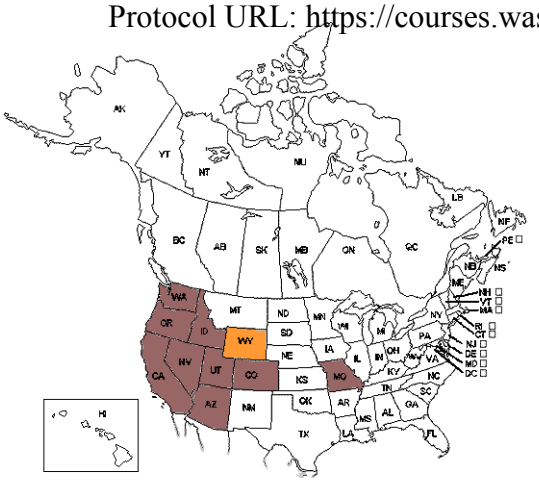
Plant Propagation Protocol for *Tiquilia nuttallii*
ESRM 412 – Native Plant Production
Protocol URL: https://courses.washington.edu/esrm412/protocols/TINU2.pdf



TAXONOMY	
Plant Family	
Scientific Name	*Boraginaceae*
Common Name	Borage family
Species Scientific Name	
Scientific Name	*Tiquilia nuttallii* (Hook.) A.T. Richardson
Varieties	None
Sub-species	None
Cultivar	None
Common Synonym(s)	*Coldenia nuttallii* (Hook.)
Common Name(s)	Nuttall's crinklemat, Rosette tiquilia, Nuttall's tiquilia
Species Code (as per USDA Plants database)	TINU2

All images (that aren't maps) from [1]

GENERAL INFORMATION	
Geographical range	Arizona, California, Colorado, Idaho, Nevada, Oregon, Utah, Washington, Wyoming, and a distinct population in Missouri [1,2,5,11] Maps from right to left [10,11]
Ecological distribution	Desert sands, sandy loam/sandy plains, washes, slopes/hillsides, saline flats [2,6]
Climate and elevation range	Climate Tolerances: 33-41ºC Elevation Range: ~0-2500m [1,5,8]
Local habitat and abundance	Most common in desert-like habitats, common associations include plants from the genera of *Artemisia*, *Atriplex*, *Chrysothamnus*, *Juniperus*, *Larrea*, and *Pinus*. [2,5,6]
Plant strategy type / successional stage	Tolerant of dry, desert environments. Is generally an early successional plant commonly found in disturbed habitats such as roadsides and building developments [3]
Plant characteristics	Herbaceous annual forb/herb with shrub-like characteristics. Dichotomously branched, slender stems woody when older, strigose. Leaves are green, ridged, have hairs, and are ovate. Flowers have 5 lobes, are white to pink, and form clusters at nodes or stem apices. Forms mats of vegetation 10-30cm high. [1,2,3,9]
PROPAGATION DETAILS	
Ecotype	Desert/sand
Propagation Goal	Seeds
Propagation Method	Seed
Product Type	Seeds
Stock Type	Seed
Time to Grow	7 months (maximum) [8]
Target Specifications	Seeds 1.1-1.5mm long and 0.6-0.8mm broad[5] 10-30cm Plants resulting from these seeds
Propagule Collection Instructions	This plant flowers from May to August, and though no information is available on seed harvest, it would be logical to collect sometime in this window, when fruits produce nutlets for propagation. Healthy nutlets will be brown, black, or gray and mottled and be shiny, oblong-ovoid, and roughly 1.3mm long and .7mm broad. [5]
Propagule Processing/Propagule Characteristics	1000 seed weight: 0.1898g Seed longevity: Given proper storage, the orthodox seeds can remain viable for 4 months [7]
Pre-Planting Propagule Treatments	Unknown if seeds require special treatment for germination. For storage, it has been reported that 100% viability can be maintained up to 4 months if moisture content consistent with 15% relative humidity is maintained and the seeds are frozen to -20ºC. [7]
Growing Area Preparation / Annual Practices for Perennial Crops	Growing media should be deep (min. 142cm) fine soil/sandy media with a pH between 5.2 and 9.9, salinity less than 64.2 mmhos/cm, and at most 2% $CaCO_3$. [8]

Establishment Phase Details	Extremely low water and soil nutrient requirements, sow seeds in media as described and monitor.
Length of Establishment Phase	Information not available
Active Growth Phase	Information not available
Length of Active Growth Phase	Information not available
Hardening Phase	Information not available
Length of Hardening Phase	Information not available
Harvesting, Storage and Shipping	Information not available
Length of Storage	Information not available
Guidelines for Outplanting / Performance on Typical Sites	Successful out-planting will be marked by high survival rates and new germinants at the out-planting site the following year. If seeds are sown in September/October, flowering on schedule in the May-August should be observed.
Other Comments	It appears that this plant has never been propagated for out-planting, but is apparently exclusively a wild forb. It was not commercially available in any nurseries in any form. Information on it's germination, growth, and phases to out-planting was completely absent from the literature, which focused entirely on the appearance, distribution, and genetic profile of the plant. This is why I have listed propagation goal simply as seed collection. I felt uncomfortable putting uncertain/inaccurate information in the protocol, so any information unavailable has been marked "Information not available". The only potential source with potential information regarding the growth of this plant was "Seed propagation of Native California Plants" by Dara E. Emery (not available through the UW Libraries system).
INFORMATION SOURCES	
References	Annual Tiquilia: Tiquilia nuttallii. (n.d.). Retrieved from https://calscape.org/Tiquilia-nuttallii-(Annual-Tiquilia)?srchcr=sc5cecae1639e58 [1] Higgins, Larry C. (1979) "Boraginaceae of the southwestern United States," Great Basin Naturalist: Vol. 39: No. 4 , Article 1 [2] Howald, A. M., & Orr, B. K. (2000). *A flora of Valentine Eastern Sierra Reserve*. Santa Barbara, CA: Herbarium, Museum of Systematics and Ecology, Dept. of Ecology, Evolution and Marine Biology, University of California, Santa Barbara. [3] Moore, M. J., Jansen, R. K., & Levin, D. A. (2005). *Molecular systematics of Tiquilia (Boraginaceae): Age, origin, dispersal history, and gypsophilic evolution*(Unpublished doctoral dissertation). [4] Richardson, A. T. (1977). Monograph of the genus Tiquilia (Coldenia, sensu lato), Boraginaceae: Ehretioideae. *Rhodora: Journal of the New England Botanical Club,79*(820), 467-572. [5]

	Ronald, B. K. (2012). *Tiquilia nuttallii*, in Jepsom Flor Project (eds.) *Jepsom eFlora*, http://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=46668 [6] Seed Information Database: Tiquilia nuttallii. (n.d.). Retrieved from https://data.kew.org/sid/SidServlet?ID=38259&Num=0bv [7] Tiquilia nuttallii. (n.d.). Retrieved from https://www.calflora.org/entry/plantchar.html?crn=7994 [8] Tiquilia nuttallii. (n.d.). Retrieved from http://intermountainbiota.org/portal/taxa/index.php?tid=315&taxauthid=1&clid=0# [9] Tiquilia nuttallii (Hook.) A.T. Richardson: Nuttall's crinklemat. (n.d.). Retrieved from https://plants.usda.gov/core/profile?symbol=TINU2 [10] Tiquilia nuttallii - (Hook.) A. Richards. (n.d.). Retrieved from http://explorer.natureserve.org/servlet/NatureServe?searchName=Tiquilia nuttallii [11]
Other Sources Consulted	
Protocol Author	Micah Adams
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