PROPAGATION PROTOCOL *for* *Trillium* L. (Liliaceae)

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NOMENCLATURE: Case and Case (1997)

Difficult" is the word commonly used to describe seed propagation of *Trillium* spp. L. (Liliaceae). "It takes too long" is the perception of most nursery propagators. This misconception has been perpetuated throughout the literature and passed from propagator to propagator. However, trilliums are not "difficult" to propagate and can be brought to flowering stage in 3 to 4 y (Solt 1998a; Greene 2002).

Trilliums occur in North America and Asia. In North America, they grow on both the West Coast and throughout the eastern half of the US. In Asia, most occur in Japan but they also grow in China, Taiwan, Korea, and the Himalayas. Two excellent references, *Trilliums* (Case 1997) and *NEWS Guide to Growing and Propagating Wildflowers* (Culina 2000), provide information on species, their distribution, and cultivation.

Trilliums are shade-loving perennials growing from horizontal rhizomes with terminal buds and contractile roots. The scape is topped with a whorl of 3 pedicellate or sessile net-veined leaves that, in turn, are topped with a single pedicellate or sessile 3-petaled flower. The flower has 6 stamen, 3 stigmas, and is subtended by 3 sepals that are generally green. Flowers of some pedicellate species bend down below the leaves. Petal color can be white, pink, dark red, yellow, green, and combinations of these colors.

Seed collection starts with scouting for sites in early spring. In Vermont, *T. grandiflorum* (Michx.) Salisb. blooms around the second Sunday in May with seeds maturing approximately 10 wk later in mid July. The fruit is a multiseeded ridged or smooth capsule (Figure 1). At maturity, the capsule (cream, red, or dark red), dehisces at its base and falls to the ground. Capsules contain between 1 and 200+ seeds depending on the species. For example, a *T. grandiflorum* capsule will have 30 to 80 seeds (Figure 2) while a *T. erectum* L. capsule can have over 200 seeds. Collection should start before the capsule dehisces when a few of the seeds in the capsule are brown, indicating most seeds are mature. At that point, the seed collector has about 2 wk to complete the harvest. Seeds are 2 to 4 mm long (0.08 to 0.16 in) with a large sticky appendage (called either an aril or strophiole or elaiosome) on 1 side. When the capsule falls to the ground, the ants come running. Ants consume appendages and abandon seeds or they take the seed and attached appendage back to their nest where they consume the appendage and discard the seed, thus "sowing" it. Ants can strip a capsule clean in 1 d so it is best to monitor, monitor, monitor! Please remember that an ecologically sustainable harvest of seeds from the wild is 5% of any group of plants.

Store capsules in the refrigerator in a plastic bag after harvesting and during cleaning. Clean seeds by removing the fleshy capsule by hand. Seed coats are tender and can be easily damaged if mechanical means are used. A less labor-intensive method is allowing the capsules to decay in the plastic bag in the refrigerator. Place the decayed capsules with seeds in a fine mesh sieve and

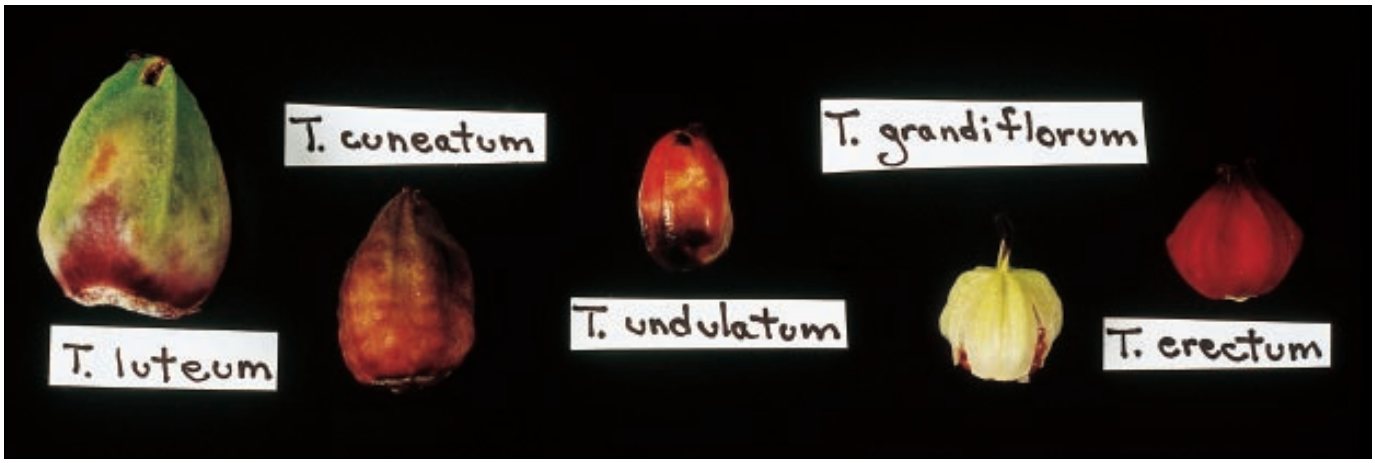

Photo by Stephanie Solt

Figure 1 • Left to right: Mature capsules of Trillium luteum *(Muhlenberg) Harbison,* T. cuneatum *Rafinesque,* T. undulatum *Willd.,* T. grandiflorum*, and* T. erectum*.*

wash with a strong stream of water. This should remove most of the capsule debris. Briefly pat the surface of the seeds dry on paper towels for easier handling during sowing.

