NATIVE PLANTS, NATURAL LANDSCAPES

WILD ONES FRONT RANGE CHAPTER

Germination Guide for Native Seeds

Jan Midgley 7/9/24

INTRODUCTION AND EXPLANATION OF TERMS

Plants can be increased in numbers in several ways. The four main methods are seeds, cuttings, division and tissue culture. The latter three methods produce clones, plants that are an exact genetic duplication of the parent plant.

Seed germination is the focus of this guide because seed grown plants provide genetic diversity and more assurance for the longevity of a species. They have the strongest resistance to disease and the vagaries of soil and climate. Weak plants die and no longer contribute to the gene pool. When too many cloned plants occupy an area, they are all equally susceptible to disease, insects or the challenges of a changing climate.

Outcrossing, pollinating with a different plant of the same species, is essential to maintain diversity and for seed fertility. Animals and insects can roam around looking for a partner, but plants are stationary. They employ various mechanisms to avoid self pollination.

If an individual plant has both sex organs, how does it avoid self fertilization? It depends on whether it has imperfect or perfect flowers.

Imperfect flowers do not have both sex organs. Imperfect flowers can be dioecious or monoecious. In dioecious plants, the male flowers and female flowers are on different plants. Cross fertilization is essential. A good example is poplars. In monoecious plants, the male flowers and female flowers are on the same plant but not part of the same individual flower. They can avoid self pollination by flowering at different times.

Most angiosperms (ovules and seeds are enclosed in an ovary) have perfect flowers. Each flower has both male and female organs. Some might have different lengths of stamens and styles. Or they might rely on genetic or biochemical mechanisms to prevent development of the pollen grain into an embryo.

If you want to collect fertile seeds, you need genetically diverse parents of the same species. One plant or several which are clonally produced cultivars will not produce a healthy fertile seed.

Provenance, the place of origin, matters. Whenever possible use plant material that originates from as close to the intended planting site as possible. Even within the natural range of a species, climate and soils can vary dramatically. Seeds from a state several ranks away may produce a plant that lives the first year but dwindles over time and eventually dies. As climate changes we will be including plants from different regions to our plant palettes. Experimentation and shared information will guide us.

This germination guide is a work in progress. The information I gather every year either validates, modifies or negates the methods I suggest. I edit the guide every 6-9 months.

The nomenclature reference is *The Flora of Colorado* by Jennifer Ackerfield, 2nd edition, 2022.

Temperature is in Fahrenheit degrees. A hyphen between two numbers, ex. 60-80˚, indicates a range between the two numbers. A slash between two numbers, ex. 70˚/40˚, indicates the daytime and the night time temperatures.

Abbreviations:

ASAP - as soon as possible
C - cover well
lt C - light cover
vlC - very light cover
d = days
w = weeks
m = months
L = light
D = dark
L = D means no light or dark requirement
germ. = germinated
OT = outdoor treatment
strat = stratification

70(40d) = 70˚ for 40 days
40(3m) = 40˚ for 3 months
40-70 = 3 months at 40˚F followed by a temperature shift to 70˚F.
40-70-40-70 = 3 month cycles at temperatures of 40˚F and 70˚F

SEED COLLECTION

When collecting seeds in the wild, have the proper permits and never collect more than a few seeds from a few plants within a stand of plants. A pinch of seeds produces a large number of plants.

WHEN

Seeds can mature anytime from two weeks to a year after the plant flowers. The seed container will change from green to yellow, tan, brown or black. If fleshy material (an aril) covers the fruit, the color will turn white, red, blue, pink, etc. Watch for color changes and for splits along seams. Some species have explosive capsules. If the plant has ballistic seeds, clip the capsule before the seeds are ejected and put them in a paper bag to explode or bag the capsules.

HOW

Various methods suit different plant families.

Seeds of some aster family species can be plucked from the receptacle once they are fluffy and release easily. Others in the family are spiky (ex. Echinacea). Let them get extremely dry. Then cut the entire head into a paper bag.

For ballistic dispersers many of which are in the mustard family, cut the entire stalk once one fruit explodes.

Strip seeds from the stalks of grass family plants. Ripe seeds will release easily in your hand.

CONTAINERS

Collect dry seeds in paper bags.

Some seeds need to remain moist. This category includes seeds with an aril (fleshy or sometimes hard, colorful material that surrounds the seed) or an elaiosome (an oily, fleshy attachment to the seed). The edible fruit of *Prunus americana* (Wild Plum) is an aril. *Erythronium grandiflorum* (Glacier Lily), violets and *Carex inops* (Sun Sedge) have elaiosomes. Place these seeds in a re-closeable plastic bag.

TRIAGE FOR INSECTS

As soon as possible, examine the plant material for insect activity. Freeze the entire mass or the cleaned seeds if the seeds are being damaged.

FREEZING

Larvae of insects can damage the seeds of some species. Some highly susceptible species are members of the legume family, gentians and iris. Freezing well dried seeds for 2 weeks will kill most insect larvae.

SEED CLEANING

Dry seeds can remain in the paper bags for a few days to several weeks. The goal in cleaning seeds is to rid the seeds of spent petals, sepals, capsules, stems, leaves and critters. Work over a clean sheet of white paper on a tray. If you cannot break the material apart by hand, various tools help. Crush hard capsules with a rolling pin. Scrape the mass of plant material across a coarse soil sieve. A hard rubber dog toy can save your knuckles. Sift the material through various grades of sieves to separate the seeds from the chaff. A hair dryer on low speed held below a sieve and gradually moved closer as the sieve is shifted left and right helps remove chaff. A small to moderate amount of debris does not interfere with seeds that are hand sown.

To identify what bit is the seed, use a 10X hand lens or a microscope. To check for fertility, press against the middle of the seed with a fingernail. If it collapses easily, it is infertile.

Seeds encased in fleshy material benefit from having the material removed, because it contains a germination inhibitor. In nature the flesh would be removed by passing through the intestinal tract of a bird or some other animal. Soak the seeds in water for a day or even a week to let the fruit ferment and soften. Then rub the mass in a sieve or strainer. Rinse well.

An alternative method for cleaning fleshy fruits other than fermenting and sieving, is to use a hand held immersion blender. Put the seeds into a sturdy, tall plastic container. Fill it about half full with water. Pulse the blender on low for several seconds. Repeat a few times if necessary. The seeds should sink. The pulp floats to the top and can be dumped off. Fill the container with water again and dump the debris again. Repeat as necessary. If you question the hardness of the fruit, test a few before whizzing the lot.

Seeds with an elaiosome are dispersed by ants (myrmecochory). The elaiosome can be removed, but it is a slippery, difficult task and is not necessary.

SEED STORAGE

Place the seeds in paper envelopes. Write the name of the plant, the date of collection, the location, and the elevation on the envelope. Place the envelopes in a waterproof container of glass, plastic or tin.

Many seeds are viable for five years or more. Never give away all of your seeds of a species unless it is only viable for a year. Some species fail to set seeds every year. For seeds that need to after-ripen, it is convenient to sow seeds from a previous year's collection.

In arid climates seeds can be stored at household temperatures. I prefer storing them in the refrigerator at around 40˚F. This temperature slows the metabolism rate of the seeds which prolongs viability and vigor. Shoeboxes full of coin envelopes pack efficiently on refrigerator shelves.

Arillate seeds or seeds with an elaiosome can hold several weeks in the refrigerator if they are packed in a re-sealable plastic bag containing barely moist sphagnum moss.

DORMANCY

Some seeds are mature upon collection and could germinate if sown right away. Others have some type of obstacle that prevents the seeds from germinating too early. This is nature's system to help the seeds germinate at the most auspicious time for their survival. Some potential problems include a formed but immature embryo, a hard seed coat, a germination inhibitor in the fruit or a physiological need for warm or cold temperatures or cycles of warm and cold, and finally light or dark. If you do not know the germination requirements of a species, try to replicate what would happen in nature.

AFTER-RIPEN

Seeds that require after-ripening may take one to six months before the embryo is ready to respond to moisture and begin growing. Store these seeds dry on the shelf or in the refrigerator until they are mature enough to germinate.

TEPID WATER SOAK

Soak in tepid water for twelve to twenty-four hours before sowing.

LEACH CHEMICALS

One of the obstacles to germination may be chemicals in the seed coat. To speed the germination process, either bubble aerate or soak and rinse the seeds for 3 days or more.

To bubble aerate, put about 1.5-2 quarts of water in a container and insert the bubbler end of an aquarium aerator into the water. Place the seeds into a "favor bag", a small mesh bag, available from craft stores. Add a marble to the seeds in the bag to keep the bag from floating. Each day change the water. This set up does not need to be in natural light.

Lacking an aquarium bubbler, put the seeds in a small glass bowl and soak the seeds for 3 days or more. Again change the water every day. I usually set the bowl on a windowsill. As far as I know, daylight is not required for the leaching process. Light can encourage radicle emergence for other reasons.

SCARIFICATION

Some seeds (ex. legumes) have a thick, hard seed coat. Water (and oxygen) cannot get through this outer layer to the embryo. In nature the seed coats are scarred by passing though an intestinal tract where they are exposed to acid and perhaps the scouring action of grit in a gizzard. Or alternating freezing and thawing temperature may create a crack in the seed covering.
In order to crack these hard seed coats, we use a chemical or physical method of scarification or both.

Professionals might use sulfuric acid with a strength of 90%. This requires a ventilation hood and serious lung protection. It is also flammable. I am able to buy sulfuric acid 10%. I still wear goggles, long heavy rubber gloves and an apron. I only use glass or plastic vessels and utensils. Sulfuric acid reacts with metal.

In the chemical category, homeowners can also try 3% hydrogen peroxide in various concentrations to etch the seed coat.

Physical methods include a hand file, an emery wheel, nail clippers or two sheets of sandpaper. Place one piece of sandpaper on a stable surface. Better yet, stick a sheet of skate board grit onto an old cookie sheet with sides. Put the seeds on the abrasive surface and rub sandpaper blocks over the top for a few seconds until the surface of the seed looks duller. Choose the grade (fine, medium, coarse) of sandpaper block that is required for the specific species. Start gently and gradually increase the grade of grit and the intensity. Test one or two seeds to avoid crushing a whole batch of fragile seeds.

BOILING WATER SOAK

Place the seeds in a small, heat proof bowl. Bring water to a boil. Take it off the heat. When the bubbling stops, pour the water over the seeds and let them soak twelve to twenty-four hours before sowing. The seeds should swell to about double in size. If they do not, retreat the ones that have not imbibed water.

STRATIFICATION

Seeds that have physiological dormancy require stratification. <u>All stratification involves moisture and temperature changes.</u> At lower temperatures, more oxygen is soluble in water, and the oxygen needs of an embryo are more easily met.

The generally accepted temperatures are 40˚F for cold treatment and 70˚F for warm treatment. A household refrigerator generally maintains a temperature around 40˚F. These temperatures do not need to be exact unless you plan to conduct publishable research.

Cold Stratification

Cold stratification can be accomplished in two places, outdoors or in the refrigerator.

Outdoor treatment or OT, means you sow the seeds in medium in a container (cells, pots, milk jugs, plastic bags, etc.) in late fall, winter or very early spring. The timing depends on the amount of time required by each species. Place on the north side of a building if possible. Protect the containers from rodents and birds.

A cold moist treatment can also be accomplished in a household refrigerator. Place the seeds in a re-sealable plastic bag with a few tablespoons of builders' sand (sterilized) or vermiculite. Add 2 tsp. of water. Once a week, remove the bag from the refrigerator and add water. Feel the medium to decide how many drops of water to add. For two Tbsp. of medium, 8-12 drops of water should be sufficient each week.

Warm Stratification

Some species require a warm, moist stratification first, followed by cold, moist stratification. Start the seeds in July or August outside if possible. In colder months, warm stratification can be done indoors in a plastic bag or clear container. Label the bag or can. Add 2 Tbsp. of vermiculite or perlite, the seeds and about 2 tsp. of water. Maintain a temperature close to 70˚. Check the contents weekly and add water as necessary to maintain a barely moist medium.

SMOKE

Prepare a dilute smoke solution by adding one part commercial smoke flavoring to nine parts water. Either soak the seeds in this solution overnight (or until they swell), or water the pot or flat once with this solution. J. L. HUDSON, SEEDSMAN

Liquid smoke is found in the grocery store in the bbq seasoning section. The ingredients should only list smoke and water! You may need to find the product online.

"Some native species that responded favorably to smoke treatments include antelope bitterbrush, big sagebrush, Great Plains tobacco, Indian ricegrass, white sage, beargrass, scarlet bugler, and big sagebrush (Blank and Young 1998; Landis 2000). Success with this novel treatment will require trials; keep good records."

https://www.fs.fed.us/rm/pubs_series/wo/wo_ah730/wo_ah730_133_151.pdf

SEED STERILIZATION

If you plan to stratify seeds in a paper towel in the fridge, you may want to sterilize the seeds with a bleach solution. Seeds in paper towel sometimes develop mold especially if they are infertile. Using vermiculite or perlite instead of the paper towel helps to avoid the mold issue but makes it more difficult to keep records of radicle emergence. I am not sure if sterilization is a good idea for heavily scarified seeds. It may also eliminate beneficial bacteria and fungi.

Mix 1 part household bleach with 9 parts water. (DI water if you have it.) Dip the seeds into the solution for 1 minute. Then rinse well. Disposable tea bags are a handy container.

KEEP RECORDS

Record the starting date on a calendar and label the container. Write a reminder in your calendar on the day the stratification will finish so you will remember to advance the seeds to the next stage.

LIGHT OR DARK REQUIREMENT

Many seeds require light to germinate. When surface sowing the seeds, press them into the soil. A ventilated clear dome cover can protect the seeds from wind. Another option is to sprinkle a very light cover of vermiculite over the seeds (vIC). A very light cover holds moisture around the seeds without blocking light.

For species that require dark to germinate, cover the seeds with medium. In addition to soil cover, layers of newspaper or cardboard over the flat, blocks light thoroughly. Weight the paper. Check underneath the paper every day starting at day eight to ten. Remove the paper as soon as cotyledon leaves start to emerge.

GERMINATION ENVIRONMENT

Outdoors, the flat should be placed in 40-50% shade when winter sown. Soon after the cotyledon leaves emerge, gradually move the flat into more light. The seeds of species sown in spring to summer should be exposed to the light and wind they will experience ultimately.

Maintain moisture in the soil mix by covering the flats with snow or watering by hand as necessary. Domes for flats, milk jugs or plastic bag containers can help maintain a humid environment around the seeds. But be careful! If a container of seeds is in a humidity chamber in full sun at high elevation, the chance of cooking the seeds is high. Know your own situation!

When germinating seeds under artificial lights be sure to ventilate humidity chambers.

MEDIA

Germination Mix - fine grade peat moss, fine grade perlite, fine grade vermiculite, dolomitic and calcitic limestone, non-ionic wetting agent, standard seedling fertilizer starter charge (minimal amount of fertilizer).

Potting Mix - coarse grade peat moss, coarse grade perlite, dolomitic and calcitic limestone, wetting agent, fertilizer starter charge

Because peat moss is difficult to wet, wetting agents are added to help it wet more easily.

