SECOND SUPPLEMENT

TO

SEED GERMINATION THEORY AND PRACTICE

Published and distributed by Norman C. Deno
139 Lenor Drive, State College PA 16801
(First Printing January 1, 1998)

Every species has some mechanism for delaying germination

until after the seed has been dispersed.

The Science of Seed Germination is the discovery and description of such

mechanisms and the development of procedures for removing them

so that the seeds can germinate.

A REQUSITE CONDITIONING TREATMENT CANNOT BE
A PERIOD OF DORMANCY FROM A CHEMICAL VIEWPOINT

To Plant a Seed Is a Noble Deed, Propagation Is Conservation

"When the World Wearies and Ceases to Satisfy,
There's Always the Garden." Rudyard Kipling

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Four people have made a special contribution to this book. Virginia M. Deno was my constant companion for fifty-two years (she died November 1996). Every idea was first described to her for consideration. Her scientific background in physics and medical technology and good sense provided a constant inspiration for refining and correcting my ideas. Even when she had no comment to make, explaining concepts to her was of value in defining them.

Janet L. Deno and I were married in 1997. Janet has been of the greatest help in collecting seeds, managing our gardens, arranging the workplace, and obtaining information from Internet.

Richard Craig (a noted Geranium breeder) called my attention to the work of Henry Cathey. Lois Lutz (a noted lily breeder) called my attention to the work of Lela Barton. Many others have contributed by sending seeds, sending data from their own work, and contributing ideas. Work of several workers has been included in the Data Section and their work acknowledged when used.

All of the above contributions are gratefully acknowledged.

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Possibly this section on memories will add a personal touch. At the age of four I had my tonsils and adenoids removed. Immediately following I was stricken with severe asthma. This limited my activities so it was natural to turn to observing nature and identifying plants and all wild life. At the age of eight a small plot was given to me for growing wild flowers. Even today seventy years later I have a vivid picture of two jack-in-the-pulpits growing two feet high. My Mother had a garden and the two of us spent many happy hours planting and weeding.

The great depression in 1930 brought a crisis to our family. Suffice to say we moved to a cheaper house and for several years lived on rice and potatoes. I have often thought that if the children of today could experience some real fear and deprivation, they would not be so quick to turn to drugs and alcohol. They would start thinking about a career from the age of eight and dedicate themselves to it. As it is a child raised in comfort and affluence will not want to leave childhood and will find himself or herself grown up physically but not mentally or emotionally.

My Mother had organized a garden club. At the age of thirteen she had me give the program on raising lilies from seeds. Amazingly I was able to bring stems of LIlium centifolium and Lilium regale raised from seed and in full flower.

Neither of my parents had gone to college, and my Mother had been taken out of high school her second year to help her Mother run a poverty stricken rooming house on the North Side of Chicago, Illinois. To their eternal credit they were dedicated to seeing that their two sons went to college and had a good primary education. To accomplish this they moved to Wilmette, Illinois, which had an excellent school system and the high school, New Trier, was like a college.

Four years at the University of Illinois, six years at the University of Michigan, and two years at Ohio State University brought me in contact with some of the great scientific minds and great researchers and great teachers. Miss Wyman in grammar school and Miss Walker in high school were outstanding. Miss Smith gave her heart and soul to a course in public speaking. At Illinois Loomis (head of physics), Carl Marvel (a pioneer in polymer chemistry), and William Rose (who founded the concept of essential amino acids) were the unforgetable. At Michigan George Uhlenbeck (who received the Noble Prize in Physics with Goudsmit for the electron spin quantum numbers) gave a memorable course in the foundations of chemical rate theory. Much of the chemical rate theory in my work on seed germination originates from this.

At Ohio State Mel Newman was not only a great teacher and researcher, but he was dedicated to seeing his students be successful. When the department head at Penn State asked him for recommendations, he wrote Bob Taft and Norm Deno. When a return reply asked him which one should he take, he wrote back "take them both you fool." That was Mel. When he got my first report, he called me in and said, "Where in hell did you learn to write." I promptly asked him, "teach me."

My career in chemistry was most successful, but time was found for the hobby of growing plants. I joined the American Lily Society, the North American Rock Garden Club, the Alpine Garden Society, and the Scottish Rock Garden Club. There were many wonderful times in the meetings and field trips of these societies and perhaps some of the following anecdotes will amuse you or warm your heart.

One night in Seattle we were on our own for dinner. A group of ten of us decided to look through the phone book and find the restaurant with the craziest name. The Hog's Breath was an easy winner. On entering there were no customers despite the fairly spacious two rooms and a bar. A bartender was industriously polishing glasses to relieve boredom. After bringing drinks the waiter took our dinner orders. It did seem strange that there was not another customer in the establishment, and this strangeness grew as we waited interminably for the waiter to return. After about forty minutes the waiter finally reappeared and came to our table with much bowing. He said, "I must apologize, we cannot serve you dinner, our cook has fled."

It was late in the evening that we arrived at a motel on the Eastern slopes of the Cascade Mountains in Washington. Next morning the group of thirty was led a block down the street to have breakfast at an establishment called Funky's. The menu was as crazy as the name Funky's, and It is too bad that a menu was not kept as a memento. The most memorable aspect of this eating place were the salads. These were in dishes on top of crushed ice in a bathtub, and the salad dressings were in bowls on ice in a toilet bowl. It was on this same trip that we ate sitting cross-legged on top of a picnic table on the slopes of Mount Baker. The snow was up to within an inch of the table top.

Morris Berd and I were walking up the entrance way to the Bouchard Gardens in Victoria. A small band was playing, and we stopped to listen. They asked if we would like them to play something. We stood gawking and open mouthed undoubtedly looking stupid. The small audience broke into laughter when they said, "Ask us to play anything, if we don't know it we'll practice it for you."

One evening we came into the hotel early in the evening and the driver offered to drive us up to a night club in the mountains for a dollar a piece. We arrive at twilight, and there were still a few minutes of daylight. We ran over the hills like lambs just put out to graze. Suddenly I gave a great shout. There were hundreds of Calochorus macrocephalus with their great lavender flowers everywhere. I thought the visitors from England would go mad with delight.

The visits to Claude Barr in South Dakota seem like yesterday in my mind. From his house there is no sign of man, no telephone poles or wires, no roads, only a dirt trail winding over the hill. He warned me to park out on the road if there had been rain as the dirt trail would be impassable. Fortunately it was always dry as this dirt trail was nearly a mile long. Claude's only water was from the rare rain running off the roof. This meagre water was carefully stored and treasured in a cistern. Thirty feet from the house was a large garden perfectly tended. He was so proud of flowering Gentian septemfida. It is doubtful that many people ever saw this beautiful garden. The endless miles of fences along the gravel road on the way to his place had hawks spaced every hundred feet or so and there were great flocks of lark buntings on these same fences. On the dirt road into his place a flock of thirty Curlews crossed in front of us busily eating grasshoppers.

Claude Barr often wrote to me and told me where to see this or that plant. He told of one large colony of a species of Astragalus out in nowhere between Centennial and Horse Creek in Wyoming. He wrote that there was plenty of it so "help your selfus."

The best horticultural talk ever heard was by Brindsley Burbridge on his trip from Ladakh over the Himalayas and south into India. They had to cross a pass at eighteen thousand feet, and there was no lower pass. On this pass a little Antennaria was growing in a pocket of soil on top of a glacier.

Some memorable sights were Iris spuria at the Denver Botanic Garden, Lysochiton americanum at Wisley in England, the Empress Trees at Longwood Gardens, woods carpeted with Trillium grandiflorum in my boyhood home in Illinois, the acres of Eritrichum nanum at the Medicine Wheel in Wyoming, Aquilegia jonesii lining the gravel road in the Bighorns, miles of Dodecatheon in the Bighorns, a beautiful Gentian on the Beartooth Highway in Wyoming, Gentiana crinita along a river in New Jersey, and the colonies of Lobelia cardinalis and Pulsatilla in my own garden.

Our own grounds are beautiful with a trout stream, little waterfalls and cascades, a spring, a small cliff, woods, and a marsh. Josef Halda who had botanized all over the Pamir Mountains, Lake Baikal, and many other far places sat on the picnic table by our stream and said Paradisus.

Plants are grown as self sowing colonies. In early May over one hundred and thirty botanical species are in flower. The season open in late February with Hamamelis mollis and Erica carnea bursting into flower. It closes the last two weeks of November with our native Hamamelis virginiana in full flower and Gentian scabra carrying a flower or two into the end of November. Rarely a Viola tricolor or a Gentiana acaulis opens a stray flower in January.

Many beautiful plants are native on the property such as Anemonella thalictroides, Aquilegia canadensis, Ceanothus americana, Lilium canadense, Polemonium reptans, Sanguinaria canadensis, and Viburnum prunifolium. The curious Aristolochia serpentaria is native here. Many other Eastern United States natives have been introduced and have naturalized such as Cercis canadensis, Cimicifuga racemosa, Delphinium tricorne, Mertensia virginica, Penstemon digitalis, Phacelia bipinnatifida, Phlox divaricata, Phlox pulcherrima, Stylophorum diphyllum, several Trilliums, and Yucca filamentosa. A special effort is made to propagate endangered species, and there are fine colonies of Arisaema quinata and Trollius laxus.

Many species from Western United States have naturalized beautifully. Among these are Libocedrus decurrens, Lysochiton americanum, Mahonia aquifolium, Nemastylis acuta, Oenothera brachycarpa, and Trillium albidum. Many species from outside the U. S. have also naturalized. Among these are Aconitum wilsoni, Anemone blanda, Antirrhinum majus, Asphodeline lutea, Buddleia davidi, Cercis chinensis, Chionodoxa luciliae, Eranthis hyemalis, Euonymus alatus, Iris tectorum, Jeffersonia dubia, Juno bucharica, Kolkowitzia amabilis, Lamium maculatum, Lilium auratum x speciosum, Lilium centifolium x henryi, Paonea officinalis and suffruticosa, Lysochiton camschaticum, Podophyllum emodi, Primula kisoana, Primulas of the vernales group, Saxifrage of the encrusted type, Styrax japonica, and Tricyrtis hirta.

Our home is a place for precious plants of the World. As Rudyard Kipling wrote, **"When the World Wearies and Ceases to Satisfy, There's Always the Garden."** With that I will end this short bit on Memories.

General Comments: This will likely be the last Supplement. The Second Edition of Seed Germination Theory and Practice and the First and Second Supplements provide data on the germination of about five thousand species. These data provide a basis for either exactly knowing the germination pattern or for making a reasonable prediction of the germination pattern based on data of closely related species or data on species from similar habitats.

Eleven species have failed to germinate in my five standard treatments despite ample quantities of seeds with endosperm. These are Aronia arbutifolia, Baumea articulata, Caulophyllum thalictroides, Ilex opaca, Jatropha macrocarpa, Medeola virginiana, Musella lasiocarpa, Nivenia stokei, Pontedaria cordata, Sandersonia aurantiaca, and Sassafras. It is curious that six of these eleven are native nearby, and three are native on our property. Perhaps the Nivenia and Sassafras should not be included because the Nivenia has given a few germinations and conditions for successful germination of Sassafras are reported from another worker.

