis</i>	bunchberry	67,000	fall	0° F70° F70° F70° F70°	60	F35° F35° F35° F35°	70-100	perolite/vermiculite				4, 6
<i>Crepis acuminata</i>	hawksbeard	800,000	fall		35° F35° F35°	F35° F35° F35° F35°	60	perolite/vermiculite	akpour boiling H ₂ O over seed-let soakp	24 hr		3, 6
<i>Cryptantha celosioides</i>	miner's candle		fall		35° F35° F35°	F35° F35° F35° F35°	30-60	perolite/vermiculite				4, 6
<i>Dalea candida</i>	slender white prairieclover	278,000	spring			none					dehull/inoculate Type M	3, 5, 6
<i>Dalea purpurea</i>	purple prairieclover	240,000	spring			none					dehull/inoculate Type M	3, 5, 6
<i>Delphinium bicolor</i>	larkspur	364,000	spring or fall			none		sand/peat			dry storage (6 months)	4, 6
<i>Dodecatheon pulchellum</i>	shooting star	4,300,000	fall		35° F35° F35°	F35° F35° F35° F35°	60	wet paper towel/zip-lock bag			needs light/plant on soil surface	5, 6
<i>Douglasia montana</i>	douglasia		fall (year old seed)	0° F70° F70° F70° F70°	42	F35° F35° F35° F35°	90	wet paper towel/zip-lock bag				4, 6
<i>Draba oligosperma</i>	few-seeded draba		fall		35° F35° F35°	F35° F35° F35° F35°	90	wet paper towel/zip-lock bag				4, 6
<i>Dryas drummondii</i>	yellow mountain avens	908,000	spring or fall		35° F35° F35°	F35° F35° F35° F35°	60-90	sand/peat				4, 6
<i>Echinacea angustifolia</i>	purple coneflower	96,000	fall		35° F35° F35°	F35° F35° F35° F35°	30-60	sand/peat				3, 4, 5, 6
<i>Erigeron speciosus</i>	showy fleabane	900,000	spring			none						4
<i>Eriogonum flavum</i>	yellow buckwheat	220,000	fall		40° F40° F40°	F40° F40° F40° F40°	90	sand/peat				4, 6
<i>Eriogonum ovalifolium</i>	cushion buckwheat	285,000	fall			none						3, 4, 6
<i>Eriogonum umbellatum</i>	sulfur buckwheat	191,000	early spring		40° F40° F40°	F40° F40° F40° F40°	30					4
<i>Eriophyllum lanatum</i>	Oregon sunshine	1,800,000	early spring		35° F35° F35°	F35° F35° F35° F35°	21	wet paper towel/zip-lock bag				4, 6
<i>Eritrichium howardii</i>	alpine forget-me-not		early spring		35° F35° F35°	F35° F35° F35° F35°	30	wet paper towel/zip-lock bag				4, 6
<i>Eucephalus engelmannii</i>	Engelman aster	1,000,000	spring			none						3
<i>Erythronium grandiflorum</i>	glacier-lily	86,000	spring			none						3
<i>Fragaria virginiana</i>	wild strawberry	300,000	fall		35° F35° F35°	F35° F35° F35° F35°	60	wet paper towel/zip-lock bag				5, 6
<i>Fritillaria atropurpurea</i>	chocolate lily		fall		35° F35° F35°	F35° F35° F35° F35°	90	wet paper towel/zip-lock bag				4
<i>Fritillaria pudica</i>	yellow bell		fall		40° F40° F40°	F40° F40° F40° F40°	90-120	wet paper towel/zip-lock bag				4, 6
<i>Gaillardia aristata</i>	blanketflower	159,000	spring			none						3, 4, 6
<i>Gallium boreale</i>	northern bedstraw	725,000	spring		35° F35° F35°	F35° F35° F35° F35°	30	wet paper towel/zip-lock bag				5, 6
<i>Gaura coccinea</i>	scarlet gaura	224,000	fall		35° F35° F35°	F35° F35° F35° F35°	60	sand/peat				5
<i>Gentian affinis</i>	prairie gentian		spring		10° F10° F10°	F10° F10° F10° F10°	21	perolite/vermiculite	rub between sandpaper		soak in GA3 solution may help	4, 6
<i>Geranium richardsonii</i>	white geranium	45,000	fall		35° F35° F35°	F35° F35° F35° F35°	42	sand/peat	rub between sandpaper			4, 6
<i>Geranium viscosissimum</i>	sticky geranium	55,200	fall	ot H ₂ Ohot H ₂ Ohot H ₂ O	5-10 min	F35° F35° F35° F35°	30	sand/peat	rub between sandpaper		soak in cold H ₂ O overnight after hot H ₂ Osoa	in cold H ₂ O o 4, 6
<i>Geum macrophyllum</i>	large-leaved avens	793,000	spring			none						6
<i>Geum triflorum</i>	prairiesmoke	450,000	fall		35° F35° F35°	F35° F35° F35° F35°	30	sand/peat				4, 5, 6
<i>Gilia aggregata</i>	scarlet gilia	1,000,000	early spring		35° F35° F35°	F35° F35° F35° F35°	21	wet paper towel/zip-lock bag				4, 6
<i>Haplopappus acualis</i>	cushion goldenweed		fall		35° F35° F35°	F35° F35° F35° F35°	60	sand/peat			seed deteriorates after 2 yrs	4

<i>Townsendia montana</i>	mountain townsendia		early spring			none							4
<i>Vicia americana</i>	American vetch	46,400	spring			none			dehull and rub with sandpaper		inoculate Type C		3
<i>Viola nuttallii</i>	yellow montane violet	450,000	fall			35° F	60-90	perlite/vermiculite					6
<i>Wyethia amplexicaulis</i>	mule's ears	30,500	fall			35° F	60	sand/peat					4, 6
<i>Xerophyllum tenax</i>	beargrass	217,000	fall			35° F	90	sand/peat					4, 6
<i>Yucca glauca</i>	yucca	28,800	spring			none			sandpaper H ₂ O soak	24 hr			4, 6
<i>Zygadenus elegans</i>	mountain death camas	419,000	fall			35° F	21						4

References:

1. Young, James A. and Cheryl G Young. 1992. Seeds of Woody Plants in North America. Dioscordes Press, Portland OR
2. Young, James A. and Cheryl G. Young. 1986. Seeds of Wildland Plants. Timber Press, Portland OR
3. USDA/NRCS Plant Materials Center. Bridger, MT
4. Morrison, Shiela. 2003. The Magic of Montana Native Plants: A Gardeners Guide to Growing Over 150 Species From Seed. Montana Native Plant Press, Missoula, MT
5. Prairie Moon Nursery Winona, MN prairiemoon.com
6. Native Plant Network: Propagation Protocol Database npn.rngr.net

Seeds/Pound Sources

Granite Seed and Erosion Control Lehi, UT graniteseed.com

Majerus, Mark and Lee Arbuckle. 2012. Harvestability of Native Wildflowers. Native Seedsters, Billings, MT

Prairie Moon Nursery Winona, MN prairiemoon.com

Wiese, Jessica. 2005. Native Plant Seed Weights. Glacier National Park, Montana.

Young, James A. and Cheryl G. Young. 1992. Seeds of Woody Plants in North America. Sioscordes Press, Portland OR

Draft, March 10, 2022