INGREDIENTS
Peat moss - Peat moss decomposes very slowly, retains moisture in the potting mix while providing a balance of air space and water for healthy growing roots. Peat is acidic (low pH) and limestone is usually added to the mix to neutralize the acidic reaction and balance the pH.
Perlite - small white irregular shaped, **volcanic rock** that was crushed and heated. The heating causes it to expand. It is non-toxic, sterile and odorless. Perlite is used to improve drainage and aeration. [I use expanded shale in the soil of my gardens. Perlite is not bird friendly.]

Vermiculite - very light, grayish puffy substance that forms when **mica chips** are heated. It contains some potassium, magnesium and calcium that will slowly become available. It is used to increase moisture and nutrient retention in mixes since it can also hold onto fertilizer for a period of time - helping to keep nutrients around the roots of your plants instead of washing out the bottom of the pot.

Ingredients definitions from https://ag.umass.edu/home-lawn-garden/fact-sheets/bagged-potting-mixes-garden-soils-for-home-gardeners

Some mixes contain coir instead of peat. Fine pine bark or charcoal might be included. The proportions of the various ingredients can vary.

Commercial mixes are soil-free so they are considered sterile, free of weed seeds and pathogens.

AMENDMENTS

Adding soil to a commercial mix might encourage germination and healthy growth. Many native plant species benefit from the action of soil mycorrhizae. These are specific to the species.

Using some soil from the site where the seeds originated, or as close as possible, might be the key to seed germination. Most of the seeds that germinate readily at 70˚ do not need this extra boost. I do not recommend adding soil to mixes used for indoor or greenhouse growing. Soil diseases thrive in warm humid environments.

Native soil should not be “sterilized” in any way. Baking or microwaving the soil will eliminate the beneficial organisms. The drawback to adding soil to a commercial mix is the presence of weed seeds. Let seedlings develop for a short time until you are sure you want to pull a volunteer. It might be another native plant.

For extra drainage, add perlite, coarse squeegee, expanded shale or road base gravel. Choose road base gravels based on the dominant rock in the area where you live and intend to plant the plants.

For moisture retention, add vermiculite or compost. Compost that has animal manures might have extra sodium.

CONTAINERS

Pots of any shape are fine as long as they have plenty of drainage holes. Tall and skinny drains better than short and fat and accommodates tap roots.

For seed germination, using new clean cell packs or trays reduces disease problems, especially if the trays are going into a greenhouse. For greenhouse use of recycled containers, soak them overnight in a 10% solution of household bleach. Rinse and brush them well. For containers that stay outdoors, rinsing and brushing with water are adequate cleansing.

SEED SOWING

Spread the pre-moistened germination medium in the container. Bounce the tray on the potting bench to settle the medium. Add medium as needed but do not compress the mix aggressively. Air spaces in the medium are essential. Water gently but thoroughly before sowing the seeds. For larger seeds, place two seeds in a cell or space them in rows in a community flat. For small seeds, sow lightly over the top of the medium. Cover very small seeds or seeds that need light to germinate with a very light sprinkle of cover. This minimal cover retains a bit of moisture without blocking light. Cover large seeds to a depth equal to the diameter of the seed. Gently water again or bottom water and label the tray with the name of the plant and the date.

Place the flat outside on a mesh flat, wire fencing panels or gravel. Direct soil contact exposes the seedling to slugs, pill bugs, earwigs and snails.

FERTILIZER

When seedlings develop true leaves, fertilize once every week or two with half-strength liquid fertilizer that has N-P-K in equal proportions.

If you used soil as the germination medium, fertilizer for seedlings is not necessary.

Larger plants can be fed with liquid fertilizer or a slow release fertilizer which is incorporated in the mix or sprinkled on top (1 tsp. for a qt. pot, 1 Tbsp. for a gal. pot)

Once the native plant is in the ground fertilizer is unnecessary.

TRANSPLANTING

If plants are started in cells, transplant to 2.5” - 3.5” pots as soon as the seedlings have 2 sets of true leaves. A clam knife is a handy tool for lifting an entire plug from the cell tray. It is a dull knife with an inch-wide blade. Another version has a half inch-wide blade and is good for lifting very small plugs.

Plants started in larger containers may not need to be planted or transplanted to a larger container until the fall.

INDIVIDUAL SPECIES

E (easy) - M (moderate ease) - D (difficult)

FORBS

D *Abronia fragrans* (Fragrant Sand-verbena) - Nyctaginaceae
In fall or mid winter, scarify the seeds (acid 10 minutes plus rinsing or sandpaper), soak 12-24 hours, sow in situ. Cover the seeds to depth. 47% germination 2023.
Sulfuric acid 10% for 10 minutes cracks the seed coat. The seeds require at least 2 months of cold moist treatment after scarification.
Untreated seeds may take a few years to germinate.
Use half sand or perlite in the potting mix.
A few bloom the first year.

E *Achillea millefolium* (Common Yarrow) - Asteraceae
Dry store the seeds at 70˚ over the winter. Sow, cover very lightly. Expose to 70-77˚ in the day and 60˚ at night. These temperatures are goals. A warm daytime temperature is the most important one.

D *Actaea rubra* (Red Baneberry) - Ranunculaceae
Remove the aril.
Seeds stored dry over the winter at 70˚ and soaked 24h. 40(3m) - 70(6m) - 40. 65-75% produce a radicle during that cold cycle but do not produce a cotyledon the following warm cycle. They probably need 2 years to germinate and are most easily maintained if sown in situ.
Twice, I have worked with seeds from an exchange that were stored dry. If the seeds were sown promptly after collection and cleaning, they might germinate in 1 year.

E *Agastache urticifolia* (Nettleleaf Giant Hyssop) - Lamiaceae
Store dry at 40˚.
Sow mid March to mid May. Stratification is not necessary but some cool temperatures do not harm the seeds. Very light cover. Cotyledons emerge in 2-4w.
Hardy at elevations lower than natural range.

M *Agoseris glauca* (Pale Agoseris) - Asteraceae
Store clean dry seeds at 40-70˚ until sowing and stratification in April-May.
40(3w) -70, vlC
The main limiting factor seems to be seed fertility.

M *Alciella subnuda* Polemoniaceae
Biennial. Regional species (AZ, UT)
Sow mid December - early Jan. lt C. Put outside.
Cotyledons emerge April - May.
When transplanting, use a well draining medium.

M *Allium cernuum* (Nodding Onion) - Amaryllidaceae
After-ripen: store dry at 40-70˚ for 6 months before sowing.
Some people cold stratify for 1 month and some just sow the seeds in May after the after-ripening period. Either way seeds germinate at 70˚.
Cover the seeds to depth.

M *Allium textile* (Textile Onion) - Amaryllidaceae
Collect the seeds when the scapes easily pull from the bulbs. Place the capsules in a paper bag to dehisce.
Store the seeds at dry 70˚ unless sowing right away.
Sow in situ shortly after you collect the seeds (July-August) or sow in early March in a container or in situ. Cover the seeds.

E *Amsonia illustris* (Ozark Bluestar) - Apocynaceae
Regional species. Central MO to KS and TX
Scarify the woody seeds with sandpaper and soak in tepid water for 12-24 hours. Then cold stratify for 60 days. The cold treatment can be accomplished in the fridge or by sowing in Nov. in deep cells or in situ.
Cover the seeds to depth.

E *Amsonia eastwoodiana* (Wooly Bluestar) - Apocynaceae
(A. tomentosa)
Scarify gently with sandpaper.
Sow in spring to provide about 4 weeks of cold treatment. C. Put outside

M *Amsonia jonesii* (Jones' Bluestar) - Apocynaceae
Scarify gently with sandpaper. Follow with a boiling water soak.
Provide 4-8 weeks of 40˚ cold treatment outside by sowing in spring, lt C.

E *Anaphalis margaritacea* (Pearly Everlasting) - Asteraceae
This species is dioecious or polygamo-dioecious (a plant can have female and bisexual flowers or male and bisexual flowers). If it is dioecious, it has separate male and female plants. You need both to get fertile seeds. The female heads can be recognized when the seeds are ripe by the reflexing of the involucral bracts. The receptacle "sticks its chest out" and displays the pouffy pappus. At this point you can easily pluck the seeds from the receptacle.
Store dry until the following spring.
After the last frost date, sow these tiny seeds on the soil surface and press in. 70˚L. Mist or bottom water. Fall sowing might work, but I think losses would be large.
Germinate in 1-2 weeks.

Anemone patens* var. *multifida (Pasque Flower) - see ***Pulsatilla nuttalliana***

M *Antennaria* spp. (Pussytoes) - Asteraceae
Dioecious. Female heads are taller and skinnier than male heads which look like small heads of cauliflower.

Collect seeds when the pappus is fluffy, June-July.
Store dry at 40˚ or 70˚. The storage allows the embryo to after-ripen which may be required for germination success in spring.
Sow mid-April in the Front Range (55-65˚). Be generous with the pinch of seeds. vlC
Germinate in 1-2 months. The seedlings are tiny.
Pussy toes also increase by stolons and can be divided in early spring. Maintain sod-like sections.

Aphyllon fasciculatum (Clustered Broomrape) - Orobanchaceae
Syn. Orobanche fasciculata
Seeds are ready for collection 34d after they bloom.
Seeds collected in July and sown in situ in Sept. of the same year resulted in 2 plants which is a very low percentage.
Two year old seeds sown in situ did not produce plants.
This information is from just 2 germination attempts so it is far from scientific.

E *Aquilegia chrysantha* (Golden Columbine) - Ranunculaceae
“No cold stratification is necessary. Sow in May.” Cover very lightly. email 11/2/20 from Sherry Fuller, propagator at the Gardens on Spring Creek, Ft. Collins, CO
Golden Columbine can be sown in situ in late fall or in spring (March-April).

Aquilegia coerulea (Rocky Mt. Columbine) - Ranunculaceae
Sherry Fuller treats the same as *Aquilegia chrysantha,* i.e. no cold stratification.
I have sown in cells, placed outside in late February, vlC and had 60% germination.

Argemone pleiacantha (Southwestern Prickly Poppy) - Papaveraceae
Annual to short-lived perennial. Regional species.
Sow in situ outside in mid to late fall. Cover lightly.

Argemone polyanthemos (Crested Prickly Poppy) - Papaveraceae
Annual to short-lived perennial.
Sow in situ outside late fall to early winter. Cover lightly. Put outside.

M *Artemisia frigida* (Fringed Sage, Prairie Sagewort) - Asteraceae
Collect seeds Sept-Nov. Store dry at 40˚ or 70˚ for 6 months (after-ripen). Viable 2-3 years.
Sow after the last frost date. Ideally, the night time temperature is above 50. Lightly cover the seeds and make sure they do not dry out.
Germinate in 1 week.
Vegetative reproduction by cuttings (Feb-May) and by layering.

***Asclepias* spp.**
Seed Collection and Cleaning
Collect seeds when the follicles begin to split. Contain the fly-away silks by putting a rubber band around the follicle until you are ready to clean the seeds. Clasp the silks and thumb the seeds off onto a piece of paper on a tray.
If the seeds and silks are already escaping, gather the entire mass into a paper bag. Add a coin or two and shake very hard for several minutes. Cut a small slit in the bottom of the paper bag and shake the seeds out.

Store all asclepias seeds dry 40˚ for 4-6 months before sowing at temperatures 70-85˚.
Treatments and Sowing

“I have fantastic success with several *Asclepias spp*. by skipping the cold strat times and instead soaking them in an aerated water bath 2-3 days…they almost always germinate in the bath!” email 3/19/23 Brooke Palmer, CCGG, Horticulture Coordinator (Greenhouse Production), Denver Botanic Garden.
Brooke picks out and sows the seeds that germinate.

FOR ALL MILKWEED SPECIES:
Starting around your last frost date or later, begin a soaking treatment.
Lacking an aquarium bubbler for an aerated water bath, soak seeds in tepid water in a clear bowl on a windowsill. Change the water every day. Radicles emerge in 4-15 days. Even soaking for a day or two is helpful.
Sow in small but deep cells or containers. vlC

Any seeds coaxed to germinate during cold weather need to be kept under lights at 70˚or higher.

E *Asclepias arenaria* (Sand Milkweed) - Apocynaceae
Radicles emerge in 3d (84% on 2 yo seeds stored dry 40˚). Cotyledons show within 2 weeks.

E *Asclepias incarnata* (Swamp Milkweed) - Apocynaceae

E *Asclepias pumila* (Plains Milkweed) - Apocynaceae
This is a short, small, rhizomatous species.

E *Asclepias speciosa* (Showy Milkweed) - Apocynaceae

E *Asclepias subverticillata* (Horsetail Milkweed) - Apocynaceae
Once soaked and sown, cotyledons emerge 11-14d.

E *Asclepias sullivantii* (Prairie Milkweed) - Apocynaceae
Regional species.

E *Asclepias syriaca* (Common Milkweed) - Apocynaceae
Regional species.

E A*sclepias tuberosa* (Butterflyweed, Orange Milkweed) - Apocynaceae
After soaking and sowing, seeds germinate in 7-10 days if the temperature is high enough.

E *Asclepias viridiflora* (Green Comet Milkweed) - Apocynaceae

E *Astragalus spp.* - Fabaceae
(*A. amphioxys, A. asclepiadoides, A. bisulcatus, A. drummondii)*
Clean the seeds as soon as possible and check for weevils. Freeze the dry seeds 1-2 weeks if you note predation. Store dry seeds at 40-70˚.
Sandpaper, tepid water soak 18-24h, inoculate (opt.), sow in 2.5” pots or deep cells, cover well and put outside. 70˚. The radicles begin to emerge in 11 days and continue emergence over the next month.
Plant as soon as the seedlings have 1-2 pairs of true leaves. Avoid root disturbance.

Bahia dissecta - see *Hymenothrix*

E *Berlandiera lyrata* (Chocolate Flower) - Asteraceae
Collect when the bracts are very dry and brownish for easy removal of the bracts. Rub hard on a soil sieve screen to dislodge the bracts. Some bract material will not interfere with germination.
Store dry at 40˚.
Start in late April to May. Soak the seeds in diluted peroxide (1/2 C. tepid water + 1/4 oz. 3% hydrogen peroxide) for 24 hours (opt). Rinse well. Skipping the peroxide soak just adds a few days to the germination time.
Sow in cells or in situ. Cover very lightly for light exposure. Leaves emerge in 10 days.

Boechera pusilla (Small Rock Cress) - Brassicaceae
WY endemic.
Store dry seeds at 40˚.
Surface sow in well draining mix Dec- Feb. Put outside. Cold germinator.

E *Brickellia spp.* - Asteraceae
(*B*. *eupatorioides* (False Boneset), *B. grandiflora* (Tasselflower Brickellbush)
Fertility is best when more than one seed grown plant is in the vicinity.

No pretreatment is necessary for this part shade tolerant plant. Sow at 70˚. Cover the seeds very lightly. The seeds germinate in 7-10 days.

D *Callirhoe involucrata* (Wine Cups, Purple Poppy Mallow) - Papaveraceae
Scarify with sandpaper and sow in situ in fall.
OR
Pour boiling water over the seeds in a pyrex dish. Let the water cool and soak the seeds 12-24 hours. Sandpaper scarify and try to peel the seed coat off of the seeds. Cold stratify for 1 month. Sow, cover lightly and expose to 70˚.
Flower the second year.

