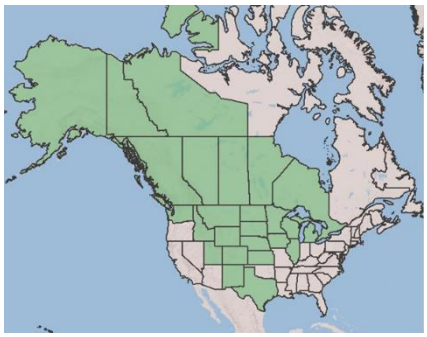
Plant Propagation Protocol for *Pulsatilla patens*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/*2021*/*PUPA5.pdf*

TAXONOMY	
Plant Family	
Scientific Name	*Ranunculaceae*
Common Name	Buttercup family
Species Scientific Name	
Scientific Name	*Pulsatilla patens* (L.) Miller
Varieties	*Anemone patens* L. var. *patens* *Anemone patens* L. var. *multifida* Pritz.
Sub-species	*Pulsatilla patens* (L.) Mill. ssp. *multifida* (Pritz.) Zamels *Pulsatilla patens* (L.) Mill. ssp. *patens* (L.) Mill. *Pulsatilla patens* (L.) Mill. ssp. *flavescens*
Cultivar	
Common Synonym(s)	*Anemone patens* L.[2] *Pulsatilla patens* (L.) Mill. *Pulsatilla patens* (L.) Mill. ssp. *patens* *Pulsatilla patens* (L.) Mill. var. *patens*
Common Name(s)	eastern pasqueflower, prairie pasque flower, pasqueflower prairie crocus, crocus anemone, pasqueflower, cutleaf anemone
Species Code (as per USDA Plants database)	PUPA5
GENERAL INFORMATION	
Geographical range	 Throughout Asia-Temperate, Europe and North America[5] from Alaska to Wisconsin, south to Illinois, Missouri, New Mexico, and Washington. Image: Distribution of *P. patens* in North America including Washington State.[1]

Ecological distribution	Prairies, hillsides, dry woods, edges of gravel pits, roadsides, clearcut areas, in fescue grassland, in open grasslands and in dry open woods in montane and boreal areas. [3, 10]
Climate and elevation range	330 to 12,500 feet.[4]
Local habitat and abundance	Part shade; sun; dry sandy soil; prairies; open woods. [6] Widespread throughout the temperate regions of the Northern Hemisphere covering a wide range of climatic and habitat conditions. [7] *P. patens* is well adapted to disturbed habitats. Forest fires enhance the conditions for seed germination and seedling development by reducing moss and litter layer thickness and decreasing competition pressure. [3, 8] Strongly associated with native mixed-grass and short-grass prairies. [7] Relatively well represented in the United States and Canada however, populations have declined to less than 20% of their original extent on the North American continent. [7]
Plant strategy type / successional	Stress-tolerator. Several studies have suggested that dormancy may buffer individual plants from stress encountered above-ground. [7] Seral stage: Mid to late.[3] Increaser; pasqueflower has a reserve of viable dormant buds enabling the plant to initiate new branches. [3,8]
Plant characteristics	Long-lived, slow-growing perennial forb; 10 to 40 cm high with a tap root, vertical and branched rhizomes, silky hairs throughout; long stalked basal leaves appear after emergence of (early-spring) flowers, three times divided, the middle segment three-cleft and the lateral two-cleft, divisions further cleft into linear or lanceolate acute lobes; involucre leaves similar but sessile; solitary flowers with pale blue to purple sepals 2 to 4 cm long, hairy on the back, no petals. Fruit consists of one-seeded achenes born on heads. [3, 9] Flowers from April to June with leaves emerging late May and early June. Vegetative growth occurs in July. Seeds are dispersed beginning in June through the beginning of July. Seeds germinate late summer or following spring. Blooming date has advanced by two weeks since 1936 due to climate change; increasing the species susceptibility to frost damage. [3, 11]

