DORMANCY IN SEEDS OF TEMPERATE ZONE WOODY PLANTS

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In nature's scheme of things many remarkable adaptations have evolved which prevent germination of seeds at times unfavorable to seedling survival. While many kinds of seeds germinate on being provided with conditions such as moisture, air and warmth, other seeds refuse to do so even 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, often irksome to propagators, are functional in design. They are safeguards which nature has furnished to insure continuance of the species. If these protections did not exist and germination occurred during a warm spell in autumn or winter, the seedlings would perish during subsequent cold. Dormancies which cause germination to be erratic and extended over long periods of time lead to a reserve of seeds which stand ready to germinate during years when the species might not be fruitful. Some dormancies are simple and readily explained, others are complex and more difficult to understand.

DORMANCY IN SEEDS OF SORBUS

Sorbus seeds are contained in fleshy pomes which occur in a wide variety of attractive colors and usually are small in size. Natural dispersal is dependent upon birds who are fond of its fruits. The pulp furnishes food to the birds who in turn carry the seeds about in their digestive tracts until eliminated in droppings and scattered about the countryside. In the northeast this takes place in September and October. Were the seeds to germinate at this time they would no doubt fail to survive the cold of winter.

Seeds of most *Sorbus* species are prevented from germination only by dormant embryos. In nature this barrier is overcome out-of-doors by seasonal cold and the seeds are prepared to germinate with the advent of spring. Following is a list of *Sorbus* seeds which were prepared for germination by a 3 month period of cold stratification at 40°F.

Sorbus arnoldiana
S. aucuparia
S. bakonyensis
S. cashmiriana
S. prattii
S. x pseudovertesensis
S. randiensis
S. reflexipetala

S. chamaemespilus
S. commixta
S. discolor
S. esserteauiana
S. folgneri
S. hupehensis
S. intermedia var. arranensis
S. pluripinnata
S. pohuashanensis
S. rehderiana
S. rufo-ferruginea
S. sargentiana 'Warleyensis'
S. scopulina
S. sibirica
S. subsimilis
S. tianshanica
S. wilsoniana
S. alnifolia (response variable – seeds from some trees are double-dormant)

DORMANCY BY CONFINEMENT

An example of dormancy by confinement is found in seeds of the fire pines. Cones of *Pinus attenuata* (knob-cone pine) remain on the trees unopened for indefinite periods. Opening to release the seeds takes place only after the tree dies or its cones have been exposed to heat from a fire. Seeds confined within are insulated by the structure of the cones and survive despite heat intense enough to kill the tree. In the arboretum at Wakehurst Place in Britain a tree of *P. attenuata* has fruited consistently year after year. One branch has clusters of unopened cones which can be counted back for 16 years. Still further back on heavier limbs, cones perhaps 40 or more years old are now partly imbedded in the branches and remain unopened. In 1909, W.C. Coker investigated cones of *P. attenuata* and found viable seeds present in 20 or 30 year old cones.

DORMANCY IN SHOOTS OF AESCULUS PARVIFLORA

At the Arnold Arboretum the natural dispersal of *Aesculus* (horsechestnut, buckeye) is carried out by squirrels. The seeds are removed from the trees and buried to a depth of about 1-1/2 to 2 inches. Seed germination of most species takes place during the warm days of spring after a dormant condition in the embryo has been overcome by cold.

Seeds of *Aesculus parviflora*, (bottlebrush buckeye) however, ripen about mid-October and germinate a few days after they have matured. In the process of germination the cotyledon petioles elongate and carry the rudimentary plant out through the seed coat. In a few weeks the ample food reserves present in the thick fleshy cotyledons are exhausted by the rapid development of a large thick root system. Meanwhile, the shoot has grown to a length of about one inch and has gone dormant. Squirrels bury the seeds to a depth whereby the small shoots remain below the surface of the soil and therefore seedlings which develop in late autumn are protected and survive the winter. Occasionally the

shoots fail to go dormant and continue to develop. Seedlings which do this would be eliminated by natural selection for they would not be prepared to survive the winter.

DORMANCY IN UNCLEANED SEEDS

The fleshy pulp which surrounds the seeds of many plant species can contain substances which nullify the effectiveness of stratification. If the pulp is allowed to remain the cold period is ineffective and the seeds remain dormant.

To demonstrate this, 100 fruits of *Prunus americana* (American plum) were divided into two lots and treated as follows: The pulp was removed from lot #1 and the seeds were combined with a dampened stratifying medium consisting of half sand and half peatmoss. The 50 seeds in lot #2 were allowed to remain within the pulp. Both lots were placed in polyethylene plastic bags, bound at the mouths with rubber bands to make them vapor proof. They were then put side-by-side in a refrigerator set at 40°F after 3 months of stratification, the seeds were sown. by this time, the pulp in lot #2 had deteriorated into a mushy mass which was washed away.