“Take tip cuttings as early as February, before buds form.” Ann Grant 2/20/21 Zoom chat box from her propagation talk for CoNPS.

E *Calochortus gunnisonii* (Gunnison’s Mariposa Lily) - Liliaceae
Sow in November. Put several seeds in each cell. Use about 1/8” cover. Put outside. The radicles emerge in late fall and survive the winter in cells or pots. In the Denver area, the first leaves emerge early April.
Move to larger pots in clumps within 3-6 weeks. First year seedlings in the Liliaceae tend to go dormant earlier than mature plants.

M *Caltha leptosepala* (Marsh Marigold) - Ranunculaceae
Seeds do not remain viable in dry storage at 70˚.
Clean seeds promptly and sow in situ in a moist site or begin processing.
70D & moist(2-7w) - 25-39°(4–6w)

Use a nondraining container such as a clear produce box. Put 1/2” of horticultural charcoal in the bottom. Fill to 1” from the top with mucky soil or potting mix. Sow the seeds over the medium. Cover to depth. Keep the container covered with snow or water if the medium becomes dry.
Cotyledons emerge at 41-54 (70)˚, early April at 5690”.

M *Campanula rotundifolia* (Harebell) - Campanulaceae
40(30d) either outside or in the fridge, vlC.
Very small cotyledons emerge in 5w.

D *Castilleja chromosa* (Red Desert Paintbrush) - Orobanchaceae
Treat the same as *Castilleja integra.*
35% of radicles emerged in 35-81d in fridge stratification at 38-40˚. Only 1 cotyledon emerged in 2 different years. They died within a month in the 2.5" pot containing a host (*Artemisia ludoviciana* and *Festuca arizonica). Artemisia ludoviciana* is aggressive. *Artemisia frigida* would be a better choice as a host plant.

M *Castilleja integra* (Wholeleaf Paintbrush) - Orobanchaceae
Hemiparasitic.
Place the seeds in the palm of one hand. Rub them with a finger to remove a loose net that surrounds each seed. Cold stratify the seeds for 3-4 months either in the fridge or outside. If giving an outdoor winter treatment, sow in situ near a grass or less aggressive artemisia or sow in cells/pots and cover lightly. Pile snow on top of the cells/pots. Water as necessary during the winter. With a constant moist 40˚, radicles begin to emerge as early as 16 days. Cotyledon leaves appear in 3.5 months. As soon as the seedling has 2-4 sets of true leaves, pot it in well draining soil with a host plant such as *Artemisia frigida*, *Liatris punctata, Penstemon* spp. or a nonaggressive grass.
Sowing the castilleja along with a seed of a host species seems logical, but they are not likely to germinate at the same time.

D *Castilleja linariifolia* (Wyoming Paintbrush) - Orobanchaceae
Hemiparasitic.
Give 1-3 months cold stratification or plant outside fall to early spring. Cover very lightly.
Sow beside a host plant in situ (see *Castilleja integra* suggestions) or pot with a host plant when the seedling has 1-2 sets of true leaves.

D *Castilleja miniata* (Red Indian Paintbrush) - Orobanchaceae
Starting in December, 40(231d)-70(100d)-40(77d)
Surface sow, dome, indoor lights, mist several times a day.
A few cotyledons emerged in 3d.
When the plants have 2-4 sets of true leaves pot with a seedling of *Artemisia frigida* or another non aggressive host plant.

M *Chamerion angustifolium* (Fireweed) - Onagraceae
Harlequin Garden's propagator, Gary, and the USFS (www.fs.fed.us/database/feis/plants) say no cold stratification is required. Some other sources recommend 60 days of cold before sowing at 70+˚. I'm voting for no stratification. Past failures may be due to aged seeds. They are only viable in dry storage for 18-24 months (USFS).

Sow after danger of hard frost has passed. If sowing in situ, press into the soil and protect with burlap until they germinate (Prairie Moon Nursery). The seeds need light. If sowing in cells, cover **very** lightly.
Leaves emerge in 3-4 weeks.

Rhizomes of mature plants sprout readily and can bloom within a month (USFS).

E *Cirsium undulatum* (Wavy Leaf Thistle) - Asteraceae
The seeds of this species are often infested with weevils. Infested seeds turn a darker color. Promptly after collecting dry heads of seeds, place the entire head in the freezer for 2 weeks. Then clean the seeds. Press the seeds with a thumbnail. Dispose of any that collapse under pressure. Seed viability at 40˚ dry may decrease rapidly each year.

Seven month old seeds stored dry at 40˚ and given a cold stratification (outside or in the fridge) germinate (extend a radicle) 75-79% in 1 month at the cold temperature. Because the seeds produce a gel when exposed to moisture, it is easiest to sow the seeds in cells/pots and to place the container outside. Cover the seeds to depth. I used ant grit from the collection site to cover the seeds.
Transplant into 2.5" pots. Plant by mid June (5690') or bump up to a deeper pot.

Clematis ligusticifolia (Western White Virgin's-bower) - Ranunculaceae
Store dry seeds at 40˚. Avoid longterm storage. Viability decreases rapidly.
Sow fresh seeds in fall in situ or in cells. Cover lightly.
Fresh seeds (collected in March following bloom the summer before) soaked in tepid water develop radicles in 19-31 days.
Stored seeds: Soak for 2-3 days. Remove the style and the pericarp by peeling the fruit with your fingernails or a dull paring knife. Cold stratify stored seeds for 2-6 months.
Sow in situ or in cells. Cover lightly.

E *Cleome trachysperma* (Red-whisker Clammyweed) - Capparaceae
syn. *Polanisia dodecandra*
Annual.
(Horrible common name. It should be Beeblossom. There is a strange smell from the glandular foliage if you touch it, but it does not waft in the air.)
Late fall to winter, right before a snow, sow seeds of this annual outside where you want the plants to germinate. For me, this is more successful than container growing.
It can be sown in pots in late winter. Plant as soon as it has a few true leaves.

Cleome* or *Peritome serrulata (see Cleomella)

E *Cleomella lutea* (Yellow Spiderflower) - Capparaceae
Annual.
Sow seeds in deep cells filled with 1:2, expanded shale:high perlite potting mix in early Feb. (5690', FR). Cotyledon leaves emerge in 8w.
Or direct sow in situ in winter. Cover.

E *Cleomella serrulata* (Rocky Mountain Beeplant) - Capparaceae
syn. *Cleome* or *Peritome serrulata*
Annual.
Direct sow where you want them in the garden fall to late winter. Cover 1/8-1/4".
Radicles begin emerging after 3 weeks of cold stratification.

E *Coreopsis lanceolata* (Lanceleaf Tickseed) - Asteraceae
Introduced to CO from more eastern and southern states.
Sow the seeds in cells or in situ when the soil warms in spring. The seeds have a light requirement so cover them very lightly just to help keep them moist. Leaves emerge in about 18 days.

E *Coreopsis tinctoria* (Plains Coreopsis) - Asteraceae
Annual.
About 4 weeks after bloom, the inner bracts should be turning brown. If the seeds remove easily, cut the heads into a paper bag. Clean to remove chaff, leaves, receptacles, and any extraneous matter. Store dry at 40˚. Viable 3 years or more.
No pretreatment is necessary. Sow in fall or spring. Light requirement, vlc.
Germinate in 8-9d.

M *Dalea purpurea* (Purple Prairie Clover) - Fabaceae
Store seeds dry at 40˚.
After the last frost in spring, sandpaper the seeds. (Purchased dehulled seeds do not need to be sandpapered.) Next put them in a pyrex bowl and pour boiling water over them. Let the water cool and soak the seeds for 24 hours. Every 24 hours, remove seeds that have imbibed water and double in size. Repeat the boiling water treatment as many times as necessary until the seeds increase in size. (Success with multiple boiling water treatments information from Kristine Johnson of Boulder, CO, email 4/3/23)
In order to avoid the days of boiling water soaking, place the scarified or dehulled seeds in a pyrex bowl and cover with 3% peroxide for 20 min. Rinse and proceed with the next steps.
Roll moist seeds around in a light dust of inoculant (opt. but helps). Sow in cells or pots. Cover with 1/8” of medium. Expose to 70˚.
Seeds can be sown in situ outside. I prefer early spring sowing to fall. The seeds need no cold stratification. After all the pretreatments, press into a prepared surface if you cannot easily cover the seeds lightly.

Datura wrightii (Indian Apple, Sacred Datura) - Solanaceae
Regional.
In spring after danger of frost is past, soak the seeds for 24 hours, sow the seeds and cover with 1/8” soil. worldseedsupply.com

Delphinium ramosum (Mountain or Showy Larkspur) - Ranunculaceae
Store seeds dry 40˚. Viability decreases rapidly after 1-2 years.
No cold stratification is necessary. Sow mid April (5690’). Cover well for dark. Put outside. 72% germination (radicles) in 9-45d.
Plants self seed moderately in the garden.

Delphinium spp.- Ranunculaceae
D. geyeri (Geyer’s Larkspur), *D. nuttallianum* (Nuttall’s Larkspur)
Sow ASAP. Use fresh seeds. Sow in situ outdoors in fall and cover well. Delphinium species require dark. They germinate at 50-55˚. Dorn & Dorn, “Growing Native Plants of the Rocky Mountain Area”, p 81)

E *Dieteria* spp. - Asteraceae
D. bigelovii (Bigelow’s Tansyaster), *D. canescens* (Hoary Tansy-aster)
Store seeds dry at 40 or 70˚ for 3-6 months before sowing (after-ripen).
Sow seeds at 70˚. Cover **very** lightly to meet the light requirement, 70L.

E *Echinacea angustifolia* (Prairie Coneflower) - Asteraceae
Sow in situ in fall. OR. Cold stratify for 3w -3m before the last spring frost date. Sow in cells or in situ. Cover the seeds. Cotyledons emerge in 2-3w.

D *Echinocereus viridiflorus* (Nylon Hedgehog) - Cactaceae
Use dechlorinated water. 2/24/24 Stephen Hornbeck at CO Native Plant Landscaping Conference.
Sow in late fall in situ. Add drainage material to loamy clay or clay soils. Cover very lightly.
The seeds benefit from a period of cold moist conditions. Seeds of some cactus species can sit in the soil bank for a number of years before germinating.

Engelmannia peristenia (Engelmann's Daisy) - Asteraceae
syn. *E. pinnatifida*
Sow in situ in early fall. Press tightly into the soil. The seeds require light to germinate.
wildflower.org
Seeds stored 40 ˚dry over the winter, germinate in 3d if sown 3w after last frost date. lt C.

E *Erigeron* spp. - Asteraceae
(*E. divergens, E. speciosus, E. vetensis*)
Self Sterile
Dry store at 40˚ or 70˚.
Surface sow (light requirement) or cover **very** lightly. Expose to 70˚. 70L.
Leaves emerge in 1-2 weeks.

***Eriogonum* spp**. collection and cleaning.
When the perianths turn brown or rusty colored, strip the seeds from the heads into a paper bag. The radicle of buckwheat seeds is in the pointed tip. lt can be damaged by aggressive rubbing on a screen. Rigorous cleaning is not necessary because the seeds can germinate with the perianth attached.

M *Eriogonum alatum* (Tall Winged Buckwheat) - Polygonaceae
40(30-60d). A few radicles emerge in 30d at 40˚, so either be prepared to pick out a few seeds and insert them into a pot of soil which can go outside or conduct the cold treatment outside. Use medium cover.

E *Eriogonum flavum* var. *flavum* (Golden Buckwheat) - Polygonaceae
Winter sow seeds outside. Seeds collected 9/22 (8400'), stored dry 40˚ and sown 1/8/23 (5690', FR) began developing cotyledon leaves in 12 weeks (April).

M-D *Eriogonum jamesii* (James' Buckwheat) - Polygonaceae
Store seeds at 40˚. Long term storage at 70˚ may be detrimental.
About Dec. 1 to Jan. 1, sow the seeds outside (in cells or in situ), cover with about 1/16" of fine vermiculite and put the cells outside. Germination may occur at 70˚ or at 40˚ or anywhere in between.

M-D *Eriogonum umbellatum* (Sulfur Flower) - Polygonaceae
Store dry at 40˚ (Storing 6 months at 70˚ is very detrimental according to Norm Deno, 2nd ed., 140.)
Sow outside in late fall. Cover the seeds lightly. To cold stratify in the fridge, you must sow in cells or pots because the radicles emerge erratically for 2-3 months. Leaves will not emerge until they are darned ready in the spring.

E *Erysimum asperum* (Western Wallflower) - Brassicaceae
Biennial.
Thirty days before your last frost date, sow in situ or in cells/pots. lt C.
Cotyledon leaves emerge in 4-5 weeks.

Erysimum capitatum (Sand Dune Wallflower) - Brassicaceae
Biennial or Perennial.

April 28 (5690') sow in situ or in cells/pots. lt C.
Cotyledon leaves in 10 days.

M *Escobaria missouriensis* (Missouri Foxtail Cactus, Nipple Cactus) - Cactaceae
syn. *Corypantha missouriensis*
Dechlorinated water. 2/24/24 Stephen Hornbeck at CO Landscaping Conference.
Collect soft red fruits late April-May (FR, 5690'). Store cleaned seeds dry at 40.
Sow just cleaned or stored seeds on very well draining soil (add extra expanded shale, gravel, perlite, etc), vlc. In 1m, seeds turn from black to red and a radicle appears.
The first vegetative material is a stem and spines (leaves). It looks like a miniature ball cactus.
Clean one year old seeds have a 3x higher germination rate than fresh seeds.

M *Euphorbia marginata* (Snow-on-the-Mountain) - Euphorbiaceae
Annual
In my experience, one month of cold stratification followed by a high germination temperature (up to 86-90˚ daytime and 68˚ at night or at least not below 40˚) results in good germination. The seeds should be covered to depth whether sown in cells or directly in the ground. If sowing in situ, sow 3 weeks before the last frost.
One online source recommends sandpaper scarification and soaking with no stratification.
selectseeds.com

E *Eutrochium maculatum* (Spotted Joepyeweed) - Asteraceae
Seed viability in storage may be 3 years or less.
Cold stratify for 1 month or more either in the fridge or by sowing in situ Jan. 1 to Ap.1. 40(1m)-70L.
For germination in pots, sow early April in Front Range.
Light requirement. Either surface sow and bottom water or cover the seeds very lightly with medium.

D *Frasera speciosa* (Monument Plant) - Gentianaceae
Collect seeds August to Sept. Store dry at 70˚ until January 1. Sow in situ outdoors or cold stratify 4 months and then sow in cells or in situ. This plant is monocarpic. It dies after blooming and fruiting. It can take many years to germinate and 18-28 years to bloom.

E *Gaillardia* spp. (Blanketflower) - Asteraceae
G. aristata, G. x *grandiflora* (*G. aristata* X *G. pulchella*) Tetraploid with large blooms.
No cold stratification is needed. Sow in situ after danger of frost has past in the spring. and press into the soil or sow in cells and cover the seeds lightly. Germination can be erratic. 70, vlC.