Seed storage is a vast and relatively unexplored field. The traditional procedure is to store seeds dry in the refrigerator. **It is likely that this is never the optimum conditions for storage of seeds.** Barton has shown that seeds of L. regale dry store better at 23 deg. F than at 40 suggesting that dry storage of seeds would be better at temperatures below that of refrigerators (around 40 deg. F) even perhaps down to the temperatures of freezing units (around zero deg. F). **Then there is the whole subject of moist aerobic storage of seeds which has been virtually untouched.** I have shown that seeds of Eranthis hyemalis and Salix arctica store better in the moist state, and it is likely, even probable, that this would be true in general for seeds with 70-40, 40-70, and more extended germination pattterns. These subjects are taken up in more detail in the Section on Seed Storage.

Every species must have some mechanism for blocking germination until the seeds are dispersed. While this is true, it was not emphasized sufficiently in the Second Edition or First Supplement that many seeds that germinate in the D-70 pattern use an additional physical method. Examples are grains and annuals like Cosmos. Relatively short periods of a week or two of drying are sufficient to destroy the chemical systems blocking germination. The seeds remain in the recepticles on the upright stems for weeks after that. The seeds would germinate after a rain were it not for the fact that the seeds are held open and upright so that moisture readily drains away and the seeds quickly dry out after a rain. They are thus prevented from germination before dispersal even though such seeds will germinate immediately if placed in moist paper towels or moist soils.

Bamboos, garden herbs, Iridaceae and Liliaceae from South Africa, and Australian rushes and sedges are covered in this 2nd Suppl. Incidentally, many South African plants with bulbs or corms have seeds that germinate at 40 and not 70, a fact not generally recognized heretofore. I am particularly indebted to Susan H. Woods of West Wind Technology Inc., Athens GA, for six samples of seeds of bamboos (Bambusa, three Dendrocalamus, Phyllostachys, and Thrysostachys). Bamboos rarely flower and set seed so that these bamboo seeds were particularly appreciated.

A troublesome question is whether differing germination characteristics can result because seed was grown in different geographical region, different growing years, or different growing conditions. Such effects have been suggested frequently. The clearest example to my knowledge is with seed of crown vetch. Seed commercially grown in Eastern Colorado has a much higher percentage of impervious seed coats than seeds produced in Central Pennsylvania (Fred Grau, Pine Grove Mills PA). In my work seeds from different sources generally gave the same rates and pattern in germination so that it is likely that this is not generally a factor.

Two lengthy lists have been constructed. The first (pages 72-81) is for all of the families and genera studied in the Second Edition and the two Supplements.The second (pp. 82-100) is a listing of common names followed by the botanical name. A list of this type has been much needed.

Improvements are being introduced in marketing seeds. J. L. Hudson Seeds are marketing seeds in which GA-3 is already on the seed coats for those species where GA-3 is beneficial or required. Recently a practice of "priming" seeds has come into commercial practice. This involves giving the seed a limited exposure to moisture which causes some of the chemical reactions involved in seed germination to take place without actual exertion of the radicle. In some species such seeds will germinate more rapidly and more uniformly than untreated seeds. This has some advantage for a commercial grower but is not of much interest to the amateur horticulturist since the savings of time are only of a few days or perhaps a week.

One of the key features of my work has been to demonstrate that any treatments that were required to condition the seeds for germination were periods of maximum metabolic activity for destruction of certain chemical systems blocking germination and not periods of dormancy as had been so often described in the past. In this regard it is of interest that the phenomenon of sleeping in humans and animals is actually a period of metabolic activity for certain chemical reactions that first induce sleep and then further reactions ultimately cause awakening.

The suggestions given in Chapter 14 of the Second Edition entitled <u>Growing Plants From Seeds</u> have proven to be of the utmost value. Surface sterilization of the media, germinating the seeds in moist paper towels, and growing the seedlings in pots enclosed in polyethylene bags are all valuable techniques.

Delayed Light Effects, Three New Patterns. Three new patterns have been discovered in which light is required for germination, but germination does not occur during the exposure to light but rather in a later treatment. These are termed delayed light effects. The following examples illustrate these new patterns.

Alophia (two species) germinated 100% in the dark at 70 but only if given eight weeks in the light at 70 first. Without the prior eight weeks in the light germination in the dark was much lower. The interpretation is that the light performs two separate and independent functions. One is to destroy a chemical system blocking germination. The second is to shift a photoequilibrium to the side that produces a germination inhibitor. As soon as the light is removed, the photoequilibrium shifts back to the dark state and germination begins.

Alisma plantago-aquatica germinated 70L-40-70D(100% on 2nd d), 40-70L-40-70D(70% on 3rd d), and none in 70D-40-70D and 40-70D-40. Here an initial three months in light at 70 F was necessary for germination in the dark at 70 two cycles later.

Baeometra uniflora germinated 70L-40(4/4 in 7-11 w) and 70D-40-70D(1/5 on 3rd d). Here light was required for germination in a following cycle at 40. The results with Alisma and Baeometra are interpreted in terms of two or more chemical systems blocking germination. The first is destroyed by light.

Dry Storage Effects on Germination. Annona cherimola (Annonaceae) and Strelitzia reginae (Musaceae) germinated 75%-100% in a week or two at 70 providing the seeds were dry stored at 70 deg. F. for a year. Fresh seeds failed to germinate at 70. Three things are surprising about these results. First is that these species grow in the tropics, and it is not clear why a long period of dry storage would have survival value. Second is that the seeds are large and large seeds do not have a D-70 pattern usually. Third is that the seeds of the Annona are enclosed in a fleshy fruit and D-70 germination patterns had not been found previously in seeds in fruits.

Many examples have been found where dry storage changes the germination pattern. Different amounts of dry storage can cause different samples to give different results as well as divergent result between different workers.

Long Extended Germinations. A specific example, Leucopogon fraseri (Epacridaceae), will illustrate the type of problems encountered. Seeds germinated 70D-40-70D-40-70D-40(2/6 in 11th w). The seeds that germinated grew away rapidly and seemed healthy in every respect. The question arises as to whether germination would have occurred earlier if cycle lengths other than three months had been used. Also this species is a greenhouse shrub so that both the extended germination and the germination at 40 were surprises. Again the results show that one must keep an open mind when investigating the germination pattern of a species previously unstudied.

Time of Collection of Seeds. It has been suggested in the literature that seeds collected while still green germinate more rapidly than thoroughly ripened seeds. It was found that seeds of Juno bucharica collected in a state just before they turn completely dry and brown ("green seed") will germinate immediately at 40 (1st Suppl.). This technique has now been found to be successful with Juno magnifica. Unfortunately this technique is not readily adaptable to commercial distribution of seeds or seeds distributed through seed exchanges.

It might be thought that the "green seed" technique would be generally applicable to seeds which develop impervious seed coats. In fact it was successful with Sophora japonica, but an extensive study showed that the technique will not work with Gymnocladus dioica.

Are Temperatures Above 70 F Beneficial ? Bottom heat and temperatures above 70 F have often been recommended for germination, particularly of the common garden vegetables and annuals. Henry M. Cathey has already studied this question extensively, and his results were published in Florist's Review August 21, August 28, and September 4, 1969. He studied germination at five degree intervals from 50-85 F. Germination was usually optimum around 70, and temperatures down to 50 or up to 85 often result in markedly lower germination. I have studied germination at 40 and 70 for most of the species studied by Cathey and confirm that germination at 70 is satisfactory. A significant number of the common garden annuals require light for germination. This data is incorporated in the data section.

Both Cathey's results and my own indicate that temperatures above 70 are neither necesary or desirable for germination. However, there are two situations to date where temperatures in the 85-95 region may be beneficial. Fresh seed of Gomphrena required such temperatures for germination (2nd Ed.), but soon lost this requirement on dry storage. The second situation involves the genus Passiflora (refer to the Data Section) where there have been reports that temperatures above 70 are required for germination. I have not tested this myself.

Why have temperatures above 70 have been recommended so often? Many of the recommendations in the literature are inferential such as recommendations to use heating cables or place the seed flats on hot pads or other warm surfaces such as the top of a refrigerator. There are possibly two reasons for these traditional concepts. Many greenhouses in spring may be at temperatures significantly below 70 and particularly the soil temperatures are below 70. Bottom heat could be helpful. Secondly, a century ago temperatures inside houses were colder than the 70 which is now customary. In such colder houses bottom heat was beneficial in order to raise the temperature to 70.

Update on Gibberellins. Many species require gibberellins for the germination of their seeds, it is a pleasure to inform readers that J. L. Hudson, Seedsman (Star Route 2, Box 337, La Honda CA 94020) can supply GA-3 to private growers. This company is also trying pretreatment of seeds with gibberellins so that the grower need only plant the seeds. The sources for gibberellin given in the First Supplement would not in general market them to private individuals.

It has been reported that a sample of Ranunculus lyalli seed germinated without gibberellins whereas germination occurred only with GA-3 treatment in my work. Of course such a discrepancy could arise from different strains and genetic variation within a species and even possibly seed collected in a different year and different geographical location. However, there are two other explanations for such discrepancies that are more likely.

(1) When seeds are sown in various media, such media may have sufficient fungal activity to generate the requisite gibberellins. (2) Rotting of dead seeds and other debris in a seed sample can produce sufficient gibberellins to initiate germination. As an example, a large quantity of seed of Trillium grandiflorum was received. Many of the seeds were dead and soon began rotting when placed in moist paper towels. The Trillium grandiflorum seeds began germinating without any application of GA-3. It became evident that the fungal action on the rotting seeds was supplying the requisite gibberellins because part of the seeds were kept free of this fungal action by frequent washing, and these seeds did not germinate.

Kim Reasoner, a high school student in Texas, has done extensive experiments on the effects of GA-3 (5, 500, and 1000 ppm), GA-4 (5 ppm), zeatin cytokinin (5 ppm), Bioform, and compost inoculants (mixtures of fungi spores and bacteria). In general the Bioform and the compost inoculants have not improved germination and were usually detrimental. The cytokinin had positive value in a few instances, and these are documented in the Data Section. Gibberellic Acid-3 (GA-3) is still the principal chemical for either initiating germination or increasing the rate of germination. However, there are examples where GA-4 or GA-7 works and GA-3 does not.

Update on Impervious Seed Coats. In the Second Edition and First Supplement I had taken the view that a hole must be made in the seed coats clear through to the endosperm. This certainly works and is the best treatment for testing for the presence of an impervious seed coat. However, J. L. Hudson has pointed out that at least in certain species just a scratch is sufficient and that the traditional term "scarification" is appropriate. To check on this an extensive set of experiments were conducted on the seeds of Gymnocladus dioica. This is a large seed with an extremely hard impervious seed coat. To my surprise a scratch was effective. It appears that the impervious part of the seed coat is limited to a surface layer. This is important to the commercial grower, as devices for scarifying the seeds are easier to construct and operate than a device for puncturing the seed coat.

