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PROPAGATION OF WOODY PLANTS BY SEED

SEED, nature's most common method of plant reproduction, provides a means by which an amateur can propagate many woody plants. Facilities needed are simple and inexpensive. By the use of polyethylene plastic bags, seeds requiring periods of pretreatment can be handled in an almost carefree manner.

Germination is defined as: "The process of the development of a seed into a perfect plant." Before this takes place conditions must be favorable and the seed must be ready to germinate. Many kinds of seed germinate on being provided with conditions such as moisture, air and warmth. Other kinds of sound seed refuse to germinate when given these favorable conditions. Such seeds are not prepared to develop and are termed dormant. This word stems from the Latin word *dormio* which means to slumber or sleep. Until the inhibiting conditions of dormancy are overcome, the seed is prevented from development. Dormancies are protective adaptations which prevent germination at times unfavorable to seedling survival. If these safeguards did not exist and germination occurred during a warm spell in winter, the seedlings would perish in a subsequent cold period. This situation, together with others, is prevented by these natural inhibitors. Nature has furnished these protections to insure continuance of the species.

Immediate Germination

Many woody plant seeds have no inhibiting factors and will germinate shortly after having been sown. Among these are:

Seeds Without Inhibiting Dormancy

Buddleia sp.
Calluna (heather)
Catalpa
Cercidiphyllum (katsura tree)
Clethra (summersweet)
Deutzia
Diervilla
Enkianthus

Erica (heath)
Hypericum (St. John's wort)
Kalmia (mountain-laurel)
Kolkowitzia (beauty bush)
Leucothoe
Oxydendrum arboreum (sourwood)
Phellodendron (cork tree)
Philadelphus (mock orange)
Pieris (andromeda)
Potentilla (cinquefoil)
Rhododendron and Azalea)
Spiraea (bridalwreath)
Weigela

After cleaning, seeds in this group are stored dry until sowing time. When handled indoors or in a greenhouse they are best sown in late winter or early spring so that they will germinate and grow with the lengthening days.

Complex Dormancy

Some dormancies are simple, others are complex. Germination of most woody legumes, for example, is retarded by seed coats which are impervious to water. A dormancy of this kind is relatively simple to overcome. To obtain prompt and uniform germination the entry of water becomes necessary. Several procedures will accomplish this. Large type legume seeds, handled in small quantities, can be perforated with a file or sharp knife. Smaller type seeds or large seeds handled in volume can be treated with hot water or sulphuric acid. Sulphuric acid treatments are not recommended for amateurs because of the hazards involved. Accidental spatterings of sulphuric acid could be destructive, if not disastrous.

Hot water provides a simple, safe and effective means of obtaining rapid germination. Seed is placed in a container; water at about 200 degrees F. is poured over the seed and allowed to cool. Permitting it to remain in the water over night before sowing is advantageous. The amount of water should be about five times the volume of seed. On being removed, the seed must be sown at once. If permitted to dry before sowing, the dormancy can recur. Should this happen, the process would have to be repeated.

The second method is to sow the seed in a can, flat, or other container and pour boiling water over it. In the event that an insufficient number of seeds germinate, the seedlings which have developed may be removed and the ungerminated balance retreated with hot water. A second treatment will usually stimulate further germination.

Stratification

Many seeds have internal conditions which inhibit germination. Often this is caused by an immature embryo, which is not ripe although the seed appears mature. Exposure to a period of cold overcomes this dormancy. In nature, such seed would germinate in the spring after being provided with cold by the winter. A period of artificial cold works equally well. Stratification is the term commonly used to define this procedure. This word is derived from the practice of placing

seed between layers, or strata, of medium for storage or pretreatment. It is now interpreted as any process used to facilitate the germination of dormant seeds which require pretreatment by time and temperature. This cold stratification is accomplished by placing the seed in a refrigerator at about 40 degrees F. for the required time. Forty degrees is a recommended temperature, but this has latitude. Within reason, whatever temperature the household refrigerator is set for should be effective. Freezing is unnecessary and seed should not be placed in the freezing unit. The container for these seeds should be a polyethylene plastic bag.