E-M *Geranium viscosissimum* var. *incisum* (Sticky Purple Geranium) - Geraniaceae
Scarification increases germination. If seeds have been air-dried, they are more permeable to water and will require less scarification. www.wildflower.org
Scarify gently in one spot with a nail file. The seed coat is quite thin, and you will quickly see a soft green interior. Stop filing! Next, soak in hot water, not boiling, for 12 hours. After treatment, plant outside 1/4"deep in fall or in spring after the last frost.
OR
In spring, about 4 weeks before the last frost, scarify, soak, cold stratify 30 days, sow in cells, cover to depth and put outside in sun.
Transplant into a deep pot filled with very well draining soil.

In late Feb. 2023, scarified each black seed in one small area with a nail file. Green interior exposed rapidly. Soaked in tepid water for 18h. Placed in fridge. Radicles on 75% formed in 1w at 40 in the

fridge. Sown in cells, 3 per, C. Placed under lights. Cotyledon leaves emerged 1w after sowing. Full sturdy plants 1m later. Total of 6w. Could be transplanted. Remaining seeds without radicle sown in cells and put outside.

Glycyrrhiza lepidota (Wild Licorice) - Fabaceae
No cold stratification is required, but it will not harm the seeds.
If sowing outside in the fall, do not scarify the seeds. Inoculate the seeds with rhizobium inoculum (opt.) and cover the seeds well.
If sowing in the spring in situ or in cells, scarify the hard seed coat with sandpaper, inoculate (opt.) the seeds, and cover them well.
prairiemoon.com

E *Grindelia* spp. - Asteraceae
G. subalpina (Subalpine Gumweed), *G. squarrosa* (Curlycup Gumweed)
Super pollinator plant. Long blooming perennial.
Collect the seeds as late as possible hoping the stickiness of the involucral bracts will decrease. The pappus of the seeds can glue the seeds to each other and to the bracts. The involucral bracts make a cup that is upright, and the seeds remain in the cup for months. Alternatively cut a long stalked inflorescence and stick it into a chain link fence with the cup upright. After a month or more, the cleaning is much less gummy.
Freeze dry seeds for 2 weeks to kill seed eating pests.
Store dry at 40˚.
Sow mid-May. Cover lightly. 70, lt C. Leaves emerge within 2 weeks.

D *Harbouria trachypleura* (Whiskbroom Parsley) - Apiaceae
Sow in situ in the fall.

M *Hedysarum boreale* (Utah Sweetvetch) - Fabaceae
Remove the seeds from the loment before storing dry at 40˚.
Mid April (5690') scarify with a boiling water soak. Leave in the cooled water 12-24 hours. Inoculate (opt.). Sow in situ or in cells in fall or spring. Cover the seeds with 1/4" of medium.
Transplant quickly into deep cells or pots or plant in the ground. Avoid root disturbance. Better yet start in deep cells or narrow deep pots.

E *Helianthus annuus* (Common Sunflower) - Asteraceae
Annual.
After danger of frost is past in the spring, sow directly onto the soil where you want the plants.
Space the seeds at least 12" apart. Cover with 1/2" of soil.
If the temperature is 68-75˚, the seeds should germinate in 2 weeks.
Self seeds prolifically so the seeds can survive very cold temperature outside.

E *Helianthus maximiliana* (Maximilian Sunflower) - Asteraceae
Store dry at 40 or 70˚.
Sow 40(4-6w) - 70-85, lt C. for L=D
Cotyledon leaves emerge in a few days once the temperature is above 70˚.

M *Helianthus pumilus* (Little Sunflower) - Asteraceae
Clean as soon as possible and put in the freezer for 2 weeks to treat for predatory insects. Be sure they are very dry first.
Store dry at 40˚.

The seeds of this species have a higher germination rate when sown outside for cold stratification (temperature fluctuations?) and when they have some native soil in the medium.
Sow in mid Dec. in native soil instead of artificial mix whether sowing in a container or in situ. lt C
Expose to outdoor winter and spring temperatures.

M *Heliomeris multiflora* (Showy Goldeneye) - Asteraceae
Self seeds. After 3 years, becomes a bit unruly in a garden.

Keep seeds dry at 70˚ for a year to after-ripen. Sow at 70-80, lt C.
OR
For fairly fresh seeds, 40(4-6w) - 70-80, lt C.

E *Heterotheca spp.* - Asteraceae
H. foliosa (Foliose False Goldenaster), *H. villosa* (Hairy False Goldenaster)
Store seeds dry at 40˚. Sow after last frost in situ or in cells. 70+, lt C.

Heuchera parvifolia (Littleleaf or Common Alumroot) - Saxifragaceae
Collect small black seeds in paper bags when the capsules turn brown and split. May-Aug.
Sow, C, outdoors for 5m cold stratification. Keep slightly moist. Germinate in cool weather in spring.
4-6 true leaves 3 weeks after germination.
https://npn.rngr.net/renderNPNProtocolDetails?selectedProtocolIds=saxifragaceae-heuchera-203&referer=wildflower - Tara Luna, et. al.

E Humulus neomexicanus (Hops) - Cannabaceae
syn. *Humulus lupulus* var. *neomexicana*
Cold stratify in the fridge or outside for at least 3 months. After sowing the seeds, cover them well (dark requirement). Germinate in 2.5-3.5 weeks at temperatures about 60˚ daytime and 35-45˚ nighttime.

E *Hymenothrix dissecta* (Cutleaf) - Asteraceae
syn. *Bahia dissecta*
Sow after last frost date. 70L, vlc. Heavy germination occurs from 7-28 days.
This biennial to short-lived perennial self seeds heavily in the garden.

E *Hymenoxis hoopesii* (Orange Sneezeweed, Owl's Claw's) - Asteraceae
syn. *Helenium hoopesii*
No pretreatment of the seeds is required. Sow in cells or in situ in fall or spring. lt C. Seeds germinate in 10-19 days. Bump up from cells 2 weeks after germination.

M *Ipomoea leptophylla* (Bush Morning-glory) - Convolvulaceae
Store dry 40.
Sand, soak in 3% hydrogen peroxide 15 min, rinse, water soak 24h.
Sow in deep cells or 2.5" pots, C, 70.
Germination is erratic. Pot and plant in sandy soil. Hummingbird attractor.

M *Ipomopsis aggregata* (Skyrocket, Scarlet Gilia) - Polemoniaceae
Biennial to short lived perennial, self incompatible, monocarpic. Hummingbird pollination if red.
When stored at 40˚, viability decreased by years 3 and 4.
Sow the seeds promptly in situ shortly after collection. For stored seeds, 40(30d) - 70, lt C.
Leaves emerge in 3 weeks.

M *Ipomopsis congesta* (Ball-head Ipomopsis) - Polemoniaceae
Perennial.
Seeds produce a gel when soaked.
40(60d) - 70, vlc. Alplains.com

E *Ipomopsis rubra* (Standing-cypress) - Polemoniaceae
TX, OK, MO and east to the Atlantic coast in alkaline soils..
Biennial.
Direct sow in situ in fall. 1/16" C. Blooming plants produce copious amounts of seeds and will replace themselves every year with dark green ferny rosettes.
OR
Start inside 6-8w before the last frost in spring. Transplant to the ground as soon as possible.

D *Iris missouriensis* (Rocky Mountain Iris) - Iridaceae
Native iris have a deep dormancy that is best tackled with scarification (in this western species) and outdoor stratification.
Nick with nail file, 40(90d) outside for temp fluctuations - Brook Palmer 4/23/24
OR
3% peroxide soak. Rinse. Sow outside in situ or in cells or pots. Cover lightly. Outside for temperature fluctuations. 23% germination.

E *Liatris ligulistylis* (Rocky Mountain Blazing Star) - Asteraceae
40(60d) either in the fridge or in cells sown in Feb. (5690') and put outside. Press the seeds into the soil and/or cover them to depth. Germination (radicle) about day 60 and cotyledon leaves 2-3w later. They bloom in 2-3 years.
If the soil is quite rich and moist the plants can get to 5' and require staking.

E *Liatris punctata* (Dotted Blazing Star or Gayfeather) - Asteraceae
40(1-2m). Outside stratification in situ or in cells is preferable to seeds in a resealable plastic bag in the fridge, because the radicles begin to emerge in 19 days. Cotyledon leaves emerge 9 days after that at 65-70˚. Use light to medium cover. If you have an indoor grow light array and want to cold stratify in the fridge, it works well.
Seeds sown in late Feb. to early March, in cells placed outside (5690', FR) had leaves in 34-42 days.

M *Ligustichum porteri* (Osha) - Apiaceae
Start in late Nov. Bubble aerate or soak and rinse for 3-4 days. Sow in deep pots, C. Place outside. Cotyledons (33%) in about 5 months in the Front Range.

E *Linum lewisii* (Blue Flax) - Linaceae
Store seeds dry at 40.
Sow in spring around the last frost date or a bit later. Cover lightly.
Cotyledon leaves emerge about 2 weeks later.
No cold treatment is required. Seeds can be sown in fall or winter, but the germination percentages will be lower.

D *Lithospermum occidentale* (Western Marbleseed) - Boraginaceae
syn. *Onosmodium bejariense* var*. occidentale*
After cleaning, freeze the seeds for 2 weeks to kill any pests.
Store dry at 40˚ for 4-6 months or longer (after-ripen).

Sow in situ in the fall.
OR In winter, cold stratify after scarifying with a boiling water soak. Fertile seeds will sink.
1. Sow around Jan. 1, cover the seeds 1/8" deep with medium, and put the cells/pots outside.
2. Or 3 months before the last frost date, cold stratify the seeds in the fridge, 40˚(3m). Sow in cells or direct sow in garden. Cover 1/8" deep.

M-D *Lomatium orientale* (Salt-and-Pepper) - Apiaceae
Collect seeds of this early bloomer May-June. Store the seeds dry at 70˚ for 3m.
In late Nov., bubble aerate for 3d or soak 3d. Change the water every day.
Sow in a deep cell/pot, C. Place outside.
Germination occurs in dark anywhere from 44-133d (1.5-4.5m).
After the cold treatment, cotyledons emerge from 4-21d in 70L. 50%

M *Lupinus argenteus* var. *argenteus* (Silvery Lupine) - Fabaceae
Store seeds dry at 40˚ or 70˚.
For fall sowing: Scarify by pouring boiling water over the seeds. Let the water cool. Soak for 24 hours. Repeat if necessary. Inoculate the seeds with rhizobium legume inoculant (opt.). Sow in situ or in cells/pots, cover the seeds. Containers will stay outside all winter.
OR
For spring sowing: 46 days before the last frost date, do a boiling water treatment and 24h soak. Inoculate the seeds with rhizobium legume inoculant (opt.). Sow, cover the seeds, place containers outside if you did not sow in situ.

After scarification, radicles begin to emerge in 7-9 days at 40˚.

If you collect the seeds slightly "green" before they form a hard seed coat, you can sow them immediately. They will germinate in 10-14 days. They will be sticky and the color will be more tan than green. This has worked on every legume I have tried. It also helps avoid seed predation by insects. I use the term "green" to indicate a hard seed coat has not formed.

E *Machaeranthera tanacetifolia* (Tansyleaf Tansy-Aster) - Asteraceae
Taprooted Annuals or Biennials
Store seeds dry at 40˚. Viability may last only 4-5 years.
Sow outside in spring in situ or in cells after the last frost date. No pretreatment is necessary. Cover very lightly.
Germinate in 4-8 days, even if the temperature is 20˚ below normal.

E *Maianthemum stellatum* (False Solomon's Seal) - Ruscaceae
Remove the tan seeds from the red fruit. Sow them as soon as possible. Keep them moist until beginning required temperature cycles. The seeds require two years with 4 temperature cycles of 40-70-40-70. (Possibly one long cold period of 100+ days would suffice.) They form a radicle the first spring. Leaves emerge the second spring. The easiest way to germinate the seeds is outdoors in situ.

Take rhizome cuttings after flowering is finished.

Melampodium leucanthum (Blackfoot Daisy) - Asteraceae
Seeds viable 1 year only. 70L. Disc flowers do not develop fertile seeds. Rays do.
see Jim Borland article in the Colorado Native Plant Society journal
www.CoNPS.org *Aquilegia* Volume 46 No. 1 Winter 2022, pg. 28

***Mentzelia* spp.**- Loasaceae
M. decapetala (Ten-petal Eveningstar) Biennial or perennial, *M. multiflora* (Adonis Blazingstar) Perennial, *M. Nuda* (Bractless Eveningstar) Biennial or perennial.

Collect capsules when the pore in the membrane at the mouth of the wide capsule opens. Place in a paper bag. Seeds fall into the paper bag as they dry.
About 5 weeks before the last frost date, soak the seeds for 24 hours in tepid water. Seeds that float may not be fertile. Cold stratify in the fridge for 4-5 weeks or just sow and put outside. Sow in cells/pots or in situ. Cover lightly. Cotyledons emerge in 14 days after 4-5w cold (83%). They can be potted in a well draining mix in a 2.5" pot as early as 9 days later.
Or sow in situ, in fall fairly soon after collecting the seeds.

M *Mertensia lanceolata* (Plains Bluebells) - Boraginaceae
From mid June to mid July, depending on elevation, collect fruits and put them in a paper bag. Each may have as many as 4 nutlets. Store the seeds dry, 40-65˚ until the fall.
In mid November, sow in situ and cover the seeds lightly. They will germinate the following spring and bloom the second year. This works!
I have had minimal success sowing the seeds in deep cells shortly after collection and leaving them outside. It is difficult to keep the moisture consistent from June, through the summer and over the winter. They may also require mycorrhizae in the soil to germinate.
I have had no success with cold stratification in the fridge (2 years trying).
Rabbits are not overly fond of them but may snip a bloom just to taste.

E *Mirabilis* spp. - Nyctaginaceae
M. albida (syn. *M. lanceolata*) (Lanceleaf Four O'Clock), *M. glabra* (Smooth Four O'Clock), *M*. *linearis* var. *linearis* (Narrowleaf Four O'Clock)
Two weeks before the last frost date, sow in cells/pots or in situ. Cover the seeds.
When they are exposed to moisture the seeds form a gel so fridge stratification is difficult unless you have space to put the germination container in the fridge.
Leaves appear within 39 days.
Plants bloom the first year.

E *Mirabilis multiflora* var. *glandulosa* (Colorado Four O'Clock) - Nyctaginaceae
Collect the large dark seeds in early Sept. in the Front Range. The persistent bracts enfold the seeds. Put the whole thing into a paper bag. Many of the seeds will fall out of the bracts as they dry. It is fairly easy to remove the rest manually. Store dry at 40˚.
Give the seeds a peroxide soak for 24h (1 tsp 3% peroxide to 16 tsp water). Sow the seeds in cells or in situ. Cover lightly.
All the seeds will germinate over a 2 week period.
OR
Seeds can be sown in situ in the fall.
No cold treatment is required but it also does no harm. Many of the seeds will extend a radicle at week 7 and will need to be sown if they are in a baggie in the fridge.

E *Monarda fistulosa* var. *menthifolia* (Wild Bergamot) - Lamiaceae
Collect the seeds when the corollas are brown, very dry and about to shatter. Nutlets are firmly held at the base of the corolla. Put flower clusters in a paper bag. Some seeds will drop, but to harvest most of them, rub the corollas on a sturdy sieve with a hard dog chew toy.
No pretreatment of seeds is necessary. Sow the seeds in cells, pots or in situ after the last frost date, probably about May 10 on the Front Range.