Data from Commercial Growers. J. L. Hudson (David Theodoropoulos) has reported several observations that merit reporting here. (1) Potassium nitrate often increases the rate of germination without affecting the overall percent germination. The effect of potassium nitrate merits more study particularly since it was suspected as being a major factor in smoke treatment of seeds (1st Suppl.). (2) Seeds of Bursera germinated only after treatment with hydrogen peroxide but the concentrations and duration of treatment were critical. (3) Seeds that germinate at 40 often die if shifted to higher temperatures such as 70 too quickly. This confirms my observations on Eranthis. (4) One species of Carthamus germinated at 70, but the seedlings die whereas seeds germinated at 60 F and kept at 60 grow satisfactorily.

Low Temperature Metabolism in Plants. Temperate zone plants have had to develop control systems to stop growth in fall and initiate growth in spring. Thus terminal buds and bulbs and corms produce growth blocking hormones in the fall. These are destroyed over winter by chemical reactions that take place only at temperatures around 32-45 deg. F. Enzymes catalyze these processes. These enzymes are in the active configuration around 32-45. Somewhere between these temperatures and temperatures around 70 the enzyme changes structure to an inactive form. This low temperature chemistry is also common in seed germination patterns such as 70-40, 40-70, and more extended patterns.

Chemical reactions with negative temperature coefficients, that is they go faster as the temperature falls, are rare in small molecule chemistry. They are commonplace in biological processes in the plant kingdom.

Optimum conditions for storage of seeds depend primarily on the germination pattern. Seeds with the D-70 germination pattern can be expected to store best in the dry state. Seeds with multicycle germination patterns such as 70-40 and 40-70 may store best in an aerobic moist state. **The concept that many seeds may store best in an aerobic moist state does not seem to have been previously recognized.** The following discussion has been divided into five sections, each of which is basically a question. These sections are (a) Moist or Dry Storage of Seeds, (b) What Temperature Is Best, (c) Should Dessicants Be Used, (d) Sealed or Unsealed, and (e) Are Complex Storage Patterns Ever Beneficial.

The final conclusion at the end of these three sections will be that optimum conditions for seed storage must be determined on a species by species basis the same as seed germination patterns. Rates of dying in storage depend on the species and on the conditions of storage. These rates vary widely, and storage lives can range from a few weeks to over a hundred years.

Several large collections of seeds have been received in which the seeds had been dry stored for two to ten years. Data are recorded for these in the Data Section only where the seeds germinated or where they all rotted showing that they were dead. Obviously these are poor storage experiments, but they do give some qualitative idea of how long these species retain viability on the shelf in a dry state at 70.

Moist or Dry Storage of Seeds. Storage of seeds in the dry state is generally the most convenient so the question is when is moist storage superior. Two examples are now described where moist storage is better.

Salix arctica seeds cannot tolerate dry storage at 70 and are dead in two weeks. In contrast Salix arctica seeds show no sign of dying when stored moist for three months at 40 (First Suppl.). Such seeds when shifted to 70 germinate the same as if they had been placed directly in moist paper towels at 70. It will take further work to find out how long the seeds of Salix arctica can be stored moist at 40. The success of this moist storage at 40 depends on the fact that the rate of germination of Salix arctica is enormously slower at 40 than at 70. Obviously moist storage at 40 is not applicable to species where the rate of germination at 40 and 70 are the same or where the rate of germination at 40 is much faster than at 70.

Moist storage may be best for seeds with 70-40, 40-70, and more extended germination patterns. The only study to my knowledge is the following one of my own.

Eranthis hyemalis seeds germinate in a 70-40 pattern. These seeds can be stored for at least eighteen months in moist paper towels at 40 or 70 with no sign of dying. Such seeds still germinate in the 70-40 pattern and at the same rate as fresh seeds. It is imperative that such storage be conducted in an aerobic atmosphere since sealing such seeds in Ziploc bags at either 40 or 70 and either moist or dry led to total rotting in one month.

Eranthis seeds dry stored at 70 start dying after 60 weeks and are dead after 74 weeks. The number of weeks of dry storage at 70 and the percent germinations were 60 w (91%), 62 w (81%), 64 w (60%), 66 w (40%), 68 w (25%), 70 w (15%), 72 w (6%), and none for 74 w and beyond. The dying followed an approximate zero order rate curve with a half life of five weeks after the 60 w induction period.

When Eranthis seeds were dry stored at 40 up to 74 weeks there was no sign of dying. After that the results became erratic with the samples stored for 74 and 82 weeks totally rotting and the samples at intervening two week intervals still germinating 90%. After 110 weeks significant dying became evident.

Dry storage will be best for species with D-70 germination patterns. Most common garden annuals and vegetables have the D-70 pattern which accounts for dry storage being so deeply entrenched. However, even with dry storage there are several unanswered questions which will now be discussed.

What Temperature Is Best. For dry storage of seeds, it is traditional to assume that seeds will dry store longer at refrigeratore temperatures around 40 than at 70. The work of Lela Barton summarized below confims this for Lilium regale, but it also shows that storage temperatures of 23 are even better. The question immediately arises would freezer temperatures around zero or even lower be better.

It is probably safe to assume that the lower the temperature the slower the rate of dying. The limitation would be that formation of ice crystals would be fatal because it would rupture cell walls. The fact that seeds in temperate zones endure winter temperatures down to zero and below shows that most seeds can take this. **Thus it is likely that many seeds will dry store better in freezer compartments than either at refrigerator or room temperatures.**

Seeds could be stored at liquid nitrogen temperatures, and government laboratories are using this in programs on preserving genetic diversity. For most growers the expense and inconvenience of liquid nitrogen would prohibit its use, but freezer storage is readily available and needs far more study.

The same problem of what temperature to choose applies to moist storage as well as dry storage. I have begun an extensive program on seed storage that I trust will culminate in a book entitled <u>Seed Storage Theory and Practice</u>. In the moist storage experiments temperatures of 70, 40 , and 0 are being used.

Germination of Lilium regale Seed Under Various Storage Conditions
Lela V. Barton (Lily Yearbook, N. Am. Lily Soc., 1947)

T deg. F	Moisture Content(a)	Open or Sealed	% Germination (Years of Dry Storage) 1	2	3	5	7	11	13	15
Lab. (70)	9.9%	O	88	42	0	0				
		S	87	35	0	0				
	4.5%	S	91	89	87	74	31	0		
41 deg.	9.9%	O			16	0				
		S				87	87	37	17	8
	4.5%	S	89	86	96	94	93	76	49	0
23 deg.	9.9%	O	98	78	95	87	92	80	83	74
		S	91	87	92	90	96	91	85	81
	4.5%	S	93	89	96	86	88	91	89	93

(a) The seeds with 9.9% moisture content had been dried in the open. The seeds with 4.5% moisture content had been dried over calcium oxide.

Should Dessicants Be Used. The work of Barton on Lilium regale shows that storage life is increased if the moisture content of seeds of Lilium regale is reduced from 9.9% to 4.5% by the use of chemical dessicants. However, the effects varied widely in the three studies that have been found. The effect was none with a bamboo (Ramyarangsi), small with Lilium regale, and large with certain vegetables (Pandey).

S. Ramyarangsi (Proc. Intnl. Bamboo Workshop, 1988) found that seeds of Thyrsostachys siamensis showed no signs of dying when dry stored for 27 months at 35-40 F. It did not make any difference if the seeds had the 10% moisture when collected or had the moisture reduced to 6% by drying. In contrast, seeds dry stored at 80 F were all dead by the end of 27 months. The death rates at 80 followed a zero order rate curve with the half life increasing with lower moisture content. The moisture content and half-lives were 10% (7 months), 8% (12 months), and 6% (17 months).

In the November 1997 issue of the Avant Gardener a procedure is described (developed by Dr. D. K. Pandey in India) in which seeds are treated with a solution of 25 g. of calcium chloride in 75 g. of glycerol and stored in aluminum foil. Seeds of carrots, onions, peas, and peppers so treated retained viability for six years whereas sun dried seeds were dead after six years.

Seeds of Dendrocalamus asper (a bamboo) show no evidence of dying after a year of dry storage sealed and unsealed at 40 and 70 and with and without dessicant.

Seeds with an impervious seed coat have the longest lives in dry storage (2nd. Ed.). It would be surprising if dessicants or sealed storage would have any effect on this group. Low temperatures might increase storage life, but it would take many years to get results. Most species in this group show no sign of dying in years of dry storage at 70 so that any increase in storage life would be of nominal value.

Sealed or Unsealed. Barton's data show a small beneficial effect of storing the seeds of Lilium regale in sealed containers. Thompson and Morgan have begun the practice of distributing seeds in sealed packets. Susan H. Woods of West Wind Technology Inc. sent bamboo seeds in a sealed Ziploc bag containing a packet of dessicant.

It is my guess that any favorable effects of storing seeds in sealed packets will be limited to keeping out adventitious moisture and to preserving a low moisture content in seeds that have been dried over dessicants. I have not included this variable in my program on studying seed storage.

Are Complex Storage Patterns Ever Beneficial. This is a subtle question that has not even been recognized. For example let us take a species with a D-70 germination pattern and one in which something of the order of six months of dry storage is needed to remove the chemical system blocking germination. Will it be better to start storage such as dry storage at zero with the fresh seed or with seeds that have had six months of dry storage at 70. I have no idea. It has at be studied.

Final Conclusion. The field of seed storage has received little serious study. No doubt a factor in this is that such studies take many years and are not applicable to Ph. D. Theses or to research programs of young faculty members. Much work is needed. I would appreciate any help in my program on seed storage.

DATA ARRANGED BY GENERA

Data from the following workers is indicated by their initials in parentheses: Ken W. Allan, Ontario, Canada (KA), Alan D. Bradshaw, Kiowa, Colorado (AB), Richo Cech, Williams, Oregon (RC), Robert Charnock, New South Wales, Australia (RCh), Ann Crawford, Boiceville, New York (AC), Carl Denton, Leeds, England (CD), J. L. Hudson, Redwood City, California (JH), Darrell Kromm, Reeseville, Wisconsin (DK), Vaclav Plestl, Czech Republic (VP), Kim Reasoner, Bridgeport, Texas (KR), Jane Stanley, Ireland (JS), Kristl Walek, Ontario, Canada (KW), and Eugene Zielinski, Milesburg, Pennsylvania (GZ).

The abbreviations and symbols are the same as used in the Second Edition and the First Supplement with the addtion of two new abbreviations. The two new abbreviations are OT for outdoors treatment and OS for daily oscillating temperatures between 70 and 40. The symbol DS means dry storage at 70 with relative humidity about 70% unless otherwise noted.

The data on cacti have been placed in a separate section.

Abies (Pinaceae). See next page.

Abutilon (Malvaceae).