Polyethylene has the property of allowing air to pass through it, but is vapor-proof. A medium composed of one-half sand and one-half peat moss is suitable. This is mixed together and dampened. Dampened is stressed as it must be moist but not wet. In proportion, the medium should be two or three times the volume of the seed. Advantages in keeping the bulk small will be obvious at sowing time as the entire contents of the bag is sown. Twisting the top of the bag and binding it with a rubber band makes it vapor-proof for the period of cold stratification. If properly sealed it can be left until time for sowing, be this a month or a year. The following list shows some plants whose seeds respond to this type of stratification, together with recommended periods of time:

Seeds to be Stratified

	Approximate stratification time in months
Abies sp. (fir)	2–3
Acer sp. (maple) most kinds	3
Aesculus sp. (horsechestnut)	4
Berberis sp. (barberry)	2–3
Betula sp. (birch)	2–3
Campsis sp. (trumpet creeper)	2
Carpinus sp. (hornbeam)	3–4
Carya sp. (hickory)	3–4
Cedrus sp. (true cedar)	1–2
Celastrus (bittersweet)	3
Chamaecyparis sp. (false cypress)	2
Clematis sp. (virgin's bower)	2
Cornus florida (flowering dogwood)	3
Cornus kousa (Japanese dogwood)	3
Fagus sp. (beech)	3
Fraxinus sp. (ash)	2–3
Ligustrum sp. (privet)	3
Liquidambar sp. (sweetgum)	3
Magnolia sp.	3–4
Malus sp. (apple)	1–3

Nyssa sp. (tupelo)	3
Picea sp. (spruce) most species	1–3
Pine (most species)	2
Prunus sp. (cherries, etc.)	3
Pseudolarix (golden larch)	1
Pyrus sp. (pear)	3
Ribes sp. (currant and gooseberry)	3
Sorbus sp. (mountain ash) most kinds	3
Syringa sp. (lilac)	2–3
Thuja sp. (arborvitae)	2
Tsuga sp. (hemlock)	3
Vitis sp. (grape)	3

These recommendations cover most species in the genera listed. In the maples and mountain ashes, for example, there are some exceptions that will not respond to this treatment. Many of the conifers will germinate when sown without pretreatment, but do so erratically. Cold stratification tends to stabilize this condition and provide a uniform stand of seedlings. This can be important as many conifer seedlings are susceptible to damping-off diseases. When induced to germinate quickly and in unison, they can be potted or boxed in a matter of days. By quickly separating them the spread of these diseases is minimized.

Double Dormancy

Still other seeds have conditions of double dormancy. They require warm, fluctuating temperatures followed by a cold period to be prepared for germination. Dormancies of this kind are caused by reasons such as hard seed coats and immature embryos. The endosperm (food storage tissue) can also be responsible for this. Due to the length of time required for germination, they are called two-year seed.

In nature, after being shed in autumn, such seed would go through the first winter without benefit from the cold because water had not penetrated the seed coat. Through the following summer the seed coat decomposes and permits the entry of water. Consequently, the second winter can provide the cold requirement. With the advent of favorable conditions in spring, the seed, thus prepared, can germinate. Some plants produce seed in a given seed crop which germinate each year for a period of years. Apparently variations in structure cause some of them to require more seasonal cycles than others to overcome inhibitors. This again is a survival adaptation. Should the flora of an area be destroyed, there would be dormant seed remaining which wonld germinate and furnish replacements. Some examples of these two-year seeds, together with suggested pretreatment, are as follows:

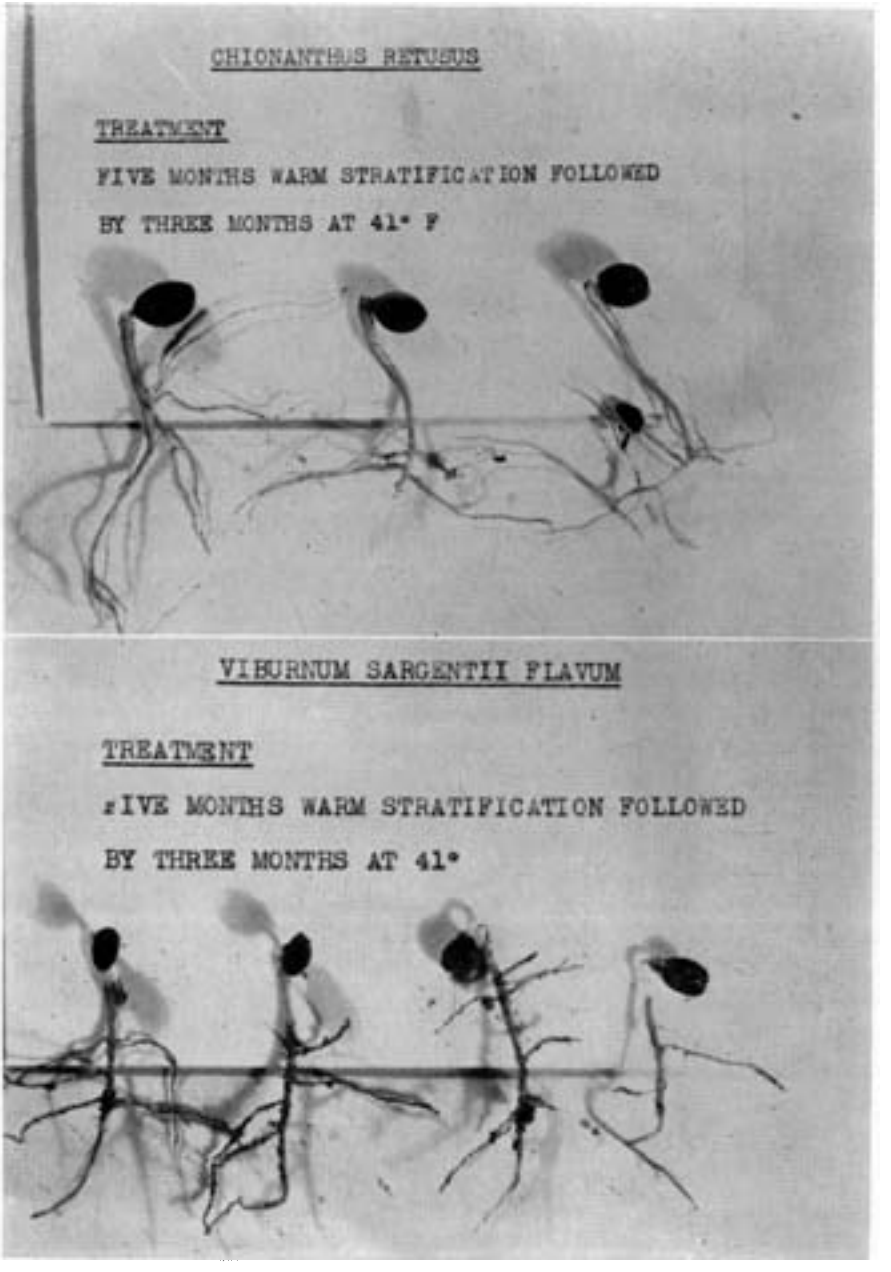

PLATE IX

These seeds of *Chionanthus* and *Viburnum* have been exposed to a period of warm stratification and roots have developed. They are now ready for the second requirement consisting of a 3-month cold treatment. If this is not provided to ripen the shoot bud, they will never go beyond this stage.

Seeds with Double Dormancy

	Stratification Time in months *Warm*	Stratification Time in months *Cold*
*Chionanthus sp. (fringe tree)	5	3
Cotoneaster sp.	5	3
Crataegus sp. (hawthorn)	4	3
*Davidia (dove tree)	5	3
Halesia (silver bell)	5	3
*Paeonia (tree types)	4	3
Stewartia sp.	7	3
*Viburnum	5	3

*These have a dormancy in the shoot bud after seed germination.

Pretreatment of seeds in this group must be done in two stages. They are mixed with medium and placed in polyethylene plastic bags as previously described. For warm stratification they should be provided with a location where the temperature will fluctuate. In some controlled experiments temperatures varying between 68 degrees at night and 86 degrees in the daytime have been used to provide this. Again there is latitude. Bags of seed placed on a greenhouse bench where the temperature ranged between 60 and 100 degrees have produced good results. Any location such as a window sill or similar situation where the day and night temperature varies would be suitable. A place in full sun, however, could result in a build up of high heat which would be detrimental. After the period of warm stratification has been completed, the bag is placed in a refrigerator for its cold requirement. Keeping track of this is easily done by labeling each bag and marking on a calendar the dates they are due to be moved.

Those preceded by an asterisk (p. 38) have a dormancy in the shoot-bud. Toward the end of warm stratification, roots will appear. These signify that the seed is ready for the second or cold stage of stratification. It is well to check this as the time required might vary in different species and with different seed lots. By carefully lifting the bag and looking for roots in the part which faces downward, this is done.

Roots travel down and will be found spreading in the bottom of the bag. When it appears that most of the seeds have produced roots, the bag can be moved to the refrigerator. If this is not done, the root will continue to grow until food stored in the seed is expended. When this happens, the seed will die. The period of cold must be provided to condition the shoot-bud or the seedling will never develop. Plate IX shows examples of seed in this class. Warm treatment has been completed and roots are down. They are now ready for the second treatment consisting of a three-month cold period.