	Cross-pollinated by honeybees, andrenid bees, bumblebees and syrphid flies. Self-pollinates as well.[3] Animal and wind dispersed, using awn either to ride breezes or catch on passing animals. [3]
PROPAGATION DETAILS	
Ecotype	N/A
Propagation Goal	Plants
Propagation Method	Seed
Product Type	Container
Stock Type	Ray Leach Cone-tainer™ Cells
Time to Grow	12-24 months
Target Specifications	Matched to the outplanting site, seeds are from genetically appropriate and locally adapted source. [16] P. patens may be too small or delicate to survive outplanting until their first or second year. [14, 15] Juvenile (year-one) and immature plants (year-two), ~5 cm in diameter, will have a better chance for survival in the field.[14, 15]
Propagule Collection Instructions	Seeds are linear-ellipsoid, 3 mm long with persistent slender styles, short-plumose, 2 to 3.5 mm long. [3] Collect by hand in late spring to early summer [3] when pistils develop into clusters of achenes and easily separate from the receptacle. [7] If possible, collect seeds from sites where below normal temperature and above-normal rainfall have occurred. This will increase germination rates. Avoid collecting seed from sites exposed to extended drought which lowers germination.[13]
Propagule Processing/Propagule Characteristics	Seed Weight: 1.96 g/1,000 seeds. [3] Seed is usually removed clean. [3] Germination: 50%-60% for untreated seeds in NE Alberta [3]; 82 % following moist-cold treatment in S. Dakota.[13] Seeds are relatively short lived and must be planted immediately, or stored. [8,14]
Pre-Planting Propagule Treatments	De-awning can be done by hand if desired, but is not necessary. Seeds are dried to low relative humidity and stored at freezing temperatures in hermetically sealed containers.[3]

	Morpho-physiological dormancy of *P. patens* [2] can be broken with a cold-moist stratification for 60 days.[2,13] Seeds are treated on moist filter-paper and chilled in a refrigerator at 38° F (3° C). Germination following this treatment is 4-15 days.[13]
Growing Area Preparation / Annual Practices for Perennial Crops	A greenhouse or cold-frame is ideal for nursery cultivation of *P. patens* as controlling heat and moisture speeds propagation and protects plants from drying out, or damping off. [14] Cover with light shade cloth March through August. [14] Moist, well-drained, organic, growing media will produce higher survival and growth rates. [3,14] If available, media should be inoculated with arbuscular mycorrhizal fungi. [12] Due to extensive tap-root[14], transplant juvenile plants from Ray Leach cone-tainer cells to round pots one year after establishment phase. *P. patens* is slow-growing and vulnerable to drying out for the first two years. Seedlings must be kept constantly moist. [14]
Establishment Phase Details	Cold-moist stratified seeds will germinate in 4-15 days. [13] Sow one seed/cone-tainer, 0.32 cm deep in sterile growing media such as fine-grade perlite and peat moss. Media must not dry out as moisture is critical for seedling establishment.[7, 14] In 6-weeks check to see if root inoculate took effect. [16]
Length of Establishment Phase	2-3 months. Entails rapid growth of the primary root that begins when the cotyledons expand. [7]
Active Growth Phase	Water seedlings daily, preferably in the morning.[16] Active growth accelerates if seedlings are kept moist. Prone to quick wilting when dry. Keep in greenhouse second year to prevent over-wetting by rains. Do not remove shade cloth or expose to full-sunlight until September. [14]
Length of Active Growth Phase	1-2 years. First year: Onset of first true leaf and formation of primary shoot and some lateral roots. Second year: Plants have one to two leaves and a well-developed lateral root system. [7]
Hardening Phase	Begin hardening first or second year in September by placing seedlings outside, gradually introducing them to full sunlight. Some drying may be desirable to harden plants and promote root growth. [14]
Length of Hardening Phase	4-weeks
Harvesting, Storage and Shipping	Once target size has been reached, seedlings are delivered to planting site. To avoid drying out, water seedlings deeply before shipping and just prior to outplanting.[16]

	Flowering is variable; occurring within 3-7 years (if at all). [7] With this in mind, seeds are harvested in late spring to early summer.[3]
Length of Storage	Since *P. patens* are slow-growing[7], seedlings may remain at the nursery for up to two years. If this is not feasible, seedlings may be transplanted (or seeded directly) into a holding bed which could be watered and weeded as necessary. When large and sturdy enough, plants can be transplanted to the field. [15]
Guidelines for Outplanting / Performance on Typical Sites	Outplanting conditions include well-drained soils. Transplant juvenile plants in October. Will grow in both clay and sandy soils, but grow best in a limey, sandy-loam, high in organic matter. [14]
Other Comments	*P. patens* possibly produces new rosettes near the parent plant from underground rhizome. This branching of the vertical root system might allow vegetative reproduction. [3,10] There is rising concern over conservation of *P. patens* in North America and its endangerment in most parts of Europe. Conservation status has been reviewed and ranked in six states of the United States and two provinces of Canada. [7] Anemone patens is a valuable reclamation species. It is well adapted to disturbed habitats. Forest fires enhance the conditions for seed germination and seedling development by reducing moss and litter layer thickness and decreasing competition pressure. [3]
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