

**Plant Propagation Protocol for *Asplenium trichomanes* L.**  
 ESRM 412 – Native Plant Production  
 University of Washington, Spring 2018



© Bruce Patterson



©Donald Cameron

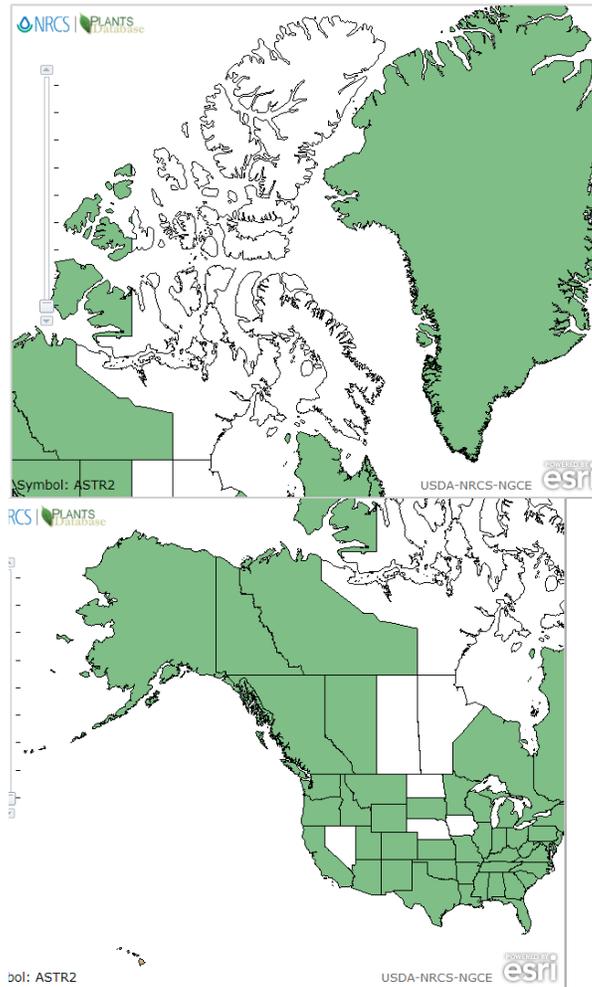
### TAXONOMY

#### Plant Family

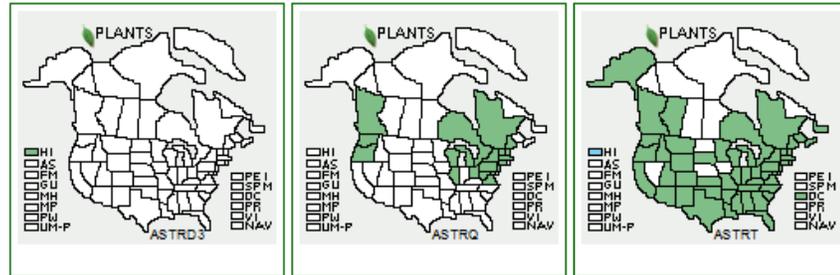
Scientific Name	Aspleniaceae (USDA, 2018)
Common Name	Spleenwort family
Species Scientific Name	
Scientific Name	<i>Asplenium trichomanes</i> L. (USDA, 2018)
Varieties	None
Sub-species	<i>Asplenium trichomanes</i> L. ssp. <i>densum</i> (Brack.) W.H. Wagner <i>Asplenium trichomanes</i> L. ssp. <i>quadrivalens</i> D.E. Mey <i>Asplenium trichomanes</i> L. ssp. <i>trichomanes</i> (USDA, 2018)
Cultivar	
Common Synonym(s)	<i>Asplenium trichomanoides</i> (The Royal Horticultural Society, 2018) <i>Asplenium densum</i> Brack, (dense spleenwort subspecies) (USDA, 2018)
Common Name(s)	Maidenhair spleenwort, dense spleenwort (USDA, 2018), common spleenwort, English maidenhair, green spleenwort, waterwort (The Royal Horticultural Society, 2018)
Species Code (as per USDA Plants database)	ASTR2: (California Native Plant Society, n.d.) <i>Asplenium trichomanes</i> L. ASTRD3/ASDE7: <i>Asplenium trichomanes</i> L. ssp. <i>densum</i> ASTRQ: <i>Asplenium trichomanes</i> L. ssp. <i>quadrivalens</i> ASTRT: <i>Asplenium trichomanes</i> L. ssp. <i>trichomanes</i> ASTR9/ASDE14: <i>Asplenium trichomanes-dentatum</i> L. ASTR10/ASVII10: <i>Asplenium trichomanes-ramosum</i> L. (USDA, 2018)