A. sp. mixed DS 6 m or 1 y after being received germ. 70D(20% in 2nd w) with or without puncturing the seed coat. Germination fell to 10% and zero after 2 y and 3 y of further dry storage. The results suggest a half life of around 2 y.

A. vitifolium germ. 70D(30% in 2-14 d)-40-70D(4%). Puncturing the seed coat led to total rotting of the seeds.

Acacia (Fabaceae). The five species studied (three in First Suppl.) all had an impervious seed coat although 0-30% (depending on the species) had an imperfection in the seed coat and germinated the same as seeds that had been punctured.

A. cyanophylla germ. 70D(100% in 2-4 d) if the seed coat was punctured and 70D(30% in 6-14 d) in unpunctured seed.

A. dealbata germ. 70D(100% in 2-4 d) if the seed coat was punctured and 70D(10% in 3rd w) in unpunctured seed. Germination was unchanged after 2 y of DS.

A. iteophylla seeds DS 1 y germ. the same as fresh seeds (50% in 3-12 d in 70D) if punctured and none otherwise, First Suppl.

Acaena (Rosaceae). A. caesiiglauca, A. nova-zelandiae, and A. microphylla all DS 3 y failed to germinate after 4 m in 70D.

A. saccaticupula germ. 70D(5% in 2-15 w).

Acanthus (Acanthaceae). A. balcanicus germ. 2/6 on 5th d in 70D. The remaining 4/6 rotted.

Acer (Aceraceae).

A. ginnala germ. faster at 70 than at 40 once the blocking system has been destroyed at 40 (KR). Gibberelins speed up the rate of the chemical reactions at 40.

Achlys (Berberidaceae). A. triphylla seeds germ. 40-70(3/17 in 3-5 w). In the 2nd w in 70D or 70L 70% of the seeds rotted and in 70 GA-3 100% of the seeds rotted. Removing the seed from the loose black shell made no difference.

Abies (Pinaceae). Grateful acknowledgement is made to Schumacher Seed Company of MA for a gift of fifteen species of this genus. All fifteen germ. at 70D albeit somewhat slowly with germination taking place in 5-10 weeks. Some gave slightly greater percent germination with light or in a 40-70D pattern, but, GA-3, OS, or OT had no significant effects. Some germ. at 40. A significant number of the seeds rotted indicating that they were dead, but there was no simple way of detecting such seeds from outward appearance nor of separating them. The seeds of all fifteen species were largely viable and producing healthy seedlings.

SUMMARY OF RESULTS ON FIFTEEN SPECIES OF ABIES

Species	Germination in 70D Percent	Time		40-70D Results	(c)
A. alba	30%	6-9	weeks	40(5%)-70(41%)	0
A. boris-regis	20%	7-11	weeks	40(23%)-70	0
A. cephalonica	40%	5-7	weeks	40(70%)-70(3%)	0
A. cilicicia	60%	6-9	weeks	40(60%)-70(8%)	0
A. equi-trojani	20% (a)	6-8	weeks	40(20%)-70(25%)	0
A. fabri	40% (b)	7th	week	40(5%)-70(20%)	0
A. firma (A)	35%	5-7	weeks	40(20%)-70(10%)	0
A. firma (B)	60%	7th	week	40(20%)-70(45%)	0
A. holophylla	70%	4-6	weeks	40-70(70%)	0
A. nephrolepsis	70%	5-7	weeks	40-70(65%)	36%
A. nordmannia	60%	6-10	weeks	40(60%)-70(15%)	0
A. pindrow	40%	4-6	weeks	40(15%)-70(5%)	0
A. recurvata	45%	6th	week	40(5%)-70(10%)	0
A. religiosa	55%	6th	week	40(35%)-70(10%)	0
A. veitchii	70%	5-7	weeks	40-70(55%)	5%

(a) This result is for seeds placed in light at 70 for six weeks followed by shifting to dark at 70. Most curiously the seeds placed directly in dark at 70 all rotted.

(b) This result is for seeds placed in light at 70. Germination in the dark at 70 was only 10%.

(c) This is the percent germination at 70 for seeds DS two years.

Ackama (Cunoniaceae). A. roseifolia germ. 6/6 in the 7th w in 70L and none in 70D, but there was so much chaff that it is possible the sample in 70D was all chaff and that germination would have been the same in 70D as 70L.

Acnistus (Solanaceae). A. australis germ. 70D(30% in 3-7 w) and 70L(75% in 2-7 w).

Actinomeris (Asteraceae). A. alternifolia was all chaff.

Actinotus (Apiaceae). A. helianthii were all empty seed coats.

Adonis (Ranunculaceae). There has been virtually no germination in numerous samples of A. vernalis and in wild collected samples of the closely related A. chrysocyathus and A. sibirica (2nd Ed. and the 1st Suppl.). Examination of the seeds showed that they consisted largely of empty seed coats. Brian McGowan in Montague Center MA had a small amount of commercial seed germinate readily one year. Large amounts of seeds were purchased following years none of which germ.

Aethephyllum (Aizoaceae). A. pinnatifidum germ. in 2nd w in either 70D or 70L. There was so much chaff that percent germinations were inaccurate.

Aethiopsis (Lamiaceae). A. cabolica germ. 100% in 2nd w in 70D.

Agastache (Lamiaceae).

A. foeniculum had shown little deterioration after DS 6 m. A separate sample that had been DS 3 y was dead.

A. occidentalis seeds had germination drop from 68% on 5th d in 70L for fresh seeds to 26% in 4-8 d in 70L for seeds DS 2 y (1st Suppl.). Seeds DS 3 y were dead. This indicates a half life of about 18 m.

Agathosma (Rutaceae). A. ovata seeds several years old rotted.

Ageratina (Asteraceae). A. occidentale germ. 10-14 d in 70D. There was so much chaff that percent germinations were inaccurate.

Ageratum (Asteraceae). The common garden annual germinates with no significant difference from 50-85 in light or dark (Cathey).

Agrophyron (Poaceae).

A. pubiflorum germ. 100% in 3rd w in either 70D or 70L.

A. scabrum germ. 100% in 2nd w in either 70D or 70L. After 1 y of DS the seeds germ. 15% in 2nd w indicating a half life of 6 m.

Agrostemma (Caryophyllaceae).

A. githago DS 2 y germ. 70D(100% on 2nd d).

A. tinicola DS 2 y germ. 100% on 3rd d in 70D the same as fresh seeds.

Albizzia (Fabaceae). A. julibrissin DS 7 y or 8 y germ. 100% on 3rd d in 70D, but only if punctured. This is the same as fresh seed (2nd Ed.).

Albuca (Liliaceae). The four species studied germ. in either 70D or 70L. Germination at 40 was more varied.

A. aurea germ. 100% in 5-7 d in either 70D or 70L and 40(1/5 in 7th w)-70D(4/5 on 5th d).

A. canadensis germ. 70D(95% in 1-5 w), 70L(none), and 40(100% in 3rd w). Seeds DS 1 y germ. 70D(4/11 in 2nd w) indicating a half life of 1 y.

A. humilis germ. 100% in 1-3 w in 70D. Neither light at 70, a prior 3 m at 40, or DS for 1 y had any effect.

A. longifolia seeds DS 1 y rotted, but fresh seeds might have done likewise.

A. shawii seeds DS 1 y germ. 81% in 2nd w in 70D.

A. sp. germ. 100% in 1-3 w in 70D and 40(30% in 3-8 w)-70D(70% in 1-4 w). Light seemed to delay the germination at 70 so that germination occurred over 1-12 w but it was still 100%. Seeds DS 1 y germ. the same as fresh seeds in 70D.

Alcea (Malvaceae). A. ficifolia germ. 100% in 6-10 d in 70D.

Aletes (Apiaceae). A. humilis germ. 40-70D(1/5 in 11th w) and 70L-40-70L-40(1/4 in 12th w) and none in 70D, 70 GA-3, or OT.

Alisma (Alismaceae). A. plantago-aquatica exhibited the remarkable and unusual phenomena of a delayed light effect as discussed in the Introduction. Seeds DS 6 m germ. 70L-40-70D(100% on 2nd d), 40-70L-40-70D(70% on 3rd d), and none in 70D-40-70D. An initial month of OS had little effect. Seeds DS 1 y were dead.

Allardia (Asteraceae). A. tridactylites was chaff.

Allium (Liliaceae). A. alba DS 2 y, A. flavum DS 4 y, and A. pulchellum DS 6 y were dead. Germination of fresh seeds was reported in 2nd Ed. and 1st Suppl.

A. unifolium germ. 40(100% in 8-2 w) and 70D(none).

Alonsoa (Scrophulariaceae).

A. meridionalis (JS) germ. 70L(100% in 24 d) and 70D(none in 3 m).

A. warscewiczii (JS) germ. 70L(100% in 9 d) and 70D(25% in 9 d).

Alophia (Iridaceae). Although light blocks germination, the rate and the percent germination in 70D are improved by a prior period of 8 w in 70L in both of the species studied. This is another version of the delayed light effects discussed earlier.

A. drummondi has been reinvestigated with a new sample which germ. much better and gives a clearer picture of the pattern. This germ. 70D(50% in 4-6 w)-40(5%)-70D, 70 GA-3(100% in 2-4 w), 70L(none), and 40-70D(40% in 2nd w)-40-70D. When the sample in 70L was shifted to 70D after 8 w, 100% germ. on the 7th d. When the sample in the 70D-40-70D treatment was then given 2 m in 70L followed by a shift to 70D, 20% more germ. in 3rd w.

A. lahue germ. 70D(2/11 in 4th w)-40-70D and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 100% (11/11) germ. on the 7th d. When the sample from 70D-40-70D was shifted to 70L for 2 m and then returned to 70D, 1/11 germ. in the 2nd w.

Alstroemeria (Amaryllidaceae).

A. garaventae germ. 2/3 on the 7th d at 40 after a prior 4 w at 70D. It does not germinate at 40 without this prior period at 70.

A. Ligtu hybrid DS 3 y germ. 70D-40-70D-40(80% in 4th w).

Althaea (Malvaceae).

A. hirsuta had an impervious seed coat and germ. best if the seed coat were punctured. Such seeds germ. 100% if fresh, 6/8 if DS 1 y, and 4/8 if DS 3 y indicating a half life of 3 y. The unpunctured seeds DS 3 y germ. 1/5.

A. rosea germ. best at 60 and declines to zero at 50 and 80-85 (HC).

Alyssum (Asteraceae).

The common garden annual germinates with no significant difference from 40-70D (my work) or 50-85 in light or dark (HC).

A. saxatile DS 3 y germ. 10% in 2nd w in 70D with the rest rotting.

Amaranthus (Amaranthaceae). A. caudatus germ. in 1-3 d in 70 with germination in light (96%) better than in dark (20%). Cathey reported that germination was the same from 55-85 but dropped below 10% at 50. Presumably his results are for dark experiments.

Ambrosia (Asteraceae). A. mexicana was virtually all chaff, but one did germ. in the 3rd w in 70L.

