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Seed Germination and Gibberellic Acid

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Gibberellins are a phytohormone (plant hormone) and one of the most important natural substances in seeds and seed germination. Since they were discovered in the 1930s, scientists have identified more than 120 different types of gibberellins (GA) in plants, bacteria and fungi. These types are numbered based upon their order of discovery, and the ones most important in plants are GA_3, GA_4 and GA_7.

GA is known as a seed germination promoter but its function can vary with different seed types. In grasses and many other plants, the seed is compartmentalized into the food storage tissue called endosperm and the embryo. The endosperm contains starches that must be converted into soluble sugars and transported to the embryo for growth. This process is mediated by GA. If the GA level is too low, starches are not converted, and the seed may not germinate.

GA is a big component of seed dormancy that may be caused by a variety of factors such as light, specific germination temperatures and even chemical inhibitors inside the embryo. A light requirement in seeds may be fulfilled by exposing moistened seeds to light, but a treatment with GA can overcome that requirement so seeds will germinate in light or darkness. A seed may require high temperatures to germinate, but a GA treatment might broaden the temperature range under which the seeds will germinate. Seeds that have an embryo dormancy, one where there is chemical inhibitor in the embryo, must be cold stratified* to break down these germination inhibitors. As the inhibitors are reduced, GA often increases and is one of the main hormones promoting complete germination. GA also may be used where germination is slow or erratic to speed up the process and promote more uniform germination.

Synthetic GA is a white crystal that is not readily soluble in water. The potassium salt of GA (K-GA) is water soluble, or GA can be purchased as a pre-mixed solution. For home gardeners or hobbyists, the easiest way to use GA is as a solution because it takes a laboratory precision scale to weigh tiny amounts of the crystals. Liquids are often sold as a concentrate, and water is added to obtain the proper concentration. Follow all product label directions for use and safety.

Seeds respond to a wide range of GA concentrations from 50 ppm to as high as 10,000 ppm. A bit of experimentation is required, but a common starting point is 1000 ppm (100 milligrams GA per 100 milliliters water). If the concentration is too high or the soak time is too long, seedlings may grow leggy and weak. Dissolve the crystals with tiny amounts of rubbing alcohol, and then add boiled (to sterilize it), cooled water to the final concentration. Store in a sealable dark glass jar or plastic container in the refrigerator.

Many different species respond to a GA treatment including Alaska native plants (Table 1). However, many more native plant seeds probably respond to GA but have never been tested. Add seeds to a cup or jar, and pour in enough GA solution just to cover the seeds. Allow seeds to sit at room temperature for 24 hours. Cover the container, if necessary, to slow evaporation. Some people make small packets out of coffee or tea bag filters, then dip bag and seeds into the GA solution to make seed handling easier. Pour off the GA, and sow the seeds in a sterile seed starting mix.

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*Cold stratification is the process of exposing seeds to chilling temperatures (usually around 40°F(4°C) but as low as 32°F (0°C) for a period of time, usually 60 or more days, to metabolically break down chemical inhibitors in the embryo. The seeds must be imbibed (previously soaked in water), and the temperatures must be above freezing to allow metabolic breakdown to occur. Large seeds can be mixed into a small sealable bag of sterile, moistened vermiculite, sand or peat and refrigerated. Use 2 parts mix for every one part of seeds. Tiny seeds can be sown on clean, moistened paper toweling that is folded over the seeds, inserted into a plastic bag and refrigerated.

Table 1. Some common cultivated plants and Alaska native plants that respond to GA treatment for seed germination.

GA effect	Plant
Overcomes light requirement	Dwarf Birch, *Betula nana* Grasses, Poaceae, many species Lettuce, *Lactuca sativa* Kentucky bluegrass, *Poa pratensis* Sedges, *Carex* spp. Shrub birch, *Betula glandulosa* Western giant hyssop *Agastache occidentalis*
Overcomes light inhibitory effect	Lacy phacelia, *Phacelia tanacetifolia*
Replaces or shortens need for cold stratification	Alaska Bog blueberry, *Vaccinium uliginosum* Crowberry, *Empetrum nigrum* Pale purple coneflower, *Echinacea pallida* Highbush blueberry, *Vaccinium corymbosum* Lapland rosebay, *Rhododendron lapponicum* Trollius, *Trollius europaeus, T. laxus, T. chinensis*
Promotes more complete germination after scarification or stratification (does not replace them)	Baneberry, *Actaea rubra* Bearberry, *Arctostaphylos uva-ursi* Bunchberry, *Cornus canadensis* Wild iris, *Iris setosa*
Replaces or shortens period of afterripening	Columbines, *Aquilegia* spp. Including *A. Canadensis, A. vulgaris, A. Formosa, A. jonesii*) esp. in fresh seeds Grasses, Poaceae, many species
Hastens germination and/or promotes uniform germination (less erratic over time)	Avocado, *Persea americana* Bean, *Phaseolus vulgaris* Bellflower, *Campanula latifolia* Butterwort, *Pinguicula spp*. Cactaceae, many species Glacier buttercup, *Ranunculus glacialis* Kochia, *Bassia scoparia* Mountain buttercup, *Ranunculus lyallii* Nolana, *Nolana paradoxa* Onions, *Allium spp*. Peas, *Pisum sativum* Pepper, *Capsicum anuum* Pink plumes, *Polygonum bistorta* Poppies, *Papaver spp*. Sundews *Drosera spp*. Sweet corn, *Zea mays* Thimbleberry, *Rubus parviflorus* Tomato *Lycopersicon lycopersicum* Violets, *Viola spp*. Including *V. adunca*, *V.canina*, *V.cuneata*, *V.glabella*
Promotes germination, but specific reason unknown	Blue shrimp plant, *Cerinthe major* Fringe cup, *Tellima grandiflora* Gentian, *Gentiana verna* Lewisia, *Lewisia tweedyi* Marsh marigold, *Caltha palustris* Primrose, *Primula parryi* Saxifrages. *Saxifraga spp.* Including. *S. caespitosa, S. nivalis, S. oppositifolia, S. stellaris* Sea beachwort, *Honckenya peploides* Star of Parnassus, *Parnassia palustris* Thymeleaf speedwell, *Veronica serpyllifolia*

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