The seeds were sown in plastic trays and placed in a warm greenhouse. In 21 days a uniform stand of 49 seedlings had arisen from the 50 seeds in lot #1 while no germination had taken place in lot #2.

Secondary Dormancy. After 5 months elapsed and germination still had not occurred in lot #2, the seeds were recovered, combined with a stratifying medium, provided with three months of cold stratification similar to that described above for lot #1. However, this treatment which had been so successful previously no longer had the same effect. Three months after they were sown 28 seedlings had developed but 21 sound appearing seeds remained ungerminated. During the earlier unsuitable pretreatments, the seeds had acquired "secondary dormancy".

DORMANCY IN SEEDS OF SOME MYRICA SPECIES

Fruits of *Myrica cerifera* and *M. pensylvanica* consist of small globose nuts enclosed in waxy coatings. Germination is hindered by a dormant embyro plus the presence of the waxy coating. Dormancy in the embryo can be overcome by 3 months of cold stratification after the wax has been removed. If the wax is allowed to remain, the cold is ineffective. The fruits ripen in late September and dispersal is accomplished by birds who eat the fruits and spread the seeds about the countryside in their droppings. In nature the waxy coating is removed in the digestive system of the bird and overwintering overcomes the barrier in the embryo.

To demonstrate these two barriers, fruits of *M. cerifera* were divided into four lots and treated as follows:

Lot #1 - uncleaned seeds sown at once.

Lot #2 - uncleaned seeds placed in cold stratification for 3 months at 40°F.

Lot #3 - cleaned seeds sown at once.

Lot #4 - cleaned seeds placed in cold stratification for 3 months.

After 3 months of cold stratification lots #2 and #4 were sown. Lot #4 which had been both cleaned and stratified produced a uniform germination in 20 days. Lots #1, #2 and #3 which were started at the same time as lot #4 had only a small scattering of seedlings with some newly germinated.

Myrica gale (sweet gale) needs only a period of cold to be prepared for germination. Its seeds germinated well after 3 months of cold stratification at 40°F.

DOUBLE DORMANCY

Dormancies of this kind are caused by conditions such as impermeable seed coats plus dormant embryos. The endosperm can also be responsible. Owing to the length of time required for germination they are called 2 year seeds. In nature, after being shed in autumn, such seeds go through the first winter without benefit from the cold because water has not penetrated the seed coats. During the following summer the seed coats deteriorate and permit the entry of water. Consequently, during the second winter the cold requirement is satisfied. With the advent of suitable conditions in spring, the seed, thus prepared, can germinate. Some plants produce seed in a given seed crop which germinate each year over a period of years. Variation in structure causes some seed to require more seasonal cycles than others to overcome inhibitors. This again is a continuance adaptation. Should the flora of an area be destroyed, there would be dormant seeds remaining to germinate and furnish revegetation.

EPICOTYL DORMANCY

Seeds in this category are characterized by dormancy in the shoot buds. The shoot fails to develop even though germination has taken place and a root is present. If a period of cold is not furnished to condition the shoot bud the roots will continue to grow until the food reserve in the seed is expended. When this happens the partly developed seedling will die. Seeds with epicotyl dormancy are found in *Paeonia, Chionanthus* and many of the *Viburnums*. Seeds of *Viburnums* with shoot-bud dormancy which ripen in July and August would perhaps have enough

time to produce roots before the onset of cold weather. If so the cold of winter would condition the shoot-buds and shoots would develop in spring. Those ripening late in the season, however, would be categorized as two-year seeds. Their roots would not develop until the following summer, shoot-bud dormancy would be overcome the second winter and the completed plant would grow during the next spring.

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MODERATOR SHUGERT: Thank you, Al; a great paper. Our next speaker is Harold Pellett from the University of Minnesota. Harold and I first met in Nebraska several years ago where we both enjoyed some interesting propagation challenges. Harold's paper covers the puzzle of "Seed Stratification".

SEED STRATIFICATION

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The term stratification was coined as a description of the common means of handling seeds during the period in which their dormancy conditions were satisfied. This is the practice of alternately placing layers of seeds between layers of moist sand or peat or other suitable media. The term is used today to describe all methods of storing seeds in a moist condition such as mixing the seed with the medium or fall sowing directly in the seed bed. When we think of stratification we commonly think of cold stratification to satisfy some internal dormancy problem, but storage of seeds in a moist medium under warm temperatures is also quite helpful in overcoming some types of dormancy, so we should say warm or cold to preface the word stratification depending on the conditions desired. A warm stratification period preceding a cold stratification is very helpful with some seeds