Amelanchier (Rosaceae). All three species gave similar behavior.

A. grandiflora germ. 70D-40-70D-40-70D(33% in 2-14 d)-40-70D(51% in 2-10 d)-40-70D(16% on 3rd d) which is a total of 100% and 40-70D(37% in 2-14 d)-40-70D-40-70D(8% on 4th d) for a total of 45%. Further cycles might have germ. more. All rotted in either OT or 70 GA-3. Seeds DS 1 y were dead.

A. laevis germ. 70D-40-70D-40(100% in 10-12 w). Seeds DS 6 m or 1 y germinated over 4-6 cycles and percent germination dropped to 5-15% indicating that the half life in DS was less than 6 m.

A. stolonifera germ. 70D-40-70D-40-70D(59% in 2-4 d) and 40-70D(40% in 2-10 d). The remaining seeds rotted so that no further germination would occur. All rotted in either OT or 70 GA-3. Seeds DS 1 y were dead.

Amorpha (Fabaceae). A. fruticosa seeds DS 4 y were dead in accord with an estimated half life of 18 m found earlier (1st Suppl.).

Amsonia (Apocyanaceae). A. tomentosa DS 1 y or 2 y germ. 100% in 3-5 d in 70D the same as fresh seed.

Anagallis (Primulaceae). A. linifolia germ. 100% in 4-8 d in 70D and 100% in 4-7 w at 40. Light had no significant effect.

Anchusa (Boraginaceae). A. officinalis germ. 70% in 2-6 d in 70D for fresh seeds and 24% and 16% on the 3rd d for seeds DS 4 y and 5 y indicating a half life of about 3 y.

Androcymbium (Liliaceae). A. striatum germ. 70D(4/6 in 4-7 w)-40-70D(1/6 in 6th w) and 70L(3/5 in 3-9 w)-40(1/5 in 4th w). A second sample germ. similarly. A prior 3 m at 40 had no effect.

Androsace (Primulaceae). A. carnea alba germ. 40(100% in 5-12 w) and 70L-40(100% in 10th w). Seeds DS 1 y failed to germinate and are presumed dead.

Anelsonia (Brassicaceae). A. eurycarpa rotted within a month in 70D.

Anemone (Ranunculaceae).

A. magellanica DS 3 y were dead.

A. multifida germ. 70D(6/11 in 2-12 w)-40-70D(2/11 on 3-12 d), 70L(1/3 in 3rd w), 70 GA-3(2/4 in 3rd w), and 40-70D(6/8 in 4-6 w). Seeds DS 6 m germ. 70D(2/7 in 4-6 w). Seeds DS 1 y germ. 70D(7/7 in 3-6 w)

A. occidentalis germ. 70D(100% in 5th w), 70 GA-3(100% in 3rd w), 70L-40(100% in 11th w), and 40-70D(50% in 3-8 d). Seeds DS 6 m germ. similar to fresh seeds. Seeds DS 1 y germ. 70D(10% in 6th w).

A. ranunculoides germ. 70D-40-70D-40(12% in 8th w)-70D-40(6%) and 25% at 40 after 2 y of alternating 3 m cycles starting at 40. This is similar to A. nemorosa but even more extended. As with A. nemorosa, a true leaf usually forms in a day or two after shifting to 70 after the germination at 40.

Anigozanthos (Haemadoraceae). A. falvidus germ. 100% largely in 4th w in 70D for both fresh seeds and seeds DS 1 y. Seeds DS 3 y were dead.

Anisodontea (Malvaceae). A high proportion of the seed coats were empty. It is possible that the ungerm. seeds were empty seed coats and that the only conclusion is that the seeds germinate readily in 70D.

A. capensis DS 6 m germ. 40-70D(10% on 3rd d) and 70D(none). The ungerm. seeds could have been empty seed coats. A second sample germ. 40(1/3 in 5th w) and 70D-40-70D-40-70D-40(1/6 in 10th w)-70D(1/6 in 10th w).

A. scabrosia DS 6 m germ. 70D(1/4 on 8th d) and 40-70D(none).

Anoda (Malvaceae). A sample of A. sp. rotted.

Annona (Annonaceae). A. cherimola WC seeds were WC 7 d first. Seeds DS 1 y germ. best, 100% in 2nd w in 70D. This was confirmed on five samples. Fresh seeds germ. 70D-40-70D(3/13 in 3rd w) in one sample and 70D-40-70D(3/4 in 4th d) in a second sample. Puncturing the seed coat had no effect.

Antirrhinum (Scrophulariaceae). A. major germ. in 2-3 d in 70D.

Apium (Apiaceae). A. graveolens (celery) germ. in 6-14 d in 70D (Cathey).

Aquilegia (Ranunculaceae).

A. chrysantha germ. 70D(7%) and 70 GA-3(86% in 2-4 w). Seeds DS 1 y germ. 70D(20% in 1-3 w) and 70 GA-3(50% in 2nd w). These results indicate that the GA-3 requirement was slowly diminishing, and the seeds were dying with a half life of 1 y.

A. formosa had germ. 40-70D(52% in 2-6 w) (KR). KR now finds seeds germ. 70 GA-3(3/10 in 3rd w) and 70D(1/10 in 3rd w). If 5 ppm of zeatin cytokinin is added to the 70 GA-3 treatment the germination increases to 6/10 in 3rd w. This result is important because it is one of the few examples of a positive effect of cytokinins and because it confirms the general GA-3 requirement in Aquilegia.

A. japonica germ. 70D(7%) and 70 GA-3(12% in 3rd w). Seeds DS 1 y germ. 70D(7% in 2nd w) and 70 GA-3(100% in 1-3 w). The favorable effect of the DS needs to be checked, but it does seem that GA-3 is required for germination and that the seeds show no sign of dying after 1 y DS.

A. scopulorum germination in 70 GA-3 dropped from 100% in 2nd w for fresh seeds to 15% in 3rd w for seeds DS 1 y indicating a half life of 6 m. None germ. in 70D showing that GA-3 was still required.

A. vulgaris DS 3 y still required GA-3 for germination but the percent was only 15% suggesting a half-life of 2-3 y. This revises slightly the data in the 1st Suppl.

Ardisia (Myrsinaceae). A. crispa seeds DS 1 y all rotted.

Aralia (Araliaceae). A large sample of A. nudicaulis failed to germinate in 70D, 70L, 40, OS, OT, and 70 GA-3.

Araujia (Asclepediaceae). A. sericifera seeds DS 6 m required light and germ. 70L(5/6 in 3-8 w), 70D(none), 40-70L(2/3 in 5-7 w), and 40-70D(none). The sample in 70D was shifted to 70L after 9 w whereupon 2/4 germ. in 2-4 w. A second sample that had been DS 1 y was dead suggesting a limited life in DS.

Arbutus (Ericaceae). A. menziesii germ. 100% in 5-9 w in 70D for fresh seeds or seeds DS 6 m (1st Suppl.) . This dropped to 90% after 1 y DS, 78% in 11th w (note slowing) after 2 y DS, and zero (all dead) after 3 y DS.

Arctostaphylos (Ericaceae).

A. crustacea. data is now more complete. It germ. 70(GA-3)-40(2%)-70D(2%)-40-70D(2%) and 70D-40-70D-40(2%). Seeds DS 2 y germ. 70(GA-3)-40-70D(6% in 2-10 w).

A. pungens seeds DS 4 y germ. 70 GA-3(5/19 in 7-12 w)-40(9/19 in 7-12 w)-70D(1/19 on 8th d) similar to seeds DS 0-3 y.

Ardisia (Myrsinaceae). A sample of A. crenata rotted.

Argemone (Papaveraceae). A. munita germ. only in 70 GA-3 for either fresh seeds or seeds DS 2 y or 4 y (1st Suppl.). There was no sign of dying after 4 y of DS.

Argyranthemum (Asteraceae). A sample of A. sp. was chaff.

Aristea (Iridaceae). A. ecklonii were empty seed coats.

Aristotelia (Elaeocarpaceae). A. fruticosa x serrata were empty seed coats.

Armeria (Plumbaginaceae). A. maritima germ. about 50% in 1-6 w in 70D for either fresh seeds or seeds DS 1 y. Seeds DS 2 y were dead.

Aronia (Rosaceae). A. arbutifolia continues to be a mystery. Seeds failed to germinate after 3 y of every treatment despite the fact that there seemed to be ample endosperm, and the species naturalizes here to a limited degree.

Artemisia (Asteraceae). A. pamirica seeds either fresh or DS 2 y germ. 100% in 3-5 d in 70D, but seeds DS 4 y were dead.

Arthropodium (Liliaceae). A. cirrhatum germ. only with GA-3 (2nd Ed.). A new sample DS 3 y germ. 70 GA-3(24% in 1-3 w) and 70D(5% in 3rd w) suggesting that the GA-3 requirement may disappear with DS although there is uncertainty because of the data is not on the same sample.

Arum (Araceae).

A. concinnatum germ. 70D(75% in 3-13 w)-40(25% in 3rd w) and 40(10%)-70D-40(50% in 4th w). Seeds DS 1 y germ. 70D(60% in 8-12 w)-40(30% in 6th w) similar to the fresh seeds, but seeds DS 2 y germ. 70D-40(6/7 in 3rd w).

A. cyrenaicum germ. 70D(5/8 in 9-14 w) and 40-70D-40(3/4 in 5th w). The sample in 70D was kept at 70 beyond the usual 3 m because of the continuing germination.

A. dioscoridis germ. 70D(2/8 in 12th w)-40(4/8 in 2-4 w) and 40-70D(none).

A. italicum germ. 70D-40-70D(75% in 1-10 d) and 40-70D-40-70D(5/8 in 1-3 w)-40-70D(1/8). Seeds DS 1 y were dead.

A. nigrum germ. 70D(1/9 in 7th w)-40(2/9 in 4th w) and 40-70D-40(4/4 in 1-3 w).

Armeria (Plumbaginaceae). A. maritima percent germination was greater after 1 y DS. The DS seed germ. 70D(50% in 1-3 w) and 40-70D(100% in 1-4 w) whereas fresh seed germ. 70D(15% in 2-6 w) and 40-70D(45% in 1-3 w).

Asarina (Scrophulariaceae).

A. barclaiana seeds DS 2 y and 4 y germ. 70D(50-56% in 5-9 d). This is half of the 100% germination of seeds DS 1 y which would indicate a half life of 2 y. However, the absence of further dying from 2 to 4 y DS is confusing. Another sample DS 4 y germ. 70D(32% in 1-3 w). The initial promoting effect of light and its disappearance on DS for 1 y are described in the 1st Suppl.

A. purpusii DS 4 y germ. 70D(7% in 2nd w). The low percent germination suggests that much dying had occurred in the 4 y DS.

Asclepias (Asclepiadaceae). Seeds of A. cordifolia, A. erosa, and A. speciosa that had been DS for 20 y were dead.