Cover the seeds **very** lightly (light requirement). They germinate in 10-14 days.
Seeds from the previous fall may be best.

E *Monarda pectinata* (Plains Beebalm) - Lamiaceae
Annual
Cold stratify for 45 days whether in a container or in situ. Cover the seeds very lightly. Germinate around 70˚.

D *Oenothera albicaulis* (Whitest Evening Primrose) - Onagraceae
Annual
No pretreatment of the seeds is necessary. 70C. Dark requirement.

M *Oenothera cespitosa* (Tufted Evening Primrose) - Onagraceae
I find that many seeds and plants in the trade key out to *Oenothera harringtonii* which has a caulescent stem 6-16 inches tall.

Sow right away in situ or in containers outside.
OR
Store seeds dry at 40˚ and sow Dec-Jan outside in situ or in cells/pots. Cover the seeds with 1/8" of grit or vermiculite.
Germination will be staggered after temperatures begin to warm.

D *Oenothera coronopifolia* (Crownleaf Evening Primrose) - Onagraceae
Collecting any quantity of seeds is challenging.
Sow in situ in fall. Barely cover with soil. Dorn & Dorn, "Growing Native Plants of the Rocky Mountain Area", p. 128.
E Rhizomatous and easy to transplant in April (FR, 5690'). Aggressive in garden soil.

E *Oenothera flava* (Yellow Evening Primrose) - Onagraceae
Locucidal fruits cluster at the base of the rosette of leaves. The capsules are woody and upright. Many seeds remain in the capsules the following spring. Collect in Dec. or wait until spring.
No pretreatment is required. 70 vlC. Germinate in about 2 weeks.

M *Oenothera harringtonii* (CO Springs Evening Primrose) - Onagraceae
Fruit formation is not reliable every year so do not share all of your seeds. Store some at 40˚.
Collect (cut off) the woody seed capsules when they turn brownish and the tips spread open. Put them in a paper bag to release as many seeds as possible. Let them dry for a week or more. Pliers may still be required to get the last seeds out.
Viable dry 40˚ at least 4 years.
Follow directions for *O. cespitosa.* My results vary from 25-33% germination over 5 years and 5 different seed batches.

E *Oenothera macrocarpa* (Missouri Primrose) - Onograceae
syn. *Oenothera missouriensis* - a regional species for CO. It has large yellow blooms and makes a fine bedding plant.
The wings of the large fruits catch wind, dispersing the seeds by tumbling freely.
Remove the wings before cleaning or sowing the fruit which contains many small dark seeds.
Sow 2 months before the last frost date either in situ or outside in cells/pots. Cover the seeds well.
Radicles begin to emerge in 1 month. Leaves begin to emerge about a week before the last frost date. About 75% or more of the seeds germinate. A good number of the plants bloom the first year.

Oenothera villosa (Hairy Evening Primrose) - Onagraceae
“No pretreatment. Plant outside fall to spring. Plant to 1/16 inch deep. Takes 3-4 weeks to germinate.” - westernnativeseed.com

***Opuntia* spp.**
“Opuntias germinate more effectively the second year after harvest. Fresh seed often lies in the ground for about a year before germination.” jelitto.com

Use dechlorinated water. Stephen Hornbeck at CO Landscaping Conference, 2/24/24.

If your water supplier uses chlorine, let the water sit in an open vessel for 24h, and the chlorine will dissipate. If the water company uses chloramine, put 1/8 tsp of powdered ascorbic acid in a gallon of water to deactivate it. Christine Gust, 4/7/24.

Opuntia Fruit Cleaning
Use tongs to handle fruit or paddles. Sheets of newspaper work too but are unwieldy.
Soak/ferment the fruit for several days to soften the flesh around the seeds. The chemical action of bacteria, yeasts or other microorganisms breaks down the soft flesh. Do not change the water, let it roil. Eventually you can lift and discard the skin with glochids. Again, use tongs or tweezers. Rub the remaining seeds and pulp on a sieve under running water to separate the seeds which are about half a cm. in size. Dry the seeds on a paper towel in a warm place for a week or two until completely dry. Store dry at 40˚.

Opuntia Soil Mixes
I have minimal experience germinating and growing cacti.
Ex. of a cactus potting mix: 3 parts light potting soil, 3 parts sand, gravel, or grit, and 2 parts perlite or pumice

M *Opuntia macrorhiza* (Western Pricklypear) - Cactaceae
No gel forms when seeds are soaked in water.
Scarify. Boiling water soak. 40(12w) - 70L but provide mist or a humidity chamber.
I have low germination rates (~38%) the first year in pots. It is probably best to sow in situ if you do not have a set up for long term monitoring of seeds in containers.

E Cuttings
Use tongs to remove paddles from a large plant. Let them dry and callus for a few days. Stick the callused end into a pot of cactus soil mix or directly into the ground.

Opuntia phaeacantha (Tulip Pricklypear) - Cactaceae
When soaked in water overnight, a gelatinous material appears around the seeds. I am not sure if it is a germination inhibitor or if it helps hold moisture around the seeds in the ground in a natural situation. Maybe it does both.
See *Opuntia macrorhiza* but due to gel, stratify outdoors unless you have a dedicated fridge for cold treatment of seeds in cells.

M *Opuntia polyacantha* (Plains Pricklypear) - Cactaceae
Gel forms when seeds soak in water.
See *Opuntia macrorhiza* but due to gel, stratify outdoors unless you have a dedicated fridge for cold treatment of seeds in cells.

E *Oreocarya virgata* (Miner's Candle) - Boraginaceae
Biennial to short lived perennial. Self seeds.
The drying stalks are prickly. Wear gloves. Cut a stalk and invert it into a large paper bag. In a few weeks tip the bag and let seeds roll out onto a paper on a tray with sides.
Store the seeds at 40˚.
These seeds germinate cool. Sow in cells or in situ in mid April. They germinate in 2 weeks in the dark (cover heavily). Leaf rosette for the first year.
Bloom the second year.

M *Oxyria dignya* (Alpine Mountain-sorrel) - Polygonaceae
Sow seeds collected the previous June to Sept. in mid-April to May. Use medium cover. Cotyledons emerge in 48-63 days.
Seeds that have been stored longer may require pretreatment(s).

E *Oxytropis* spp. - Fabaceae
O. lambertii (Purple Locoweed), *O. multiceps* (Nuttall's Oxytrope), *O. sericea* var. *sericea* (White or Silky Locoweed)
Store seeds dry at 40˚.
Some sources recommend scarification and cold stratification. I get germination rates of around 45% with scarification and no stratification.

When daytime temperatures hover consistently around 70˚ or after the last frost date, scarify seeds with sandpaper. Inoculate with rhizobium inoculant (opt.) Sow in deep pots or direct sow in situ to avoid disturbing the roots.
Cotyledons emerge in 3 days to 2 months.
Germination is **E**. Maintenance in pots is **D**.

D *Pediocactus simpsonii* (Mountain Cactus) - Cactaceae
"Pediocactus are primarily very active in the spring when hard frost is over and then again in early fall when the hot days of summer are over. In late fall many of them will bud; they hold the buds over the winter. It does not hurt the buds to freeze…By late spring, they will have finished flowering; when the days turn hot, they will go dormant for the summer. Let them become dry so they shrink down into the soil a bit; in nature most species pull down into the soil and can go underground. Just give them very little water during the summer; it is fine if the plants have some wrinkles on the epidermis. In late summer and early fall, they will show signs of growth, so give them a few waterings, which improves flowering and growth the following spring. During the winter, they need a couple of waterings, but most of the time they can be dry.

"In early winter, sow seeds in a very well draining mix. Cover to depth with coarse sand or gravel. Keep moist for 2-3 weeks, then dry for 2-3 weeks. Some seeds will germinate in the spring. Maintain the tiny plants on the dryish side. Some of the seeds may take 5 years to germinate. https://www.new-mexico.cactus-society.org/pdocs/GerminationTipsforSclerocactus...--Rev1-09.pdf

Use dechlorinated water. Stephen Hornbeck at CO Landscaping Conference, 2/24/24.

If your water supplier uses chlorine, let the water sit in an open vessel for 24h, and the chlorine will dissipate. If the water company uses chloramine, put 1/8 tsp of powdered ascorbic acid in a gallon of water to deactivate it. Christine Gust, 4/7/24.

M *Pediomelum esculentum* (Indian Turnip, Large Indian Breadroot) - Fabaceae
syn. *Psoralea esculenta*
Clean seeds. Freeze 1-2 weeks. Store 40-70˚ dry.
Scarify with sandpaper and a boiling water soak. Inoculate (opt.)
70D in deep cells or pots to avoid root disturbance. OR sow in situ.
Protect from rodents in the first season.

M *Pediomelum tenuiflorum* (Slimflower Scurfpea) - Fabaceae
syn. *Psoralea tenuiflora*, *Psoralidium tenuiflorum*
Can get invasive in a garden and flowers are very small.
Boiling water soak - 40(2.5m) - 70, C OR sulfuric acid 20 min, rinse - 40(2.5m) - 70, C. Either treatment results in 58% germination. Radicles emerge from 6w on so it is best to cold treat outside starting in early-mid Feb. (5690'). Cotyledons emerge in 3m.

E *Penstemon* spp. germination information from my experience and
https://tomclothier.hort.net (updated 11/2000 by Jim Swayne https://tomclothier.hort.net/page08.html)
<jas3255@yahoo.com (Jim Swayne)

Penstemon seedlings tolerate handling. They can be started in cells or pots.

Penstemon albidus (White Penstemon) - Plantaginaceae
40(90d) - 65˚. vlC. Radicles emerge (75%) anytime from 30-90d at 40˚ .
Cotyledons emerge soon after.

M *Penstemon angustifolius* (Broadbeard Penstemon) - Plantaginaceae
Begin treatments Feb. 1 (5690').
Rinse for 3 days using a bubbler or by soaking in a small bowl of water and changing the water every day.
40(3m) - 70, lt C, put outside.
Cotyledons in 3.5m.

M *Penstemon clutei* (Sunset Crater Beardtongue) - Plantaginaceae
Arizona endemic.
Store seed @ 70ºF (21ºC) in a non-humid environment for 6 mo. Sow barely covered 8 wks @ 40ºF (4ºC), move to 60ºF (16ºC) for germ. under light. https://tomclothier.hort.net/page08.html

E *Penstemon cobaea* (Cobaea Beardtongue) - Plantaginaceae
Cold stratify 8 weeks outside in cells or in situ. Radicles begin to emerge at 5 weeks so fridge stratification is difficult unless you can place containers in the fridge. vlC (light requirement). True leaves develop when the temperature gets above 65˚ part of the day.

E *Penstemon grandiflorus* (Large Beardtongue) - Plantaginaceae
Regional.
Soak the seeds for 3 hours in tepid water. Sow 12 weeks before the last frost date in situ or in containers. Put the cells or pots outside for chilling. vlC (light requirement).
Cotyledon leaves emerge in about 2.5 months at 40˚-55˚.

E *Penstemon pinifolius* (Pineleaf Penstemon) - Plantaginaceae
Regional.

Sow 9 weeks before the last frost date. Put the container outside. vlc. If no precipitation, water the pots as needed.
Germinate at around 50˚.

P. pinifolius can be grown from stem cuttings treated with rooting hormone.

E *Penstemon rostriflorus* (Bridges' Penstemon) - Plantaginaceae
Sow in cells or in situ 3 months before the last frost date. vlC. Leaves emerge 85 days after sowing.

M *Penstemon secundiflorus* (Sidebells Penstemon) - Plantaginaceae
Cold stratify the seeds 6-8 weeks at 40˚ in the fridge in a pot or sow midwinter and put the container outside. vlC (light requirement). Outside treatment in cells requires regular piling on of snow.
OR
Sow late Dec. to Jan. in situ. Cover **very** lightly.
Radicles emerge at 40˚. Leaves emerge at 70˚.

E *Penstemon strictus* (Rocky Mountain Penstemon) - Plantaginaceae
Cold stratify the seeds at 40˚ for 3 months, preferably outside in cells/pots. vlC. Radicles develop in 6 weeks and leaves a month later.
OR
Sow the seeds in situ in the fall.
Self sows prolifically in gardens.

E *Penstemon virens* (Blue Mist or Front Range Beardtongue) - Plantaginaceae
Sow the seeds in cells or in situ 2 months before the last frost date. vlC.
Leaves emerge in 2.5 months.

M *Penstemon virgatus* var. *asa-gray* (Oneside Penstemon) - Plantaginaceae
syn. *P. unilateralis*
40(8w), vlC. Germinate around 65-70˚.
OR
In mid winter sow the seeds in situ or in cells/pots placed outside.

E *Pericome caudata* (Mountain Tail-leaf) - Asteraceae
More than one seed grown plant helps to produce fertile seeds.
Collect seeds late Aug-Oct. Store dry. First year seeds seem to germinate best.
40(4w) - 65-70, vlC
Outdoor cold treatment is preferable to the fridge since radicles begin to emerge in 16 days. Leaves emerge when temps are 65-70˚.

E *Phacelia hastata* (Silverleaf Phacelia) - Hydrophyllaceae
Store the seeds dry at 40˚.

Cold stratify for 3-4 months to break the seed dormancy. This can be done several ways.
1. Soak the seeds in tepid water for 24 hours, mix with a small amount of vermiculite or sterilized sand, add water to just barely moisten the mix, refrigerate for 3-4 months. Check the bag once a week for moisture level and any possible mold or even radicle emergence. Sow, cover with 1/4" of soil, expose to 70˚.
2. Sow in situ in early winter. Cover seeds lightly.

3. Sow in cells/pots, cover seeds lightly and place the container outside all winter, covering with snow or watering during warm dry periods.

https://plants.usda.gov/plantguide/pdf/pg_phha.pdf

In early Dec., I soaked seeds for 24 hours, sowed, covered to depth and put the cells outside. 69% of the seeds produced true leaves in 4.5 months.

E *Phacelia tanacetifolia* (Lacy Phacelia) - Hydrophyllaceae
Native to AZ, CA and northern Mexico.
Annual.
Sow in fall, winter or spring. 59-70D.
Self sows in gardens.

E *Phlox longifolia* ssp. *brevifolia* (Longleaf Phlox) - Polemoniaceae
Regional.
In Dec., sow, C. Place outside. Leaves emerge in 3.5-4m. 80%. Pot in 1-2w.

E *Physalis longifolia* (Longleaf Ground Cherry) - Solanaceae
In early Nov., sow in cells/pots. Cover. Put outside. Germinate heavily in 6.5 months or when temperature is 70˚.

M *Physaria bellii* (Front Range Twinpod) - Brassicaceae
40(6w). vlC. Sow in cells or in situ. In mid April (FR, 5690'), sow in cells containing germination mix
Leaves emerge in 50-60 days.
In two weeks, bump up to a 2.5" pot of well draining mix plus soil spiked with some broken cement.
Plant by early July.

Polanisia dodecandra* ssp*. trachysperma (see Cleome)

Polemonium brandegeei (Brandegee's Sky Pilot) - Polemoniaceae
One to two months before your last frost date, sow the seeds in situ or in cells/pots. vlC. Put outside. Cotyledon leaves emerge when the temperature is 65˚ part of the day. Bump up in 3 weeks, using well draining mix.