## GENERAL INFORMATION

### Geographical range



The pictures above (USDA, 2018) depict the overall range of *A. trichomanes* L. in North America on a state by state or province basis. It has been sighted in every state in the United States in at least one county except for North Dakota, Nebraska, Iowa, and Nevada. It is even in Hawaii as both a native and introduced plant. Native *A. trichomanes* L. extend into the Canadian territories of British Columbia, Alberta, Ontario, Quebec, Nova Scotia, New Brunswick, the Yukon Territory, the Northwest Territories, and Newfoundland & Labrador. It is native throughout Greenland as well.

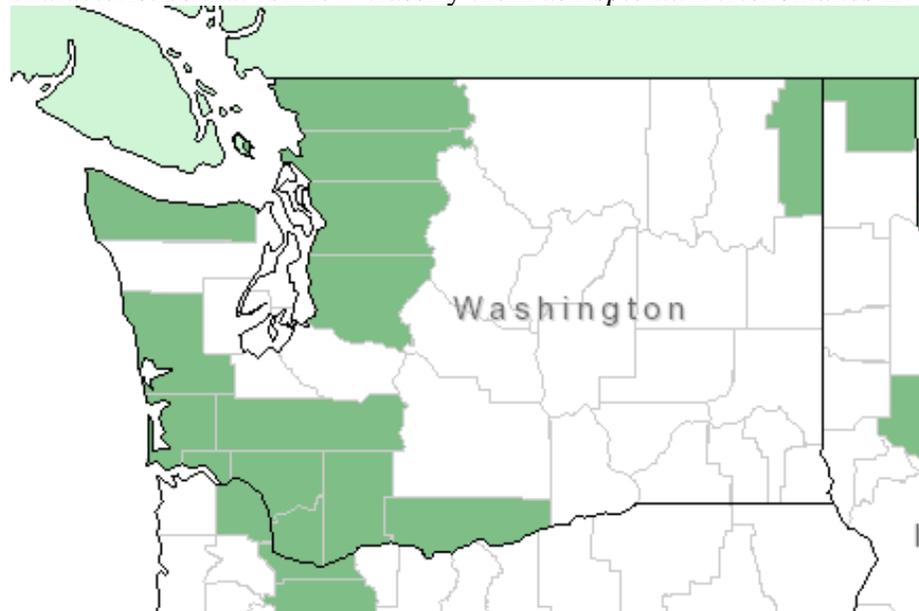


*Asplenium trichomanes* ssp. *densum*  
dense spleenwort

*Asplenium trichomanes* ssp. *quadrivalens*  
maidenhair spleenwort

*Asplenium trichomanes* ssp. *trichomanes*  
maidenhair spleenwort

The picture above (USDA, 2018) further breaks down the distribution of native *A. trichomanes* L. by subspecies. To the left we can see that the ssp. *densum* only exists in Hawaii, while other subspecies are nonnative to the region. The ssp. *quadrivalens* occupies many of the northern territories designated above, while ssp. *trichomanes* occupies those same areas plus more southern and landlocked states in the US. Notice that not all of the areas in green in the original map are covered by these three subspecies, such as the Yukon and Northwest Territories and Greenland. This could be due to a lack of data on their subspecies designation, or they have general characteristics that for now classify them as *Asplenium trichomanes* L.



This final image depicts the distribution of *A. trichomanes* L. by county in Washington state. Most of these counties are occupied by the subspecies *trichomanes*, but Clallam and Clark county are home to ssp. *quadrivalens*. This makes sense because ssp. *quadrivalens* prefers more oceanic climates than the more landlocked ssp. *trichomanes* (IUCN, 2018). *A. trichomanes* L. tends to thrive best on the West side of the Cascade crest and on the moist coasts, with exceptions by location (USDA, 2018).