Asparagus (Liliaceae). A. sprengeri fresh or DS 1 y germ. 100% in 2nd w in 70D, and seeds DS 2 y germ. 100% in 3rd w in 70D. The seeds were WC one day and further WC had no effect. A prior 3 m at 40 had no effect, but light slowed germination so that only 60% had germ. by the end of the 3rd w.

Asphodeline (Liliaceae).

A. brevicaulis data is now more complete. It germ. 70D(2/2 on 10th d) and 40-70D-40(1/2 in 7th w).

A. liburnica data is now complete. It germ. 70D(100% in 3rd w). Light blocked germination, and a sample in 70L germ. 0/2 in 8 w. It was then shifted to 70D whereupon 2/2 germ. in the 7th d. It also germ. 40-70D(1/4 in 3rd w)-40(1/4 in 3rd w).

A. lutea germ. 70D(100% in 2-5 w). This dropped to 70% after DS 2 y or 3 y.

A. microcarpus germ. 70D(7/8 in 4-9 w)-40(1/8 in 5th w).

Asphodelus (Liliaceae).

A. albus data is now complete. One sample germ. 70D-40(4/7 in 8th w)-70D(1/7 in 2nd w). A second sample germ. 70D-40(5/9 in 10th w) and 40-70D-40-70D(3/3 in 2-5 d). A third sample germ. 70D(1/6 in 2nd w)-40(1/6 in 11th w)-70D(3/6 in 2-4 w) and 40-70D(4/4 in 7-12 w). The basic germination pattern appears to be 70-40 and 70-40-70 with the latter possibly being 70-40 if more time had been given in the cycle at 40.

A. aestivus germ. 70D(2/5 in 7th w)-40(2/5 in 8th w), 70L(1/6 in 12th w)-40(5/6 in 7th w), and 40(6/8 in 10-12 w)-70D(2/8 in 1-3 d).

A. cerasiferus germ. 70D-40(2/3 in 10-12 w) and 40(1/3 in 12th w)-70(2/3 in 3-7 d).

A. fistulosus germ. 70D(4/12 in 4-12 d) and 40-70D(2/20 in 4-7 w).

A. luteus germ. 70D(0/3), 70L(4/4 in 6-9 w), and 40-70D(1/2 in 6th w). A second sample germ. 70D(5/5 in 6-10 d). This latter pattern is identical to that found for Asphodeline luteus (2nd Ed.) suggesting that this second sample was the Asphodeline not the Asphodelus.

A. microcarpus germ. 70D(73% in 3-14 w) and 40(55% in 10-12 w)-70D(45% in 1-3 d). The sample in 70D was kept at 70 beyond the usual 3 m. After 16 w it was shifted to 40 after which the remaining 27% germ. in 5-10 w.

A. ramosus germ. 70D-40(4/4 in 7th w) and 40(3/3 in 11th w).

Aster (Asteraceae). A. alpigenus v. haydenii germ. 70D(100% in 1-5 w). After 1 y of DS it germ. 73% in 3-7 d indicating a half life of 1.5 y.

Asteromoa (Astereaceae). A. mongolica germ. 100% in 5-7 d in 70D for fresh seeds or seeds DS 6 m or 1 y. This dropped to 41% in 10-20 d for seeds DS 2 y and seeds DS 3 y were dead indicating a half life of 2 y.

Astrantia (Apiaceae). Larger samples of A. major and A. minor along with two new species now give a clearer picture of germination in this genus. The most consistent germination was in the 70-40 pattern with germination taking place at 40.

A. carniolica rubra germ. 70D-40(100% in 6-8 w) and 40-70D(4/8 in 2nd w)-40(4/8 in 10th w). Light had no effect.

A. involucrata germ. 70D-40(27% in 6-8 w)-70D(7%)-40(50% in 8-10 w)-70(8%) and 40-70-40(30% in 8-12 w)-70(25% in 5-9 d)-40(45% in 12th w). Light and GA-3 had no effect. The 3 m at 70 was necessary before the germination at 40.

A. major germ. 70D-40(85% in 8-10 w) and 40(10%)-70D(55% in 1-4 d). Light had no significant effect. Samples of A. major and A. major rubra DS 3 y were dead.

A. minor germ. 70D-40(1/3 in 8th w), 70L-40(2/2 in 8th w), and 40-70D-40(3/3 in 8-10 w).

Asyneuma (Campanulaceae). A. limonifolium germ. 70D(70% in 1-3 w), 70L(44% in 1-3 w), and 40(20%)-70D(30%).

Atriplex (Chenopodiaceae). A. canescens has been reported to require extensive dry storage (USDA 1974 Bulletin). KR found that it germ. 70D(1/15 on 7th d) and that this could be raised to 3-4/15 by treatment with GA-4 or GA-7 with and without cytokinins and by GA-3 plus cytokinin.

Averrhoa (Oxalidaceae). A. carambola required either light at 70 or a prior 3 m at 40 for germination. The data were 70L(6/8 in 6th w), 70D(none), 40-70L(3/5 in 4th w), and 40-70D(2/3 in 4th w). When the sample in 70D was shifted to 70L after 10 w, 5/8 germ. in 10-12 d.

Azorina (Campanulaceae). A. vidallii germ. better in light. The data were 70L(100% on 8th d), 70D(55% in 14-17 d), 40-70L(82% in 2nd w), and 40-70D(none). When the sample in 70D was moved to 70L after 3 w, the remaining 45% germ. in the 2nd w.

Babiana (Iridaceae). In the three species studied germination was significantly lower in light, and when the sample in 70L was shifted to 70D, the remaining seeds germ. All three samples were of seeds DS 6 m.

B. dregei germ. 70D(4/5 in 5th w and the last in 12th w) and 70L(2/5 in 8th w). When the sample in 70L was shifted to 70D after 6 w the remaining 3/5 germ. in 6th w indicating that light inhibits germination. Seeds DS 1 y germ. 70D(4/5 in 2-8 w) and seeds DS 2 y germ. 70D(2/4 in 11th w)-40(2/4in 2nd w).

B. sp. germ. 70D(3/4 in 4-7 w)-40(1/4 in 5th w) and 70L(1/5 in 5th w). The remaining 3/4 in 70L rotted in the 5th w.

B. tubulosa germ. 70D(3/3 in 4-8 w) and 70L(none in 6 w). When the sample in 70L was shifted to 70D after 6 w, 3/3 germ. in the 6th w.

Baeometra (Liliaceae). B. uniflora germ. 70L-40(4/4 in 7-11 w) and 70D-40-70D(1/5 in 3rd d). The delayed effect of light is found in other species, but it is unusual and needs to be checked for this species.

Bambusa (Poaceae). B. arundinacea (a bamboo) germ. 70L(85% in 8-10 d) and 70D(70% in 1-6 w). Light speeds up the germination. Removing the husk, OS, or treating with GA-3 had no major effect. A prior 3 m at 40 was fatal.

Banksia (Proteaceae). I had quoted Hudson in the 1st Suppl. to the effect that three species had impervious seed coats. Jeffrey Irons and Paul Rezl write that it is the woody cone in which the seeds are embedded that is impervious. In regard to death rates of seeds of Banksia, there are reports that the seeds store indefinitely. This is not true. Seeds of B. integrifolia and B. prionotes several years old were removed from the woody cones whereupon both rotted. Irons writes that seeds live longer if left in the cone, and are short lived once removed from the cone.

Baptisia (Fabaceae).

B. australis germ. 70D(100% on 2nd d) if punctured and only 10% in the control. After 3 y DS the germination of punctured seeds dropped to 50% (on 2nd d) with the rest rotting which indicates a half life of about 2 y.

B. viridis seeds either fresh or DS 2 y germ. 100% on 4th d in 70D if the seed coats were punctured and none if not.

Barbarea (Brassicaceae).

B. rupicola from three different seed exchanges (but possibly the same source) were empty seed coats.

B. sp. germ. 100% in 5-7 d in 70D. Germination was a day or two slower in light.

B. vulgaris variegata germ. 70L(100% on 4th d) and 70D(36% in 6-10 d). When the sample in 70D was shifted to 70L after 9 w, 50% germ. in 1-6 w. Germination is not only better in light, but the period in 70D was deleterious. However, we may be dealing with a species in which the light requirement is disappearing on DS.

Barleria (Acanthaceae). B. obtusa were empty seed coats.

Baumea (Cyperaceae). B. articulata is notoriously difficult to germinate. Seeds failed to germinate in 70D, 70L, 40, OS, and 70 GA-3 after 9 m of alternating 3 m cycles. Abrading the seed coats in various ways failed to initiate germination. A sample was received 2 w after collection. This has also failed to germinate.

Begonia (Begoniaceae).

B. semperflorens germ. better in light (80%) than dark (10%) at 70 similar to Cathey's report that germination requires light and temperatures 60-85.

B. suffruticosa DS 3 y germ. 46% in 3rd w in 70D indicating considerable longevity in DS. However, B. hirta DS 3 y were dead.

B. tuber hybrida (Tuberous Begonias) requires light and germ. best 55-65 and less in 75-85 (Cathey).

Belamcanda (Iridaceae). B. chinensis DS 5 y were dead. The complexities of germination of fresh seeds are described in the 2nd Ed.

Berardia (Asteraceae). B. subacaulis germ. 3/4 in 1-3 w in 70D when fresh. Seeds DS 1 y were dead indicating a half life of about 6 m.

Berlandiera (Asteraceae). B. lyrata germ. 80% on 3rd d in either 70D or 70L.

Berzelia (Bruniaceae).

B. galpinii germ. 70L(2/10 in 8th w), 70D(none), and 40-70D(2/9 in 2nd w). The ungerm. seeds appeared to be empty seed coats. The sample in 70D could have been all empty seed coats. The tentative conclusion is that the seeds germ. in 70D or 70L.

B. lanuginosa seeds were several years old. They germ. 70L(2/33)

B. rubra seeds were several years old. They germ. 70L(3/11 in 4th w) and 70 GA-3(3/3 in 4th w).

Beschorneria (Agavaceae). B. yuccoides (JS) germ. 70D(1/11 in 10 d) and 40(6/7 in 18 d).

Beta (Chenopodiaceae). B. vulgare germ. in 3-5 d at 70 (HC).

Bidens (Asteraceae). B. ferrucaefolia germ. 70D(65% in 2nd w). After 1 y DS it germ. 25% in 2nd w indicating a half life of a y.

Billardiera (Pittosporaceae). Both species germ. only with GA-3 but in different patterns.

B. longiflora germ. 70 (GA-3)-40(100% in 3-6 w), 70D-40-70D(2/26), and 70L-40(1/15). Seeds still germ. 70-(GA-3)-40 after a year of althernating cycles. A second sample all rotted. A third sample was received a few weeks after collection and germ. 40(2/56 in 8-12 w))-70D(1/56 on 7th d) and none in 70D, 70L, 70 GA-3, or 40 GA-3.