Polemonium foliosissimum (Leafy Jacob's Ladder) - Polemoniaceae
The seeds form a gel when soaked in water. Frog eggs are difficult to separate out into cells.
Sow dry seeds in cells about 2 weeks before your last frost date. Cover very lightly, water well and put outside. Cotyledon leaves emerge in 18 days. My germination rate with newly purchased seeds was 28%.
Some folks use no cold stratification and others recommend 2 months cold treatment or fall sowing.

Psoralea esculenta (See *Pediomelum esculenta*)

Psoralea tenuiflora (See *Pediomelum tenuiflorum*)

E *Pulsatilla nuttalliana* (Pasque Flower) - Ranunculaceae
Sow outside from fall to early spring. Sow on the soil surface and cover with a thin layer of sand.
Western Native Seed and Prairie Moon Nursery.
First year seeds, deplumed, stored dry, sown in early March on germination mix in cells, covered lightly with grit and put outside (FR, 5690') germinated 100%.

Ranunculus pensylvanicus (Pennsylvania or Bristly Buttercup) - Ranunculaceae
Seeds sown at 70L took 1.5-3m to germinate.

E *Ratibida columnifera* (Prairie Coneflower) - Asteraceae
Sow outside in fall or spring, lt C. Cotyledon leaves in 8-21 days at 70˚ (slower if lower temp).
No strat or strat works.

E *Rudbeckia hirta* var. *pulcherrima* (Black-Eyed Susan) - Asteraceae
Annual, Biennial or Perennial
Viability in storage decreases over 4 years.
No pretreatment required according to most sources. *R. hirta* has varieties over most of the country so seed germination protocols could vary considerably.
Sow by the end of May. vlC.
They germinate within 2 weeks. Avoid overwatering and thin seedlings.

E *Rudbeckia laciniata* var. *ampla* (Cutleaf Coneflower) - Asteraceae
40(30d) in the fridge or outside. Sow 70-75˚, lt C. Some germinate in 9-10 days. Others will continue to germinate erratically into very hot weather.

E *Salvia azurea* var. *grandiflora* (Azure Sage, Pitcher Sage) - Lamiaceae
Unstratified seed can be planted in the fall or stratified seed can be planted in the field in the spring. With no cold, moist stratification approximately 40 percent of the seed will germinate. Pretreatment of cold, moist stratification for 4 to 8 weeks will increase total germination to around 80 percent.
https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/kspmcfs8483.pdf

40(6w) - 70L resulted in 67% germination. Roots tolerate disturbance during transplanting.

E *Salvia reflexa* (Rocky Mountain Sage) - Lamiaceae
Annual.
Sow in situ or in cells in the fall. Cover the seeds to depth. Germinate several weeks before last frost in the spring.
The blue blooms are quite small, but the plants bloom all summer well into fall if sheared a few times. This species is a prolific seeder and would make a good green mulch. It does not get out of control if planted with prairie grasses.

E *Scabrethia scabra* (Whitestem Sunflower) - Scabrethia
syn. *Wyethia scabra* - Asteraceae
Purchased seeds (unknown age but more than 2 years) sown in cells, in Feb., in Lakewood, 5690', covered and put outside developed cotyledon leaves (50%) in 40 days, early April, more than a month before the last frost date.
Tolerate transplanting well.

D *Scrophularia macrantha* (Red Birds in a Tree) - Scrophulariaceae
New Mexico.
No pretreatment is required. Sow the tiny seeds, cover **very** lightly, and expose to 70˚. *alplains.com*

Scrophularia marilandica (Late Figwort) - Scrophulariaceae
Regional species.

40 (60d) - 70L - prairiemoon.com

M *Sedum lanceolatum* (Stonecrop) - Crassulaceae
After-ripen the seeds for 4-6 months at 40 or 70˚.
Collect seeds mid to late July. Seeds seem to lose viability over 4 years even when stored at 40˚.
Cold stratification is not necessary but will not harm the seeds.
Sow in early May (temps 50-60˚ and fluctuating). Surface sow. Mist or provide high humidity chamber.
True leaves appear in 3-10 days.
Bump up to pots with well draining medium. Water sparingly.
Easy to germinate but difficult to maintain in pots past mid summer.

E *Senecio flaccidus* var. *flaccidus* (Theadleaf Ragwort) - Asteraceae
If several seed grown plants are fairly close to each other, seeds may be fertile.
Sow in situ or in cells in early spring, late April to mid May in the FR. vlC.
Germinate in 2 weeks.

E *Senecio spartioides* (Narrow-leaved Butterweed) - Asteraceae
Follow directions for *Senecio flaccidus*.
Self sows.

Silene acaulis (Moss Campion) - Caryophyllaceae
Sow in cells in germination medium around the last frost date. 68L. Place outside. Mist regularly or provide high humidity until the seeds germinate. Cotyledons emerge in 18d.

E *Silene regia* (Royal Catchfly) - Caryophyllaceae
Regional species.
Cold stratify 40(3-4w) - 70L. Germinate in 1w. Can divide small plants in cells at age 2-2.5m.

***Solidago* spp.** In order to collect fertile seeds, you must have more than one seed grown plant.
After-ripen: Store seeds dry for 4-6 months to allow the embryo to mature.
Light requirement.
Sow after last frost date. 70-75˚, vlC. Leaves emerge in 1-3 weeks.

Goldenrods generally do not need cold stratification, but it does no harm to sow outside a month before the last frost date. Sowing in the fall can be done but could result in a larger loss of seeds.

E *Solidago altissima* (Late or Canada Goldenrod) - Asteraceae
syn. *Solidago canadensis*
Reproduces aggressively by rhizomes.

E *Solidago gigantea* (Giant Goldenrod) - Asteraceae
Likes a bit of moisture so the medium does not have to be well draining.

E *Solidago missouriensis* (Missouri Primrose) - Asteraceae
Rhizomatous.

E *Solidago multiradiata* (Rocky Mountain Goldenrod) - Asteraceae
Rhizomatous.
It occupies similar sites to those of *S. simplex,* and they can hybridize.

E *Solidago ptarmicoides* (Prairie Goldenrod) - Asteraceae
White ray flowers, flat topped inflorescence.

E *Solidago rigida* (Stiff Goldenrod) - Asteraceae
Yellow ray flowers, flat topped inflorescence. Self seeds heavily.

E *Solidago simplex* var. *simplex* (Mt. Albert Goldenrod) - Asteraceae
Tends to clump. Grows well in gardens at elevations below it's recorded range.

M *Sophora nuttalliana* (Silky Sophora, Necklace Pod) - Fabaceae
Cleaning is a challenge. Enveloping the loments completely in a tarp (to contain runaway seeds) and stomping with heavy soled boots would work. Sandpapering with coarse sandpaper, then crushing with a rolling pin and finally scraping around on a strong soil sieve wire works but is time consuming. Seeds can be stored dry for many years at 40-70˚.
Before sowing, scarify the seeds with sandpaper and a boiling water soak. Inoculate (opt). Sow the seeds in deep cells or in situ either in late fall or in spring. Cover the seeds well.
Mature plants are rhizomatous.

D *Sphaeralcea coccinea* (Scarlet Globemallow) - Malvaceae
Store the seeds dry at 40˚.
There is a woody mericarp enclosing each seed. It does not have to be removed, but it does help to breach it. Scarify the seeds with sandpaper followed by a boiling water treatment and water soak. Cold stratify outside in cells or in situ, lt C. Radicles emerge erratically from 38-60+ days which makes stratification in the fridge inconvenient.
My germination % is very low.

D *Sphaeralcea munroana* (Munro's Globemallow) - Malvaceae
Store the seeds dry at 40˚. Starting about 8 weeks before the last expected frost, scarify the seeds with sandpaper and a boiling water treatment. Cold stratify for 6 weeks. Sow and cover the seeds **very lightly** if the mericarp has been removed which may be the situation with purchased seeds. Expose to 70˚.

D *Sphaeralcea parvifolia* (Small-leaf Globemallow) - Malvaceae
See *S. munroana.*

M *Stanleya pinnata* (Prince's Plume) - Brassicaceae
Many online references say that *Stanleya pinnata* seeds are not dormant and require no cold stratification. For 2 years, that technique did not work for me.
Add two steps: a gibberellic acid soak and cold stratification. Mix 3 Tbsp distilled water + a tiny bit (just dust on the end of a palette knife) of gibberellic acid (The Science Company, Lakewood, CO). Add the seeds and soak overnight. Cold stratify 3 months outside. Soaking the seeds reveals a thin covering of gel around each seed. If you cold stratify in the fridge, the seeds will clump together and be difficult to sow. I also found that some seeds developed a radicle in just 2 weeks when cold stratified in the fridge.

The Extension Service at Utah State University has a site called Native Plants in the Landscape. An article from that source is referenced by fs.fed.gov. They suggest cold stratification for 90 days and to "sow seed to a depth of 1⁄4'' in a well drained, peat-based soil-less substrate".

E *Symphyotrichum ericoides* (White Heath Aster) - Asteraceae
Store seeds dry at 40 or 70˚.
Sow 1 month before the last frost date in spring. vlC. 100% germination at 70 after a cool period.

E *Symphyotrichum laeve* var. *geyeri* (Smooth Blue Aster) - Asteraceae
40(30d) either in the fridge or outside. Sow at 70, vlC. Leaves in 7-9d. Pot 2-3w later.

E *Symphyotrichum oblongifolium* (Aromatic Aster) - Asteraceae
Follow directions for *S. ericoides.*

E *Symphyotrichum porteri* (Smooth White Aster) - Asteraceae
After-ripen dry 4-6m at 70. Sow 1m before last frost., vlC.

M *Tetraneuris acaulis* (Stemless Four-nerve Daisy) - Asteraceae
syn. *Hymenoxys acaulis*
Store seeds dry 70 4-6m. Sow 64˚, vlC. Intolerant of overwatering and root disturbance.

M-D *Thalictrum* spp. (Meadowrue) - Ranunculaceae
Store dry seeds longterm at 40˚ or lower.
40(8w) fridge or outdoors. Sow 68 day and 50 night, lt C. Radicles in 15-30d. Leaves in 3-4w.

E *Thelesperma filifolium* (Stiff Greenthread) - Asteraceae
Annual.
Cold stratify 2-4 weeks. Do it in situ or in cells outside, not a baggie in a fridge, The radicles emerge in 9-17 days. vlC.

M *Thelesperma megapotamicum* (Hopi Tea Greenthread) - Asteraceae
Perennial.
Sow in cells or in situ in mid March (about 7 weeks before the last frost date). Cover lightly.
Leaves emerge in 2-2.5 months when temps are around 60-65 and fluctuating widely night to day.

M *Thermopsis rhombifolia* (Goldenbanner) - Fabaceae
Scarify with sandpaper. Do a boiling water + 3% peroxide treatment (9:1). Let cool and soak in that solution for 24 hours. Rinse and soak in tepid tap water until the seeds swell. You may need to repeat the boiling water soak until the seed swell. Inoculate (opt.) Sow 70C.
They can also be scarified and sown in the fall.

M *Townsendia grandiflora* (Largeflower Easter Daisy) - Asteraceae
Biennial
Sow in cells early April (6w before last frost date), lt C. Cotyledons in 2m. Transplant in 5w.

E *Verbena stricta* (Hoary Verbena) - Verbenaceae
Store seeds dry at 40 or 70˚.
40(120-180d) in the fridge. 80% germination over that time. Sow, vlc. Leaves appear in 9 days.
The radicles emerged slowly over weeks. Perhaps sowing in situ in the fall would provide a longer cold period and higher germination rates.

E *Verbesina encelioides* (Golden Crownbeard) - Asteraceae
Regional.

Annual.
This species is both self and cross pollinated.
In fall, surface sow in situ.
OR
In spring, surface sow the seeds in situ or in pots. If the crop is too heavy, snip off some of the seedlings.

E *Vernonia baldwinii* (Western Ironweed) - Asteraceae
40(60d) - 70. 77% germination.

E *Viola nuttallii* (Yellow Prairie Violet) - Violaceae
"I find the fullness of the seed to range from full to empty. I collect the entire above ground part of the plant when the first capsules dehisce and let them finish in a paper sack. I screen it as best as I can. I find the best way to separate these seeds from similar chaff is to gently move a sloping, flat surface and let them roll away from the debris. It can be done with a fan, but this is more efficient as far as yield. You still need to blow away some of the empty seeds."
Rick Brune email 6/21/21
The seeds need a period of cold stratification. Either sow them in situ upon collection or sow them as soon as you receive them. If necessary, the seeds can be held dry until early fall of the year collected. The seeds have an elaiosome which suggests a long period in dry storage would be detrimental. Most plants with an elaiosome are ant dispersed. Ants may move them from where you sow them to another spot.
Sow the seeds in situ and cover them with about 1/8" of soil or grit. Label the location so you will not disturb them before they can germinate early the following spring.

E-M *Wyethia amplexicaulis* (Mule's Ears) - Asteraceae
Store the seeds dry at 70˚ for 6 months (after-ripen). Viability 60% on 5 year old seeds.
40(80-90d) outside in the winter or in the fridge. Sow, lt C. Leaves emerge at 60-70˚ in 2 weeks.

Wyethia scabra - see *Scabrethia scabra*

M *Xanthisma spinulosum* (Spiny Goldenweed) - Asteraceae
Clean to remove chaff. Store dry at 40 or 70 for 6 months.
Sow 70L, vlc.
Excellent overall germination on 7m old seeds grown under lights indoors.

Yucca baccata (Blue Yucca) - Asparagaceae
"Yuccas will germinate promptly from fresh seed held over winter (in moist sand in the fridge). Seeds germinate best in 60-70 degree temperatures. Yuccas may also be grown from rhizomes, stem cuttings, or by digging offsets from the side of established plants. Transplant into a well draining medium." wildflower.org

M *Yucca glauca* (Great Plains Yucca) - Asparagaceae
Check the seeds carefully for insect predation. Discard seeds with holes. Put dry seeds in the freezer for 2 weeks.
Sow the seeds at 70˚. Cover lightly. They will germinate erratically over 3 months.
Fall sowing should work as well.

D *Zauschneria garrettii* (Hummingbird Trumpet, CA Fuscia) - Onagraceae
Regional.

Viability decreases slowly when stored 40 dry.
40(3w)-70L; 35% germination.
Many died after moved to a bigger pot containing commercial soil free potting mix.

M *Zinnia grandiflora* (Rocky Mountain. Zinnia) - Asteraceae
Many seeds offered at exchanges are not fertile.
Sow in situ or in cells from mid spring to early summer, 65-75, lt C. Germination may be erratic.

M *Zizia aptera* (Heartleaf Golden-Alexanders, Meadow Zizia) - Apiaceae
Collect seeds in a paper bag Aug-Sept when the seeds roll easily from the umbel. Store at 40˚.
Sow in situ outside in fall or begin treatments in January.
Soak and **rinse each day** for 3d. A bubbler is helpful. Do this soak for seeds sown in situ or cells.
This leaching of chemicals definitely increased the germination percentage. I'll add a test for double dormancy for the 2025 season.
Sow in cells/pots, C. Put outside.
Germinate in cool temperatures (in about 3.5 months if started in January).
Bloom in 2 years.