Method of Sowing

Containers for sowing seeds in these different categories may be greenhouse flats, tin cans with drain holes or any suitable container. Tin cans make very satisfactory containers and the supply is inexhaustible. Size of the can will be determined by the amount of seed to be sown. A small soup can would be adequate for small amounts of seed, while a standard coffee can would accommodate larger quantities. The container is prepared by putting an inch or more of broken flower pots, stone, or some such coarse material in the bottom. Sphagnum moss, leaves or such is put over this to prevent the soil from filling the spaces and blocking drainage. Drainage is very essential. Loose-textured potting soil is added, firmed and leveled to fill the can within an inch of the top. A topping of milled or screened sphagnum moss about one-half inch deep, completes preparation for the sowing of fine seeds, such as rhododendron, spiraea and mountain-laurel.

The container is now placed in a vessel with water deep enough to be above the material used for drainage. Capillary action will conduct water upward, wetting the contents. It is well to do this a day in advance of sowing as sphagnum moss wets slowly. Fine type seed is sifted over the layer of sphagnum and is left uncovered. Crevices in the uneven surface catch and hold the seed in place. Judgment must be used in sowing as it is a common error to sow too thickly. Larger-type non-dormant seed is distributed over the surface and covered with sphagnum. The rule of thumb recommendation being to cover two or three times as deep as the seed diameter. A favorable time for sowing seed which has no dormancy is late winter or early spring so it will germinate and grow with the lengthening days.

In sowing seed which has been stratified by the plastic bag method, the entire contents is sown and topped with about one-quarter inch of sphagnum. Again this is planned so that one-half inch of space remains at the top when the job is finished. This half inch of space provides for watering.

Completed containers are now placed in polyethylene bags, closed at the top or inverted and tucked underneath. Water should not be needed until the seed has germinated and the bag removed, but it is well to check this occasionally. After germination, the plastic cover must be removed as the seedlings become too succulent when grown in this close atmosphere. Rather than remove this at once, it must be removed in stages for lengthening periods each day, for several days, to harden off the seedlings. They are now ready for the care required in good management of seedlings.

It is not customary to raise hybrids or varieties from seed unless it is known what their performance will be. Usually they do not provide plants with characteristics similar to the parent. Those which are grown because of deviations from normal, such as weeping forms or those with unusual fruit or flower color, often reproduce a percentage of offspring true to type. Examples would be Sargent's

weeping hemlock and the pink-flowered mountain laurel which are reputed to come about 90% true from seed. However, many years would elapse before they were ready for segregation. When raising mountain-laurel in commercial work, it would be of advantage to gather seed from only the deepest colored specimens. Premium prices would be justified at time of sale for those with superior flower eolor.

Plate IX shows *Viburnum sargentii flavum* a variety which has yellow fruit. Ordinarily a variety such as this does not duplicate the parent, and therefore would not be grown from seed. In this instance, those with yellow fruit can be separated from those with red by the pigmentation in the petioles while the plants are small.

Although it is not customary to raise hybrids and varieties from seed, many new plants occur in this way. One with curiosity and adequate growing space would find interest in raising these to see the outcome.

A. J. FORDHAM

Classes at the Arnold Arboretum

Fall Program, 1960

Economic Botany — Instructor: Dr. Joab Thomas

Six meetings. Tuesday evenings, 7:30–9:30, Oct. 4–Nov. 8. Fee $10.00

Fall Field Class in Ornamental Plants — Instructor: Dr. Donald Wyman

Five meetings. Friday mornings, 10–12, Sept. 30–Oct. 28. Fee $2.00

Field Botany I * — Instructor: Dr. Richard Howard

Five meetings. Tuesday afternoons, 2–4, Sept. 27–Oct. 25. Fee $2.00

Plant Propagation ‡ — Instructor: Mr. Alfred Fordham

Ten meetings, the first on Saturday, Sept. 24, 9:30 a.m. Fee $25.00

Plant Structures — Instructor: Dr. Burdette Wagenknecht

Six meetings. Thursday evenings, 7:30–9:30, Oct. 6–Nov. 10. Fee $10.00

Applications will be accepted now for all classes, and should be addressed to Miss Stella Whitehouse, Arnold Arboretum, Jamaica Plain 30, Mass.

* Class meets at the Barn, 135 Wellesley Street, Weston, Mass.

‡ Class meets at the Arboretum Greenhouse on South Street, Jamaica Plain, Mass.