Ecological distribution

Subspecies have been separated by ecotype, in that each subspecies is adapted to distinct environmental conditions. Spp. *quadrivalens* grows on

	alkaline, basic, calcareous rocks while spp. <i>trichomanes</i> grows in the cracks of acidic, siliceous rocks (IUCN, 2018). They are not found in wetland areas, but rather along cliffs, ledges, and rocky slopes. It is found globally in tropical mountains and in the Northern hemisphere in temperature zones (The Royal Horticultural Society, 2018). It is an understory plant, and can thrive either exposed or sheltered by foliage above on rocks.
Climate and elevation range	<i>A. trichomanes</i> L.'s aspect is typically anything other than North facing, which accounts for its adaptation to full or partial shade (The Royal Horticultural Society, 2018). It grows at low to mid elevations in moist climates (Matthews, 2017), with an upper limit of 2500 meters (IUCN, 2018). As evidenced by its wide range, it can tolerate a wide range of climatic conditions, and subspecies differentiate based on the environmental conditions of soil and rock pH and atmospheric moisture content.
Local habitat and abundance	<i>A. trichomanes</i> L. occurs in microclimates with moist but drained soil that is composed of sand, chalk, loam, or clay (The Royal Horticultural Society, 2018). The pH of the soil can range from about 7-10, but pH conditions of the rocks themselves determines which subspecies can be found in that specific habitat. It is commonly seen alongside various species of lichen, for each can survive on rocky outcroppings. <i>A. trichomanes</i> L. is abundant throughout the world, and all the subspecies recorded under the IUCN Red List of Threatened Species are listed to have a stable and widespread population of least concern (IUCN, 2018). <i>Asplenium densum</i> Brack, which has been recorded exclusively in Hawaii, is not included in this list and is less abundant than its relatives because it is landlocked by an island.
Plant strategy type / successional stage	<i>A. trichomanes</i> L. is considered a specialized species that is saxicolous which means it can grow among rocks (Raevel, 2012). For this reason, in area that has been affected by disturbances such as fire or deforestation <i>A. trichomanes</i> L. has been noted as a primary successional species. It exists in a niche with minimal competition, as other vegetation cannot colonize and thrive in rocky crevasses. It is tolerant of varying salt and temperature conditions, and can withstand desiccation (IUCN, 2018).
Plant characteristics	<i>A. trichomanes</i> L. a perennial evergreen fern (IUCN, 2018) that is distinguished by its small, oval pinnae leaflets that are asymmetrically attached to its noticeably dark stem (Matthews, 2017). It can grow to 0.4 m tall (1ft 4 in) (Plants for a Future, 2015). *see images above.

## PROPAGATION DETAILS

Ecotype	Since there are many subspecies and close relatives of <i>A. trichomanes</i> L., it is important to source seeds from the subspecies that exists in your outplanting site. There are even varieties from Europe, so whether for gardening or restoration purposes, collect spores only from native subspecies. See the distribution information above for a detailed look at this information, and which subspecies is best suited for the climatic and soil conditions of your site.
Propagation Goal	Plants
Propagation Method	Seed: specifically, by spores
Product Type	Container (plug)
Stock Type	
Time to Grow	The spores are ready to germinate in the Spring, and it takes 1-3 months for spores to germinate (Plants for a Future, 2015). Allow the plants another 9-11 months, depending on how long it took for the seeds to germinate, for the plants to grow to about 15cm tall. All in all, it takes <b>1 year</b> for <i>A. trichomanes</i> L. to be ready to be outplanted. They are sown in one Spring and planted in the next.
Target Specifications	Greater than or equal to 15 cm tall (Plants for a Future, 2015)
Propagule Collection Instructions	<p>It is possible to collect spores through the American Fern Society's spore exchange program. One can become a member, and from there can order spores with a small fee (American Fern Society, 2018). However, this is depending on if the spores of <i>A. trichomanes</i> L. are in the inventory, and at the time of writing this protocol, they were not. Collected spores may not be pure samples, so be careful if choosing the commercial method of collection (Brooklyn Botanic Garden, 2018).</p> <p>© Robbin Moran</p> <div style="display: flex; align-items: flex-start;">  <div style="margin-left: 10px;"> <p>If you are collecting spores yourself, you must be informed about when <i>A. trichomanes</i> L. matures, what that looks like, and how to best handle the spores. To the left is pictured the sori of our species, which are dense on the underside of pinnae. If they appear scruffy like the picture here, spores are likely close to being ripe (Brooklyn Botanic Garden, 2018). Bring a magnifying glass with you to view the spores up close. Though not specified for <i>A. trichomanes</i> L. specifically, referring to the image below ripe sporangia are dark in color, and start to appear so in the Spring (Brooklyn Botanic Garden, 2018). Note that different parts of the plant might mature before others, so always visually</p> </div> </div>