B. longiflora fructoalba germ. 70 GA-3(3/4 in 4th w) and none in 70D-40-70D or 70L-40-70D.

Bolboschoenus (Cyperaceae). Both species germ. only in 40-70L and none in 70D, 70L, 70 GA-3, or OS.

B. caldwellii germ. 40-70L(55% in 2-9 w)-40-70L(45% in 2nd w), 70L-40-70L(95% in 2nd w), 70D-40-70L(76% in 1-3 w), and 40-70D-40-70L(92% in 1-3 w). These patterns show that germination in 70L requires a prior 3 m at 40. Other prior treatments such as GA-3 had no effect.

B. fluviatilis germ 40-70L(3% in 3rd w), 70L-40-70L(6% in 2nd w), and 40-70D-40-70L(1%). The pattern seems to be the same as B. caldwellii. Seeds DS 3 y germ. 70L(2/112) and 70D(none).

Bomarea (Alstroemeriaceae). Extended germination had already been reported. The data is now more complete. Seeds DS 3 y germ. 70D-40-70D-40-70D(14% in 1-4 w)-40-70D(30% in 4-8 w)-40-70D-40-70D(30% in 3-9 w)-40-70D(14% in 3-5 w)-40-70D(10% in 4th w) and 40-70D-40-70D-40-70D(25% in 4th w)-40-70D-40-70D(20% in 5th w).

Boronia (Rutaceae). B. ledifolia and B. megastigma seeds that had been DS several years rotted and were dead.

Boykinia (Saxifragaceae). B. aconitifolia germ. 70D(none), 70L(96% in 2-12 w), 70 GA-3(40% in 2-4 w), 40-70D(30% in 2nd w), 40-70L(40% in 4th w), and OT(60% in March-May). Seeds DS 1 y germ. 70L(5% in 4th w) and 70D(none) showing that nearly all had died.

Brachiaria (Poaceae). B. dictyoneura seeds had an interesting behavior on DS. The length of DS and the germination in 70D were fresh seed (6% in 5-9 w), 6 m DS (36% in 4-12 d), 1 y DS (36% on 5th d), 2 y DS (44% in 3-5 d), and 3 y (64% on 5th d). Note that the percent germination continuously increased over 3 y of DS, and the rate of germination increased dramatically over the first year of DS. Fresh seeds and seeds DS 6 m had given higher germinations in OS and 70 GA-3 treatment (1st Suppl.). The germination in 70 GA-3 for seeds DS 0, 6 m, and 1 y were 28%(3rd w), 68%(3rd w) and 46%(5-9 d).

Brachycome (Asteraceae). B. iberidiflia germ. in 2-3 d in 70D.

Brodiaea (Liliaceae). B. laxa DS 3 y germ. 40(5/11 in 8-12 w)-70D(1/11) and 70D-40(7/10 in 4-8 w) indicating a half life in DS of over 3 y.

Broussonetia (Moraceae). B. papyrifera seeds DS 2 y were dead. The germination of fresh seeds and seeds DS 1 y were reported in the 1st Supplement.

Browallia (Solanaceae). A hybrid named Blue Bells germ. the same at 55-85 but dropped below 10% at 50. Another hybrid named Sapphire required light and temperatures 55-85 (HC). How many species require light ?

Brugmansia (Solanaceae). B. suaveolens germ. 70L-40-70L(3/6 in 2-4 w)-40-70L(3/6 on 8th d) and 70D-40-70D-40-70L(7/7 on 8th d). None germ. in dark.

Brunia (Bruniaceae). B. laevis and B. stokei seeds that had been DS several years all rotted.

Buddleia (Loganiaceae). B. globosa germ. 100% in 2nd w in 70D or 70L.

Bulbine (Liliaceae). The four species studied germ. at 70 in either light or dark. Germination was a bit slower in 70D, particularly with B. annua, but this may have been simply the result of a slightly higher temperature in the light. A sample of B. glauca was all dead. All samples had been DS about 6 m.

B. annua germ. 70D(100% in 3rd w) and 70L(100% on 4th d).

B. bulbosa germ. 70D(100% in 6-8 d) and 70L(100% on 4th d).

B. caulescens germ 70D(100% on 6th d) and 70L(100% on 4th d).

B. frutescens germ. 70D(100% on 6th d) and 70L(100% on 4th d).

B. glauca seeds rotted

B. semibarbata seeds DS 1 y germ. 100% in 2nd w in 70D.

Bupleurum (Apiaceae). The three species were received in Feb. and presumably had been DS about 6 m. An additional 1 y of DS at 70 was fatal for B. longifolium and B. ranunculoides. B. rotundifolium was little changed after an additional 1 y of DS at 70 but was dead after an additional 2 y of DS. A sample of B. falcatum DS 6 y was dead. All of this indicates that seeds of Bupleurum do not remain viable for more than six months to a year or so of dry storage.

B. longifolium germ. 70D-40(12% in 11th w)-70D(4%)-40(28% in 9th w)-70D(8%). Light had little effect.

B. ranunculoides germ. 70D(56% in 3-8 w) and 40-70D(21% in 1-6 w). Light blocked the germination at 70.

B. rotundifolium germ. 40(92% in 4th w) and 70D(12% in 2nd w)-40(40% in 4th w). OT treatment was essentially equivalent to the germination at 40. A second sample germ. 40(90% in 4th w) and 70D(77% in 1-3 w).

Butia (Palmaceae). B. capitata failed to germinate after 14 m of alternating 3 m cycles starting at either 40 or 70. Perhaps it should have been left at 70.

Caesalpinia (Fabaceae). A second commercial sample of C. pulcherrima also rotted suggesting that seeds of this species may have a short half life.

Cajophora (Loasaceae). C. acuminata seeds DS 1 y were dead indicating a half life of about 6 m. The data for germination of fresh seeds is in the 1st Suppl.

Calandrinia (Portulacaceae). P. acutisepala and C. casepitosa were empty seed coats.

Calceolaria (Scrophulariaceae). C. annual hybrids germ. the same from 55-75 but germination dropped to zero at 50 and 80-85 (HC).

Callistemon (Myrtaceae). C. speciosus sample consisted of two kinds of seeds as explained in the 1st Suppl. Both germ. 50-70% in the 2nd w in 70D, and this was unchanged for both types of seeds after 4 y of DS.

Callistephus (Asteraceae). C. chinensis (Annual Aster) germ. the same from 50-85 (HC).

Callitris (Pinaceae). C. canescens germ. 70D-40(1/4 in 5th w, rest rotted). JH had reported that it germ. in 1-14 w at 70 (1st Suppl.).

Calycocarpum (Menispermaceae). C. lyoni data is now more complete. Seeds germ. 40-70D-40(2/2 in 3rd w), 70D-40-70D-40-70D(4/7 in 3rd w). Germination was counted when the radicle began to develop. The seeds expand and split earlier. The radicle takes about a month to develop to a length of 2 cm. after which it is another month before a shoot and leaves start to develop. Light or GA-3 did not initiate germination.

Calydorea (Iridaceae). Except for C. pallens there is a general pattern of light blocking germination. C. pallens needs to be reinvestigated. All seeds had been DS 6 m unless otherwise noted.

C. amabilis germ. 70D(1/3 in 5th w) and 70L(0/5). The ungerm. seeds rotted.

C. nuda germ. 70D(60% in 4-8 w)-40(7% in 12th w)-70 and 70L(12% in 8th w). When the sample in 70L was shifted to 70D after 9 w, 76% germ. in 2nd w making a total of 88% germ.

C. pallens germ. 70L(6/6 in 3rd w) and 70D-40-70D(1/6 in 2nd w). This latter sample was then shifted to 70L whereupon the remaining 5 germ. in the 2nd w.

C. speciosa germ. 70D(54% in 4-11 w)-40(15% in 8th w)-70D(15% on 3rd d), 70L(none), 40-70D(45% in 2nd w), and 40-70L(4%)-40(7%)-70D(35% in 2-7 d). When the sample in 70L was shifted to 70D after 9 w, 83% germ. in 6-10 d, and 11% more germ. after 3 m in 70D and a shift to 40.

C. xiphioides germ. 70L-40(80% in 8th w) and 70D-40-70D(5/7 in 3-11 d). The two results are not as disparate as might seem since germination of the seeds in 70D-40-70D was incipient after the 3 m at 40. Nevertheless there does appear to be another example of a delayed light effect. Seeds DS 1 y germ. 70L-40(22% in 2nd w)-70L(12% on 4th d) and 70D-40(none) confirming the delayed light effect.

Campanula (Campanulaceae).

C. annuals germ. the same from 55-85 but dropped to 10% at 50 (HC).

C. carpatica alba seeds DS 1 y germ 70D(100% on 5th d) the same as fresh seeds

C. incurva (JS) germ. 70L(100% in 4 w) and 70D(none).

C. latifolia germ. 70D(95% in 5-12 d). Neither light nor a prior 3 m at 40 had much effect. Seeds DS 1 y were dead.

C. latifolia alba gave only a single germination in a sample of 100 seeds even though the seeds appeared to be normal in size and shape and were collected at the same time as C. latifolia.

C. pyramidalis germ. 100% in 70D if fresh (2nd Ed.). Seeds DS 5 y were dead. Unfortunately the seeds were not tested at intermediate DS times.

C. shetleri germ. 40-70D(2/5 in 2nd w), 70D-40-70D(none), 70L-40-70L(1/8 on 4th d), and OT(6/9 in late March through April).

C. thrysoides DS 4 y were dead.

Capsicum (Solanaceae).

C. annuum seeds DS 3 y germ. 70D(90% in 4th w). In the 1st Suppl. it had been reported that seeds DS 1 y germ. only 29%. The problem is that many of the seed coats are empty, and these are not readily distinguished from viable seeds. The final conclusion to date is that the seeds show no signs of dying in up to 3 y of DS.

C. frutescens seeds of the green, red, and yellow forms had all germ. 100% in 9-11 d after removal from the fruit and WC. After DS 1 y the red form still germ. 100%, but germination of the yellow form had dropped to 30% and seeds of the green form were dead. After 2 y DS germination of the red form had dropped to 5% and germination of the yellow form had dropped to 15%.

Cardiocrinum (Liliaceae). C. cordatum glehnii germ. only at 40 and in long extended patterns. The data were 40-70D-40-70D-40-70D-40-70D-40(5/17 in 10-12 w)-70D-40-70D-40(8/17 in 10-12 w). The cotyledon developed on shifting to 70. This long extended germination is similar to that found for C. giganteum (2nd Ed.). Seeds started at 70 ultimately rotted.

Carex (Cyperaceae).

C. arenaria germ. 70L(100% in 1-5 w) for fresh seed. Seeds DS 4 y germ. 70L(51% in 1-6 w) and 70D(1%) indicating a half life of 4 y and retention of the light requirement.

C. comans germ. 70L(85-100% in 2-5 w) using fresh seeds or seeds DS up to 2 y. Seeds DS 4 y germ. 70L(60% in 2-4 w) and 70D(none) indicating a half life of 4 y and retention of the light requirement..