SHRUBS

Amelanchier alnifolia (Western Serviceberry) - Rosaceae
Store clean seeds 40 dry.
When soaked, the seeds form a light gel coat.
Soak the seeds in 3% peroxide for 15 minutes. Rinse well. 40(60-120d). If leaving in the fridge after the first 60d, check every week for germination. Stick a germinated seed into a hole in a pot of mix. Maintain a temperature of 60-70˚.
It is easier to cold treat the seeds in the fridge for 60d starting about 120 days before your last frost. Then sow the seeds in pots of well draining mix, med C. Put outside.
Growth is slow for 1-2 seasons.
I find this species difficult to overwinter in pots in a cold frame with temperature control.

M *Amorpha canescens* (Lead Plant) - Fabaceae
Scarify with sandpaper and a boiling water soak. 40(30d). Inoculate (opt.). Sow 70˚ on well draining mix in deep cells or pots, vlC. Cotyledons emerge in 1 week.

M *Amorpha nana* (Dwarf or Fragrant Wild Indigo) - Fabaceae
Treat the seeds the same as *A. canescens* seeds.

D *Arctostaphylos uva-ursi* (Kinnikinnick) - Ericaceae
Scarification, then 60 to 90 days warm, moist treatment then 90 to 120 days cold stratification)
USDA Forest Service Gen. Tech. Rep. RMRS-GTR-274. 2012 p 69

M *Atriplex canescens* (Fourwing Saltbush) - Amaranthaceae
The plants are usually dioecious, ie. male and female flowers are on separate plants.
After-ripen (store dry at 70˚) for 90 days. USDA Forest Service Gen. Tech. Rep. RMRS-GTR-274. 2012 , p 69.

Soak the seeds in water for 24 hours. 40(5d). Sow and cover well.
Seed can also be sown in situ in fall or early spring and covered well. westernnativeseed.com

When I used the fridge for the cold stratification, about 1/4 of the seeds germinated (radicles emerged) 5 days after putting in the fridge. The rest of the seeds never germinated.
Sowing fresh, soaked and cold stratified seeds directly into a 2.5" pot containing well draining mix in mid February works well. 40(2.5m) outdoors.

When advancing from cells to a small pot, use a very well draining medium. This species can rot easily in pot culture.

Berberis aquifolium (Holly-leaved Barberry) - Berberidaceae
Pacific Northwest native plant.
Seed production is best when you have more than 1 seed grown plant. Remove flesh.
Soak the seeds for 24 hours. 40(180d) either in the fridge or outside. Cover with 3/8" medium.

Berberis fremontii (Fremont's Barberry) - Berberidaceae
Remove flesh from the fruit.
Soak seeds in tepid water for 5 hours. 70(3d) - 40(3.5m). Radicles emerge in 5.5-8.5w. Cotyledon leaves emerge 1-2w later. Cover seeds to depth. Use deep cells or pots containing a rocky mix.

In the Front Range, seeds started in the middle of January had to be kept under grow lights. A later start date would allow adaptation to outdoor conditions sooner.

B. fremontii only has physiologic dormancy while some other species in the genus have morphopysiologic dormancy. Baskin, Baskin and Susan E. Meyer. www.jstor.org/stable/3672059

Berberis repens (Creeping Oregon Holly) - Berberidaceae
Soak and ferment the berries for a few days. Remove the soft dark blue flesh. An immersion blender is helpful and does not harm the seeds if the blade is dull.

Start treatments in early November. 70(3m)-40(3-5m) - 70, C.

Germination 100% over a very long time.

***Ceanothus* spp.** (Redroot, Jersey Tea) - Rhamnaceae
Sandpaper scarify the seeds followed by a boiling water treatment and 24h soak. 40(60-90d). The stratification may not be necessary, but it will not hurt.

Cercocarpus ledifolius (Curl-Leaf Mountain Mahogany) - Rosaceae
60-90 days cold-moist stratification. Sow outside in fall to early spring. https://klamathsiskiyouseeds.com

E *Cercocarpus montanus* (Birchleaf Mountain Mahogany) - Rosaceae
De-plume the seeds and store the seeds dry at 40˚. The plume drills the seed into the ground in nature, but in horticulture, we cover the seeds with some medium.
Soak the seeds in water for 30 minutes. 40(1m). Sow at 70, vlC. First leaves appear 17 days after sowing.
Seeds can be soaked, and direct sown in the garden about a month or more before the last frost date. Cover the seeds lightly.

M *Chamaebatiaria millefolium* (Fernbush) - Rosaceae
Regional native.
Sow outside in fall or early winter. Light cover.

Fresh seeds are nondormant, whereas stored seeds require 1 to 3 months of chilling to overcome dormancy. The optimum temperature range for germination of southwestern populations is 18 to 26 °C (65-80˚F). https://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook727

Cold stratify stored seeds. Fridge treatment leads to radicle emergence in 3w. For cold stratification outdoors, sow 3-4w before last frost date, lt C. Cotyledons emerge 11d after sowing stratified seeds.

E *Ephedra viridis* (Mormon Tea, Green Ephedra) - Ephedraceae
Sow in well draining soil, C, 40(1m) outside. Germinate (radicles) in 19 days. Leaves emerge in another 29 days. Bump up as early as a week after leaves appear.

E *Ericameria nauseosa* (Rabbitbrush) - Asteraceae
Whether standard sized or dwarf this plant self seeds readily.
Use fresh seeds but viable at least 4y at 40˚ dry.
Sow in early winter either in situ or in cells. vlC (light requirement).
They germinate about 4 weeks before the last frost in spring.
Sow in Dec. rather than in spring to have plants ready for spring sales or swaps.

E *Eriogonum effusum* (Spreading Buckwheat) - Polygonaceae
Collect seeds Sept-Oct. Store dry at 40˚.
Sow in early Feb. in FR. lt C. Radicles begin to emerge in 38d. Leaves emerge when temperatures hit about 60-65˚. Bump up can begin 3-4w later. Pot in well draining mix.

E *Fallugia paradoxa* (Apache Plume) - Rosaceae
Collect seeds when the pink plumes turn white and the seeds are easily plucked. Dry and remove the style (plume). This will provide better soil contact for the seeds when they are sown.
In more southern states with summer rains, no pretreatment is necessary. In CO, store the seeds dry at 40˚. One month before the last frost, 40(1m) - 70, lt C.
Best results from fresh seeds.

D *Fendlera rupicola* (Cliff Fendler-bush) - Hydrangeaceae
Soak 24h; 40(2m) fridge; sow, vlc, 60-70. Cotyledon leaves in 19d.
Require excellent drainage. I have not managed to keep seedlings alive (FR 5690') after moving to pots with well draining soil. I may have overwatered.

M *Fraxinus anomala* (Singleleaf Ash) - Oleaceae
Samaras … can remain viable in leaf litter or humus for several years. https://www.fs.usda.gov/database/feis/plants/shrub/fraano/all.html
70(2m) - 40(3m), C.
Half of radicles emerged in the moist vermiculite in the fridge from 1-3m, about 1 every week or two.
Larval host plant of the two-tailed swallowtail. raisingbutterflies.org

M *Gutierrezia sarothrae* (Broom Snakeweed) - Asteraceae
Surface sow heavily in spring. Mist or bottom water. Cover with glass or plastic.
Easy to germinate seeds collected the previous fall under a dome, using artificial lights.
The seeds germinate in 7d at 70˚. Cotyledons in 3 more days.

M *Holodiscus discolor* var. *dumosus* (Rockspirea) - Rosaceae
Store the seeds dry at 40˚ for 6 months to allow the embryo to mature (afterripen).
The tiny seeds may have a low 7% viability, and they have a deep dormancy. fs.fed.us/database

At the Denver Botanic Gardens, one horticulturist treats the seeds with sulfuric acid, cold stratifies for 4.5 months, treats with Wright's Liquid Smoke and then surface sows. The tray of cells goes under mist at 70°.
Cold stratification for 4 months is necessary. I have had excellent germination when I sow in Nov-Dec. I treat the seeds with liquid smoke, sow in cells, vlc, and put outside. They germinate about 1 week into April (FR, 5690'). The seedlings are very small.

M *Jamesia americana* (Five-petal Cliffbush, Waxflower) - Hydrangeaceae
60-70(L)
Germinate in 26d.
Tiny seedlings.

E *Krascheninnikovia lanata* (Winterfat) - Amaranthaceae
Viability very poor after 2y. About 25% in 3yo seeds.
In January or February, sow in cells, in germination mix, 1/4" C. Put the flat outside. Radicles in 29d. Cotyledons in 53d. Germinate cold and tolerate prolonged cold.

Philadelphus microphyllus (Littleleaf Mock Orange) - Hydrangeaceae
Store clean seeds 40 dry. Viability still strong at 5y.
Add extra drainage material to mix. Sow in cells/pots, vlC, 40(45d) outside.
Seedlings are very small.

Physocarpus monogynus (Mountain Ninebark) - Rosaceae
Collect seeds in Aug. in the Front Range.
Sow seeds mid-March (5690', FR), vlc, outside. Tiny leaves emerge in about 1m. In 1m more, transplant in an intact clump into well draining soil. Avoid over watering.

Cuttings: The ninebarks are easily propagated by softwood cuttings planted under mist, or hardwood cuttings planted in the field (Everett 1981; Dirr and Heuser 1987), (USDA Woody Plant Seed Manual, 2008, pg 792)

E *Prunus americana* (American Plum) - Rosaceae
Remove the flesh (aril) from around the pits.
Shortly after cleaning, sow in situ or in pots outdoors. Cover to depth. They germinate in about 7 months in cool temperatures, including some frosts.
Cold stratification for 3 months or more could be done in the fridge.
Protect from rabbits when young.

M-D *Prunus pumila* var. *besseyi* (Sand Cherry) - Rosaceae
Clean ASAP. Embryos have a dormancy period of several months, but dry storage reduces viability down to <30%. Store in barely moist perlite or vermiculite in the fridge over winter which accomplishes 3 months or more of cold stratification. Sow in spring, cover, protect from birds. Seedlings have two pairs of true leaves by early June.

Softwood cuttings, IBA/NAA dip, take in cool part of day. Stick right away. They don't recover from wilting. Phillips, Judith, "Plants for Natural Gardens", p 64.

D *Prunus virginiana* var. *melanocarpa* (Chokecherry) - Rosaceae
Warm stratify the seeds in moist sand for 2 weeks. Then cold stratify (36-41 degrees) for 60-90 days.

Plant well before high temperatures. wildflower.org
70(2w) - 40(8-12w) - 65-70, C

E *Purshia tridentata* (Antelope Bitterbrush) - Rosaceae
If dry seeds are black they do not germinate. Use the tan seeds.
40(2w) in fridge, consistent radicle development in 2w - sow in deep cells or pots at 65, med C. True leaves develop 55-60d after sowing in cool temperatures. They are frost tolerant. Do not overwater.
OR
In winter, sow in deep pots in very well draining soil, cover just to depth, and put outside.

Advancing seedlings is more difficult than germinating them.

E *Rhus glabra* (Smooth Sumac) - Anacardiaceae
Dioecious
Collect the seeds when they strip easily from the rachis.
The red drupes have an oily mesocarp. The fruits can be cleaned after collection or stored at 40˚ dry until winter and cleaned when they are drier. Rub them on a sieve to remove the red mesocarp. Another cleaning method is to "Place the seed heads in a plastic grocery bag, once they are completely dry. Tie the bag shut, and bang it against a hard surface to separate the seeds from the berries." https://homeguides.sfgate.com/grow-rhus-glabra-seeds

When you are ready to sow the seeds either fall or late winter, scarify the seeds with acid or sandpaper or a blender with plastic blades. Give them a boiling water treatment and soak for 24h or 2-3d. If the seeds are imbibing water, they should sink. After treatments, sow in containers or in situ.
40(2-3m) - 65-70, C

If using the fridge, start the treatments in Jan-Feb. Sow in April-May. The seeds germinate quickly. Leaves emerge in 10 days at 65˚. The seedlings can be potted 3 weeks later.

D *Rhus trilobata* var. *trilobata* (Skunkbush or Aromatic Sumac) - Anacardiaceae
Dioecious.
Collect the seeds when they strip easily from the rachis.
Remove the red flesh and store 40 dry.
Sulfuric acid (10%) soak for 7 hrs., rinse, water soak 24h - 3/6/24 40(2m). 50% success.

E *Ribes americanum* (American Black Currant) - Grossulariaceae
Collect the seeds in fall when the fruits are black and still soft. Soak and clean. If the fruit has dried, and it is hard to clean the seeds, soak more days. If necessary, use an immersion blender after soaking to remove the dried fleshy material.
Store the seeds dry at 40 or 70˚. Viability decreases each year.
About January 1 or earlier, soak the seeds in water for 24h.
Sow the seeds in deep cells/pots or in situ. Medium C. Place outside for 4-5m cold treatment. Cold stratification can be conducted in the fridge, but winter sowing is easier.
Cotyledons begin to emerge 2 weeks after the last frost date.

Location matters! This species grows in "shady places along streams (and in) moist meadows, 5500-7500'." Ackerfield, Jennifer, "Flora of Colorado", 2022, p 525.

E *Ribes aureum* (Golden Currant) - Grossulariaceae
When the fruit is soft ripe (early Aug. at 5690'), collect the berries. Soak and ferment for a few days. Clean the seeds. Store dry at 40˚.
At the first of the new year, sow the seeds in deep cells/pots, lt C. Put outside for a 4 month cold treatment.
Cotyledons start to emerge around the last frost date.

E *Ribes cereum* (Wax Currant) - Grossulariaceae
Soak and ferment the berries to remove the fruit from the seeds.
Viability seems to decrease each year at 40˚ dry.
Soak in water for 24h. 40(4m) - 65-70, lt C. Germination rate about 40% with 1-2 yo seeds.

E *Ribes leptantha* (Trumpet Gooseberry) - Grossulariaceae
Clean seeds. Store 40 dry. Soak in water for 24h. 40(4m) - 65-70, lt C.

M *Rosa woodsii* (Smooth or Woods' Rose) - Rosaceae
syn. *Rosa blanda*
Remove fleshy material promptly after collection. Put the fruits in a small bowl with enough water to cover the seeds by 1 inch. Let the concoction ferment for several days. When the fruits soften, remove the seeds.

Sow in early fall, scarify the seeds with sandpaper, boil soak 24h, cover.
Scarify, soak, 70(3m)-40(3-4m)–70C.

Rubus deliciosus (Boulder Raspberry) - Rosaceae
Collect fruits in mid summer. Promptly soak and clean the seeds. Store dry for 6 months.
Sow in early-mid February, C. 40(120d). Cotyledons begin to emerge in 10d. Germination might continue for some years.

D *Sambucus racemosa* (Red Elderberry) - Adoxaceae
Soon after collection, soak/ferment the fruits and remove the fleshy material. The seeds can be stored dry.
Sand, the small seeds, peroxide 3% soak 30 min, rinse, water soak 24 hours. 70(2m) - 40(3m) - 70L.
Directions are roughly based on the FS database. https://www.fs.usda.gov/database/feis/plants/shrub/samrac

E *Shepherdia argentia* (Silver Buffaloberry) - Elaeagnaceae
Dioecious.
Viability very poor at 12 yo.
Soak 24h, 40(3m) - 65-70C.