check specimens. You must collect spores when they reach maturity, but not after the ringed band of cells around them begins to separate and straighten (usually under heat), for this is when the cells themselves are released into the air. This mechanism however, is helpful for collecting seeds. Swish the sori briefly in a 5-10% bleach solution to clean off debris and pathogens, and then place the sori face down on white butcher paper (Brooklyn Botanic Garden, 2018). Tap it slightly to release the spores themselves, and package them up in a labeled bag.



© The Cell Image Library

<p>Propagule Processing/Propagule Characteristics</p>	<p>Each sporangium contains at least a dozen spores and considering that there are hundreds of sporangia within each sori, or sporangium cluster, the density of spores is extremely high (Chao, 2010). Spores can be stored in cool conditions and still be viable, but it is best to sow the spores soon after collection.</p>
<p>Pre-Planting Propagule Treatments</p>	<p>See the discussion above on bleach treatment. Spores once attached to the paper will be lighter than debris from the plant, so one can simply tap the paper to allow this excess debris to fall away from the spores (Brooklyn Botanic Garden, 2018). You can also sift the spores through tissue paper because they are smaller than the filter. If you use the sifting method, it might be best to do this over your medium, so you are cleaning and sowing the spores at the same time.</p>
<p>Growing Area Preparation / Annual Practices for Perennial Crops</p>	<p>Spores should be sown in moist conditions, in humus-rich, sterilized soil (Plants for a Future, 2015). Add basalt or limestone to the medium to make it more basic (New Zealand Plant Conservation Network, 2014), and pumice to facilitate drainage. If you are growing the plants in conditions that might be susceptible to dry-out, put a plastic bag over the pot with small holes (Plants for a Future, 2015). To start with, you can germinate seeds in shallow containers with a diameter of about 5 cm that do not lose water easily. You will need to transplant these germinants to a larger pot as they grow, which should be at least 12 cm in diameter and 15 cm tall. If your planting area is prone to aphids, scale, or mealy bugs, target this</p>

	issue with bioremediation or treatments before sowing seeds, because <i>A. trichomanes</i> L. is especially vulnerable to these pests (New Zealand Plant Conservation Network, 2014).
Establishment Phase Details	To allow plants to establish and begin germinating, it is important to monitor moisture and light conditions. Locate them in a lightly shaded area of the greenhouse that is about 15 degrees C. The medium should be kept moist, as well as the surrounding air.
Length of Establishment Phase	Could take anywhere between 1-3 months (Plants for a Future, 2015)
Active Growth Phase	It is not specified in the sources provided as to when the active growth phase stops and the hardening phase begins for <i>A. trichomanes</i> L., but growth is the most rapid following germination in the summer and continues throughout the fall and winter (Plants for a Future, 2015). At this time, the plants would need to be transplanted from their containers to larger pots with some small plant growth.
Length of Active Growth Phase	3-6 months
Hardening Phase	The timing of hardening of the stalk itself was not specified but deducting from the growth information found it would be reasonable to conclude after germination occurs in the summer within 1-3 months of sowing in the spring, hardening would occur before winter months in Washington, beginning in October when some of the first frosts begin. The plant would continue to grow and would be ready to be planted to a different site the following spring.
Length of Hardening Phase	About 2 months
Harvesting, Storage and Shipping	You will harvest the seedlings after one year of growth, or until they are about 15 cm tall (Plants for a Future, 2015). Being hardy, once they are established they can withstand a wide range of temperature, light, and moisture conditions, but it is important to minimize the stress on the plant.
Length of Storage	Store for a maximum of 3 months after growth is at the optimal height
Guidelines for Outplanting / Performance on Typical Sites	Outplant <i>A. trichomanes</i> L. to rocky sites (IUCN, 2018). If you cultivated one of the subspecies as designated above, refer to this information to plant that subspecies in optimal conditions. Pay attention to soil acidity, shade conditions, and rock composition. Also note where you are outplanting your plant to, for only 2 counties in Washington have optimal conditions for <i>ssp. quadrivalens</i> . Plants are expected to be moderately successful in establishing at the site and have a high percent of survival after this. They will start producing their own spores when you plant them or the following season, and will be fully grown at around 1 foot tall.
Other Comments	NA