Cleaned seeds can be kept in a plastic or glass container. If it is not possible to sow seeds immediately after cleaning, keep them refrigerated. Mold will eventually form on refrigerated seeds, but it can be removed by rinsing seeds in a sieve with a strong stream of water. Allow seeds to drain thoroughly. Mixing seeds with a small amount of vermiculite will discourage mold formation. Most species do not tolerate desiccation, however, *T. rivale* Watson and *T. nivale* Tiddell are reported to be the exception (McClements 1998).

A kilogram of clean *T. grandiflorum* seeds may contain between 770 to 950 seeds (1700 to 2100 seeds/lb) depending on the amount of rainfall during seed formation. Unfortunately, information on seeds per capsule or seeds per kilogram of other species is unavailable in the literature.

Sow seeds relatively close together at a depth twice the diameter of the seeds. It is better to err on the side of deeper because the emerging radicle pushes the seed out of the soil. Medium, such as Scott's Metro-mix 560 with ScottsCoir (about 40% composted pine bark, 25% coir, 15% sphagnum peat moss, 10% bark ash, 10% perlite; The Scott's Company, Marysville, Ohio), should be well drained but moisture retentive. Place flats outside under shade cloth or in dappled shade of deciduous trees. Do not place in the greenhouse because temperatures can get too high and cause plants to go into dormancy prematurely. Water regularly throughout the growing season.

Germination starts after the first cold period (winter). A root will emerge followed by an immature rhizome and cotyledon with the seed coat still attached. The cotyledon will not grow above the soil line until after the second cold period (Figure 3). The first true leaf (heart shaped) will appear after the third cold period followed by the characteristic whorl of 3 leaves after the fourth cold period. Any reference you consult will state that trilliums have a "double" dormancy: the first cold period needed for root emergence and the second cold period needed for cotyledon emergence. Recent research has shown that seeds of most trilliums exhibit embryo dormancy: the first cold period is needed for root and cotyledon emergence and the second cold period for cotyledon maturation (Patrick 1973; Solt 1996). Anecdotal evidence suggests that, while there is some variation in length and degree of cold required, most species need cold to break dormancy. One species, *T. nivale,* is reported to germinate readily without a cold period (McClements 1998).

Seed viability varies from year to year depending on rainfall amounts during seed formation and time of collection. The germination percentage of a seed lot of *T. grandiflorum* can be between 50% and 100% (Solt 1996). Retain the flat an additional year or more as more seeds are likely to germinate.

Transplanting should be done after the cotyledons die back. This is usually during the second year after sowing. Move to a 10 X 10 X 10 cm (1050 ml

Photo by Stephanie Solt

Figure 2 • Interior of a Trillium grandiflorum *capsule.*

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Figure 3 • Development stages of Trillium grandiflorum *plants collected from the wild. Left to right: immature rhizome and cotyledon with seed coat attached after first cold period; mature cotyledon; first true (heart-shaped) leaf; whorl of 3 leaves; progressively larger leaves and rhizomes; and finally, flowering stage.*

[4 X 4 X 4 in; 64 cu in]) (or deeper) pot and plant in the same medium at a depth of 0.6 to 1.2 cm (0.25 to 0.5 in) depending on the size of the rhizome. Observe the depth of the seedling rhizome before transplanting and plant accordingly. As the contractile roots grow they will pull the rhizome deeper into the pot.

Flowering occurs when the rhizome has stored up enough energy reserves. If nutrients and water are optimized it is possible to skip the "first true leaf" stage and produce a flowering plant in 3 y (Greene 2002). Several fertilization regimes may be considered: 1) once a year in early spring before growth starts using a granular fertilizer; 2) twice a year in early spring as growth starts and when flowering finishes using a granular fertilizer; 3) weekly with a weak water-soluble fertilizer. Greene (2002) suggests a weekly application of a weak water-soluble fertilizer (Peters Professional General Purpose 20N:10P_2O_5:20K_2O; The Scott's Company, Marysville, Ohio) at 200 ppm N starting in early spring or at the first sign of growth and stopping in mid August or when foliage dies back. Try starting fertilization during the first growing season. This may promote even more rhizome and root growth. It is also very important to water regularly since most species do not tolerate desiccation (Cullina 2000). Regular watering will prevent plants from going dormant prematurely, thus allowing plants to photosynthesize longer and store up more energy for earlier flowering!

Trilliums have also been successfully grown in outdoor nursery beds under partial shade in a Lyndon gravelly loam (Griffiths 1934). At the US Bellingham Bulb Station in Bellingham, Washington, seeds of *T. sessile giganteum* were sown 6 seeds every 2.5 cm (6 per in), in rows 15 cm (6 in) apart in a 1-m-wide (3-ft) bed, and left undisturbed for 4 y. About 1000 seedlings grew in a 1.06 m X 0.9 m (3.5 ft X 3 ft bed) the first 4 y. After 4 y, seedlings were transplanted at 2.5-cm (1 in) intervals in rows 15 cm (6 in) apart and left undisturbed for an additional 2 y. After transplanting, the bed space increased to 7.6 m X 0.9 m (25 ft X 3 ft).

Propagators are learning that a flowering trillium plant can be produced in 3 to 4 y (Greene 2002). Hopefully, seed propagation of trilliums will be seen as a viable production method and nursery-propagated trillium will become a common product in the trade.

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