D *Symphoricarpos albus* (White Snowberry) - Caprifoliaceae
70(3m) - 40(4m) - 70 USDA Forest Service Gen. Tech. Rep. RMRS-GTR-274. 2012, p 69
Scarification before the start of stratification may be necessary.

TREES

Celtis occidentalis (Western Hackberry) - Cannabaceae
Store cleaned seeds 40 dry for some viability at 5 years.
At 5690', mid-February, water soak 24h, remove seed coat - 40(13w) - sow, 1/2" C
Germination rate 71%.

WOODY VINES

Parthenocissus quinquefolia (Virginia Creeper) - Vitaceae
Introduced to CO from eastern states. This may be invasive in CO!
"Collect fruits after they have turned bluish black by hand-stripping from vine. Extract seeds from pulp and air-dry. Store in sealed containers at 42 degrees.
Sow seeds in fall or stratified (in moist sand or peat for 60 days at 41 degrees.) and sow in spring." wildflower.org
Seeds stored clean at 40˚ dry germinated 45%, 2 weeks before seeds stored in their fruit, 25%.
Cover the seeds 1/4".

The easiest way to propagate is by hardwood or semi-hardwood cuttings, or by layering in the fall.wildflower.org

D *Smilax lasioneura* (Blue Ridge Carrionflower) - Smilacaceae
Soak, ferment and macerate the blue berries to remove the fleshy material around the seeds.
40(60d or more). Cover to depth. They can take several years to germinate. Sowing in situ may be the easiest method.

SEDGES

Carex brevior (Short-beaked Sedge, Plains Oval Sedge) - Cyperaceae
40(60d) - prairiemoon.com. The perigynia are removed from Prairie Moon seeds.

Carex hystericina (Bottlebrush Sedge) - Cyperaceae
40(60d) - prairiemoon.com.
40(60d) - prairielegacyinc.com. The perigynia are on Prairie Legacy seeds. Scarify.

Carex inops (Sun Sedge) - Cyperaceae
Sun Sedge has an eliaesome! They are collected and dispersed by ants as soon as they are ripe. Do not let the seeds dry out.

Carex nebrascensis (Nebraska Sedge) - Cyperaceae
"Nebraska Sedge can be efficiently germinated in nurseries if perigynia are removed by scarification and achenes stratified 32 d at 3 ˚C (37 ˚F) with a sphagnum peat moss substrate." www.fs.fed.us/rm/pubs
npn.rngr.net/renderNPNProtocolDetails?selectedProtocolIds=cyperaceae-carex

GRASSES

Many grasses, especially warm season grasses, benefit from big temperature swings anywhere in the range of 80-90˚ in the day to 34-50˚ at night.
Protect the seeds from birds and small mammals whether you sow in cells or in situ.

Spring-summer planting of grass plants is desirable.
Cool season grasses thrive if planted before June 1 (FR). Cool season grasses left in cells in the heat of summer easily rot from overwatering and heat. Many cool season grasses tolerate part shade.

Warm season grasses can be planted into the summer. Fall planting of warm season grasses may succeed if the plants have a substantial root system which is not divided. Warm season grasses do not grow over the fall and winter so the plants just sit in the hole in the ground. They begin active growth when temps warm in spring.

Acnatherum hymenoides (see *Eriocoma hymenoides*)

E-M *Andropogon gerardii* (Big Bluestem) - Poaceae
Warm season.
Store seeds 40 dry. Sow seeds at 75-80˚ (a germination blanket might be helpful to achieve the desired warm temps but temps should drop dramatically every night).
Big Bluestem has a low percentage of fertile seeds. I collected at least 5 ecotypes of seeds and established them in a meadow. Thereafter, I collected many more fertile seeds.

Andropogon hallii (Sand Bluestem) - Poaceae
Warm season.
Grows on the top of sand dunes.
It is related to Big Bluestem, and it has the same fertility issues. It may have few fertile seeds in the inflorescence.
Store seeds 40 dry.
Seeds do not require cold treatment to germinate. They germinate in the fall and overwinter as seedlings. fs.fed.gov/database
No pretreatment. Plant seeds outside fall or spring 1/8 to 1/4” deep. - westernnativeseed.com

E *Bothriochloa laguroides* (Silver Bluestem) - Poaceae
(syn. *Andropogon saccharoides*)
Warm season.
At 5690’, seeds sown in mid March germinate within 2m. Sow in cells or in situ. Cover very lightly and put the cells outside.
They bloom the first season.

E *Bouteloua curtipendula* (Sideoats Grama) - Poaceae
Warm season.
Self seed vigorously. Somewhat rhizomatous as well. Can overpower small gardens.
Store seeds 40 dry.
From mid March-mid May sow outside in cells or in situ. Cover to depth. The seeds do not require a pretreatment (cold stratification), but they germinate best when they are exposed to large temperature swings (70-90˚ with nights 35-45˚). They will germinate in 2-7w. The plants often bloom the first year.

M *Bouteloua gracilis* (Blue Grama) - Poaceae
Warm season.
Store 40 dry.
Sow mid April to mid May in situ or in cells. Cover lightly. Germination seems lower than in some of the other warm season grasses. Be generous when sowing the seeds.
Seeds collected from a cultivar such as 'Blonde Ambition' will probably be fertile, but the plants produced will not have the exact features for which the cultivar was selected.

M-D *Buchloe dactyloides* (Buffalo Grass) - Poaceae
syn. *Bouteloua dactyloides*
Warm season.
Purchased seeds primed with KNO_3 sown after the last frost day, germinate in less than 3w. Wild collected seeds may need to be older or have a cold stratification period. lt C.

E *Deschampsia caespitosa* (Tufted Hairgrass) - Poaceae
Cool season.
Sow heavily in cells or in situ in mid March in the Front Range, lt C.
Heavy germination in 1m. Began to pot mid May.

E *Elymus canadensis* (Canada Wild Rye) - Poaceae
Cool season. Partial shade to sun.
Avoid roadside seed collection. Seeding with cultivars raised for forage is common along roads.
Sow early-mid April in the FR. vlC. They germinate in 11-17d. If you sow them in situ, protect the seeds from birds. If grown in cells, plant the plugs by June.
They may bloom the first year.

E *Elymus elymoides* (Squirreltail) - Poaceae
Cool season.
Collect seeds mid June to mid July. The inflorescence tumbles. Store dry at 40-70˚.
No pretreatment is required. Sow in situ or in cells about 2w before the last frost date. Cover with 1/8-1/4" of soil. The seeds germinate in about 2w.
They can be moved from cells to small pots in 2-3w.

E *Elymus glaucus* (Blue Wildrye) - Poaceae
Cool season.
Seeds sown mid March in the FR and covered lightly germinate in 1 month or less.
Pot or plant plugs directly into the ground before June 1.

E *Elymus trachycaulus* (Slender Wheatgrass) - Poaceae
Cool season.
Treat the same as *E. glaucus*.

D *Ericoma hymenoides* (Indian Ricegrass) - Poaceae
Sand, hot water soak for 3d. 40(45d). Sow heavily at 70˚. C.
Low germination rates.

E *Festuca arizonica* (Arizona Fescue) - Poaceae
Cool season.

About the third week in March (in the FR, 5690'), soak in tepid water for 24h. Sow in cells and cover by 1/4". Leaves emerge in 24d. Pot as early as one week later if you have a clump of plants.

E *Festuca idahoensis* (Idaho Fescue, Blue Bunchgrass) - Poaceae
Cool season.
Treat the same as *F. arizonica*. The water soak is not necessary.

E *Festuca octoflora* (Sixweeks Fescue) - Poaceae
Cool season.
Annual.
Viability about 15% at 5 years when stored 40 dry.
6 weeks before last frost date, sow, vlc, out
Cotyledons emerge around the last frost date.

E *Festuca saximontana* var. *saximontana* (Rocky Mountain Fescue) - Poaceae
Cool season.
Treat the same as *F. arizonica*. The water soak is not necessary.

E *Festuca thurberi* (Thurber's Fescue) - Poaceae
Cool season.
Treat the same as *F. arizonica*. The water soak is not necessary.

E *Hesperostipa comata* (Needle & Thread) - Poaceae
syn. *Stipa comata*
Cool season.
In mid March (in FR 5690'), sow in cells. Scarification does not hurt but is not necessary. Cover 1/8" deep. Put outside. Leaves emerge in 34-44d. Plant the cells or pot within a few weeks.

Hesperostipa neomexicana (New Mexico Feather grass or NM Needlegrass) - Poaceae
Cool season.
Treat the same as *H. comata.* No scarification.

Hilaria jamesii (Galeta) - Poaceae
Warm season.
Viability strong at 4 years stored 40 dry.
Sow about 1m before the last frost date or through the summer, lt C. Germinate from 14d to 2m depending on the temperature.

E *Koeleria macrantha* (Junegrass) - Poaceae
Cool season.
Viability strong after 3 years storage 40 dry.
Mid March (in the FR, 5690'), sow pinches of seeds in cells, vlC. Put outside. Leaves emerge in 30-40d in cool temperatures.

E *Muhlenbergia montana* (Mountain Muhly) - Poaceae
Warm season.
Sow the seeds 2w before your last frost date in the spring or on into the summer, vlC. Put outside. Leaves emerge in 1-2w.

E *Nassella viridula* (Green Needlegrass) - Poaceae
Cool season.
In the FR (5690') collect seeds in July. Store dry until the next spring.
In early to mid March, sandpaper to scarify the seeds. Cold stratify 2 months in the fridge. Sow around your last frost date, vlC. Begin to show a few leaves in 1w.

E *Panicum virgatum* (Switchgrass) - Poaceae
Warm season.
Sow seeds anytime from May 1- June 1, in cells kept outdoors or sow in situ. Cover lightly.
Switchgrass germinates best when the seeds receive large temperature swings (70-90˚ day-34-50˚ night). Leaves emerge in 22-25d.

E *Pascopyrum smithii* (Western Wheatgrass) - Poaceae
syn. *Elymus smithii*
Cool season.
Cold stratify for 2w or sow 2w before your last frost date. Pretreatment is not required but speeds germination a bit. Cover well to provide dark. Germinate in 8d if cold stratified.
Careful! Rhizomatous and tends to form monocultures.

E *Schizachyrium scoparium* (Little Bluestem) - Poaceae
Warm season.
Sow mid April to mid summer in cells or in situ, lt C. Leaves emerge in about 20d.

E *Sorghastrum nutans* (Indian Grass) - Poaceae
Warm season.
Store seeds 40 dry.
Sow anytime from April 1- May 1, in cells kept outdoors or in situ, lt C. Germinate in 30-48d.

E *Sporobolus airoides* (Alkali Sacaton) - Poaceae
Warm season.
Viability good at 5 years stored 40 dry.
Collect seeds in the fall and store dry to after-ripen until the spring.
Sow in mid March in the FR (5690'), med C. Large temperature fluctuations speed germination which can occur anywhere from 2-6w. Pot or plant plugs anytime after the leaves are 1.5"-2" tall.

Sporobolus cryptandrus (Sand Dropseed) - Poaceae
Warm season.
Viability good at 7 years stored 65 dry.
Sow 5-6w before your last frost date. Add extra drainage material such as expanded shale to the mix, lt C, put outside.
Leaves in 50d.

E *Sporobolus heterolepsis* (Prairie Dropseed) - Poaceae
Warm season.
Viability good at 6 years stored 40 dry.
Sow about 5-6w before your last frost date, vlC. Germinate around the last frost date and can be potted or planted 2 weeks later.
Flower the first season.

FERN ALLIES

Marsilea vestita (Buffalo Clover) - Marsileaceae
"Marsilea is infrequently found in intermittent pools in small drainages on the Pawnee National Grassland. They are often classified as buffalo wallow plants. The areas are often heavily trampled by cattle which may serve to scarify the sporocarps. They produce floating fronds when water is present. As the water recedes, sporocarps are produced on the drying mud flats. Eventually the fronds shrink as moisture disappears. Then they bake in the hot sun on scorching soil during the summer. I believe their habitat is usually quite dry during the winter and the plants regrow with spring moisture. They do not do well indoors for a long period of time.

My procedure for growing it from sporocarps is as follows:

Scarify or cut in half the sporocarps. [Jan suggests nail clippers.]
Outdoors! Place on soil (mine is Nunn-Clay Loam) in 0.5 inches of water or less. Add water to soil from bottom to neutralize any chlorination products. Provide different depths from about 1mm to 12mm. [The water is over the top of the soil.]
Sporophylls are produced in one hour.
Germination of megaspores in about 10 days. Fine, grass-like growth. It may or may not help to lightly tip the container to spread the microspores around with the megaspores.
After 3 more days, 200 - 300 grass-like growths 3-4 mm tall.
After 1 day, first fronds begin to appear as broader blade.
After 11 more days, first four-parted fronds appear.
After doing this several times, I think the procedure can probably vary considerable.
Have fun!" email from Rick Brune, 6/12/21

I had my best success following Rick's directions when I put the containers under indoor lights.

Useful Resource:
free downloads of Deno, Norman, Seed Germination Theory and Practice 2nd ed. and 2 supplements. https://nal.usda.gov
National Agricultural Library: All Collections, Search Digital Collections, Sort by Author

npn.rngr.net Native Plant Network: Reforestation, Nurseries & Genetic Resources

SEED COLLECTION DATES IN THE FRONT RANGE

MAY
Carex inops
Escobaria missouriensis
Lomatium orientale
Vesper montanus
Viola nuttallii

JUNE
Mertensia lanceolata
Hesperostipa comata

Oxytropis sericea
Physaria bellii
Koeleria macrantha

JULY
Astragalus
Aquilegia chrysantha
Aquilegia coerulea
Astragalus parryi
Astragalus shortianus
Allium textile
Erysimum asperum
Elymus elymoides
Hymenoxis hoopesii
Astragalus drummondii
Linum lewisii into August
Penstemon virgatus
Heterotheca villosa
Lithospermum incisum
Scuttelaria brittonii
Sedum lanceolatum
Zizia aptera
Cleome trachypleura into September
Gaillardia aristata
Penstemon virens

AUGUST
Astragalus bisulcatus
Oreocarya virgata through Sept.
Berlandiera lyrata through October
Agastache urticifolia
Brickellia grandiflora
Delphinium ramosum
Monarda fistulosa
Penstemon grandiflorus
Penstemon barbatus
Tripterocalyx micranthus
Eriogonum umbellatum
Oenothera harringtonii through Sept.
Campanula americana
Cleomella lutea
Cleomella serrulata
Penstemon rostriflorus
Ratibida columnifera

SEPTEMBER
Rudbeckia laciniata
Oenothera macrocarpa
Phacelia tanacetifolia
Mentzelia multiflora
M. nuda

M. dodecatheon
Oreochrysum parryii
Gaillardia X grandiflora
Dalea purpurea
Liatris punctata
Artemisia frigida
Mirabilis liniaris
Asclepias tuberosa
Physalis longifolia
Panicum virgatum

OCTOBER
Amsonia illustris
Bouteloua curtipendula
Brickellia grandiflora
Argemone polyanthemos
Brickellia eupatorioides
Asclepias tuberosa
Gutierrezia sarothrae
Ericameria nauseosa var. nauseosa
Eriogonum effusum
Solidago mollis