## INFORMATION SOURCES

References	<p>American Fern Society. (2018). <i>Spore Exchange Background</i>. Retrieved from Spore Exchange: <a href="https://www.amerfernsoc.org/spore-exchange-background/">https://www.amerfernsoc.org/spore-exchange-background/</a></p> <p>Brooklyn Botanic Garden. (2018). <i>How to Grow Ferns from Spores</i>. Retrieved from Plant Choices: <a href="https://www.bbg.org/gardening/article/growing_ferns_from_spores">https://www.bbg.org/gardening/article/growing_ferns_from_spores</a></p> <p>Chao, Y.-S. (2010). <i>Reproductive traits of Pteris cadieri and P. grevilleana in Taiwan: Implications for their hybrid origin</i>. Retrieved from ResearchGate: <a href="https://www.researchgate.net/figure/Sporangia-and-different-spore-types-A-sporangium-with-32-regular-spores-B-sporangium_fig3_286032594">https://www.researchgate.net/figure/Sporangia-and-different-spore-types-A-sporangium-with-32-regular-spores-B-sporangium_fig3_286032594</a></p> <p>Go Botany. (2018). <i>Asplenium trichomanes L.</i> Retrieved from Go Botany: <a href="https://gobotany.newenglandwild.org/species/asplenium/trichomanes/">https://gobotany.newenglandwild.org/species/asplenium/trichomanes/</a></p> <p>IUCN. (2018). <i>Asplenium trichomanes</i> . Retrieved from The IUCN Red List of Threatened Species: <a href="http://www.iucnredlist.org/details/202937/1">http://www.iucnredlist.org/details/202937/1</a></p> <p>Matthews, D. (2017). <i>Natural History of the Pacific Northwest Mountains</i>. Portland: Timber Press Field Guide.</p> <p>New Zealand Plant Conservation Network. (2014). <i>Asplenium trichomanes</i>. Retrieved from Flora Details: <a href="http://www.nzpcn.org.nz/flora_details.aspx?ID=2061">http://www.nzpcn.org.nz/flora_details.aspx?ID=2061</a></p> <p>Plants for a Future. (2015). <i>asplenium trichomanes - L.</i> Retrieved from Plants for a Future: <a href="https://www.pfaf.org/user/Plant.aspx?LatinName=asplenium+trichomanes">https://www.pfaf.org/user/Plant.aspx?LatinName=asplenium+trichomanes</a></p> <p>Raevel, V. (2012). <i>Changing assembly processes during a primary succession of plant communities on Mediterranean roadcuts</i>. Retrieved from Journal of Plant Ecology: <a href="https://academic.oup.com/jpe/article/6/1/19/2928117">https://academic.oup.com/jpe/article/6/1/19/2928117</a></p> <p>The Royal Horticultural Society. (2018). <i>Asplenium trichomanes</i>. Retrieved from RHS: <a href="https://www.rhs.org.uk/Plants/1731/Asplenium-trichomanes/Details">https://www.rhs.org.uk/Plants/1731/Asplenium-trichomanes/Details</a></p> <p>USDA. (2018). <i>Asplenium trichomanes L.</i> . Retrieved from Plants Database.</p>
Other Sources Consulted	<p>California Native Plant Society. (n.d.). <i>Maidenhair Spleenwort</i>. Retrieved from Calscape: Restore Nature one Garden at a Time: <a href="http://calscape.org/Asplenium-trichomanes-(Maidenhair-Spleenwort)?srchcr=sc5afb649aa87ff">http://calscape.org/Asplenium-trichomanes-(Maidenhair-Spleenwort)?srchcr=sc5afb649aa87ff</a></p>
Protocol Author	Madison Bristol
Date Protocol Created or Updated	5/15/18