C. grayi germ. 70L(50% in 2-14 w) using fresh seeds or seeds DS 2 y. Seeds DS 4 y germ. 70L(1/16 in 4th w) and 70D(none).

C. lurida germ. only in light. Seeds germ. 90% in 2nd w in 70L if the husks were removed. Germination is slower if the husks are not removed. Germination was unchanged after 1 y or 2 y of DS, but seeds DS 4 y germ. 70L(1/10) and 70D(1/17) indicating a half life of about 3 y. If the 70L treatment is preceded by a 70D-40 cycle, germination is reduced to around 20%.

C. pendula germ. 70L(100% in 2-4 w) using fresh seeds or seeds DS 2 y. Seeds DS 4 y germ. 70L(95% in 3-5 w). This indicates a half life of over 4 y with no disappearance of the light requirement.

C. retrorsa germ. 70L(3%)-40-70L(3%) and none in 70D. Seeds DS 2 y failed to germinate, but this may not be significant in view of the very low germination.

C. secta DS 7 y germ. were dead.

Carica (Caricaceae). C. papaya seeds DS 4 y and 5 y germ. 70L(40% in 3rd w) and 70D(none) similar to seeds DS 0-2 y so that there is no sign of dying as yet. None germ. in 70D showing that the light requirement was unchanged.

Carpentaria (Saxifragaceae). C. californica requires light, GA-3, or a prior 3 m at 40 and does not germ. in 70D. The data were 70L(100% in 9-17 d), 70 GA-3(100% on 9th d), 40-70L(100% in 5-8 d), and 40-70D(100% in 3-11 d). When the sample in 70D was shifted to 70L after 4 w, 100% germ. in 4-10 d. The light requirement was still present after DS 1 y or 2 y, and these seeds germ. the same as fresh seeds in 70L.

Carum (Apiaceae). C. caryi germ. 70D(24% in 1-7 w), 70L(70% in 2nd w), 70 GA-3(36% in 3rd w), 40(33% in 7th w)-70D(17% on 4th d). Light was beneficial, but the effect of light needs to be studied as a function of time of DS. Seeds DS 1 y were dead.

Catalpa (Bignoniaceae). C. bignonioides seeds DS 4 y germ. 70D(2/12 in 2nd w) and 70L(7/9 in 3rd w). The light requirement is still largely present although it appears to be slowly disappearing in accord with data in the 2nd Ed.

Caulophyllum (Berberidaceae). C. thalictroides has failed to germinate under all conditions including treatment with GA-3, GA-4, GA-7, and iso GA-7.

Celosia (Amaranthaceae). C. argentea germ in 2-4 d at 70. Cathey found germination the same from 60-85 but below 10% at 50-55.

Centaurium (Gentianaceae). C. muhlenbergii seeds DS 5 y germ. 5% in 70D compared to 80% for seeds DS 0-2 y. The half life in DS is about 4 y.

Cerastium (Caryophyllaceae).

C. bossieri DS 4 y germ. 23% in 2nd w in 70D indicating a half-life in DS of 3-4 y.

C. fontanum seeds DS 3 y were dead.

Cephelaria (Dipsacaceae). C. gigantea DS 4 y were dead. A sample of C. leucantha DS 6 m germ. under several conditions (2nd Ed.).

Cercocarpus (Rosaceae). The data on C. intricatus is now more complete. Seeds germ. 40(81% in 1-3 w)-70D(15% in 2 d-2 w) and 70D(12% in 2nd w)-40(52% in 5-9 w). Seeds DS 1 y germ. 70D(17% in 10-12 w)-40(40% in 8th w). Seeds DS 2 y germ. 70D(3/19 in 7-12 w).

Cerinthe (Boraginaceae). C. major data is now more complete. Seeds germ. 70 GA-3(100% in 2nd w), 70L(3/7 in 2nd w), and 70D(5/12 in 2nd w). The promoting effect of GA-3 is real because when the sample in 70L was shifted to 70 GA-3 after 3 m, 3 of the remaining 4 germ. in 3-9 d, and a sample subjected to 40-70D treatment failed to germinate a single seed but when treated with GA-3, 80% germ. in 2-4 w.

Chaenomeles (Rosaceae). C. sinensis germ. 40(100% in 10th w) and 70D(10%)-40(70% in 9th w) for seeds WC either one d or 7 d.

Chaerophyllum (Apiaceae). C. hirsutum failed to germinate in 70D or 70L.

Chamaebatia (Rosaceae). C. millefolium germ. 100% in 4-8 d in either 70D or 70L when fresh but seeds DS 2 y were dead.

Chamaecytisus (Fabaceae). C. austriacus seeds DS 5 y germ. 70D(100% in 2-5 d) but only if punctured. This is the same as fresh seeds, and there is no sign of dying. The reduction in percent germination from 28% to 15% to zero that occurred in the controls (unpunctured seeds) on DS from zero to 3 y to 5 y can be attributed to a gradual hardening of the seed coat which made it more impervious.

Chamaedaphne (Ericaceae). C. calyculata germ. 70L(16% in 9-17 d) and none in 70D. Seeds DS 6 m and 1 y germ. 70L(10% in 4th w) and 70L(4% in 4th w) respectively and none in 70D indicating a half life of about 6 m.

Chamaespartium (Fabaceae). C. sagitate germ. 70D(1/4 in 3rd w). The other three seeds rotted.

Chamaelirium (Liliaceae). C. luteum germ. 60-70% in 3-6 w in 70D. Neither light, GA-3, nor a prior 3 m at 40 had any effect. Seeds DS 1 y were dead.

Chasmanthe (Iridaceae). C. floribunda germ. 70D-40(1/5 in 3rd w)-70D.

Chenopodium (Chenopodicaceae).

C. bonus DS 3 y germ. 70L(50% in 2nd w) and 70D(10% in 2nd w) indicating a half life in DS of 3 y. Percent germination dropped to 2% for seeds DS 4 y.

C. (Bitium) virgatum seeds DS 2 y germ. 70D(43% in 2-4 w), 70L(92% in 5-9 d), 70 GA-3(22% on 7th d), 40(19% in 6-12 w)-70D(43% in 2-30 d), and OS(91% in 3rd w). It also germ. 85% in 2nd w when placed outdoors October 1 which is in essence a verification of the OS result.

C. vulvularia had a half life in DS of 18 m. In accord with this seeds DS 3 y were dead.

Cheiranthus (Brassicaceae). C. cheiri germ. the same from 50-85 (HC).

Chiliotrichum (Asteraceae). The C. amelloides sample was chaff.

Chimonanthus (Calycanthaceae). C. praecox germination is described in the 1st Suppl. Seeds that had hung on the tree 1 y were 25% dead and seeds DS 3 y were completely dead indicating a half life of 1-2 y.

Chionochloa (Poaceae). The C. rubra sample was chaff.

Chrysanthemum (Asteraceae). C. cinerarifolium (Feverfew) germ. best at 55-80 and near zero at 50 and 85 (HC).

Cissus (Vitaceae). C. striata germ. 70D-40-70D(1/20 in 2nd w, 11/20 rotted). The seeds in 70L and 40 all rotted and this coupled with those rotting in 70D suggests that the seeds had largely died before receiving them.

Citrofortunella (Rutaceae). C. mitis seeds WC germ. 60% in 2-5 w with germination being faster in 70L than 70D presumably due to the added heat. Seeds DS 6 m were dead.

Citrullus (Cucurbitaceae). C. vulgaris seeds DS 3 y germ. 70(90% in 3-7 d) which is virtually the same as the 100% germination of seeds DS 6 m (recall that fresh seeds germ. only in light, First Suppl.).

Cladastris (Fabaceae). C. lutea seeds have an impervious seed coat and germ. immediately if the seed coats were punctured (2nd Ed.). after 5 y DS the seeds were nearly all dead (1st Suppl.) and after DS 6 y all were dead.

Cladothamnus (Ericaceae). C. pyroliflorus required light and germ. 100% in 3-6 d in 70L and none in 70D. When the sample in 70D was shifted to 70L after 9 w, 100% germ. the 3rd w. Seeds DS 1 y rotted and were dead.

Clarkia (Onagraceae). C. elegans germ. the same from 50-85 (HC).

Clematis (Ranunculaceae). C. coactilis germ. 70D(1/5 in 11th w)-40-70D(1/5 in 11th w), 70L(1/4 in 10th w), and 70 GA-3(all 4 rotted). The cotyledons opened a month after germination.

Clianthus (Fabaceae).

C. formosus seeds DS 1 y germ. the same as fresh seed, 100% in 70D on 3rd d if punctured and 15% on 3rd d in control (1st Suppl.). Seeds DS 2 y were largely dead and germ. only 10% (punctured seeds) indicating a half life of 1.5 y.

C. puniceus DS 3 y germ. 100% on 2nd in 70D if punctured and none if not.

Clitoria (Fabaceae). C. ternata had germ. 100% in 70D for punctured seeds and 75% for unpunctured seeds. After DS 1 y germination dropped to 2/7 in 2nd w for punctured seeds indicating a half-life of about 6 m.

Clivia (Amaryllidaceae). C. miniata germ. 4/4 on 6th d in 70D. In fact germination was already starting in the green seed pod.

Cobaea (Polemoniaceae). C. scandens germ. in 5-12 d at 70, and Cathey found germination the same from 50-85.

Coccoloba (Polygonaceae). C. uvifera has failed to germinate in 70D even if the seed coat was punctured.

Cochlearia (Brassicaceae). C. officinalis seeds DS 2 y were dead.

Codonopsis (Campanulaceae). C. ovata seeds DS 3 y were dead.

Coffea (Rubiaceae). C. arabica has failed to germinate in 70D, 70L, and 40 after a year of alternating 3 m cycles.

Coleus (Lamiaceae).

C. frederici DS 3 y germ. 70L(100% in 6-8 d) and 70D(none).

C. plumosa germ. in 3-7 d at 70. Cathey found germination the same from 60-85 but zero at 50-55.

Collinsia (Scrophulariaceae). C. bicolor germ. 100% in 2-8 d in 70D and 81% in 3-8 w at 40. Light or GA-3 had no effect. Seeds DS 1 y germ. identically, but seeds DS 2 y germ. 70D(60% in 3-5 d) indicating a half life of 2 y.

Collomia (Polemoniaceae). C. cavanillesii (JS) germ. 40(6/6 in 18 d) and 70D-40(7/8 in 18 d). This is somewhat similar to the pattern found for C. grandiflora (2nd Ed. and 1st Suppl.). Two other species required GA-3 (2nd Ed.). A sample of C. involucrata DS 5 y failed to germinate at either 70D or 40.

Colutea (Fabaceae). Both species had impervious seed coats.

C. arborescens seeds DS 8 y germ. the same as fresh seed which was 100% in 3-5 d at 70D for punctured seed and none in the control.

C. hyb. media seeds DS 3 y or 5 y germ. 100% in 4-8 d at 70D if the seed coat is punctured and none if not.

Commelina (Commelinaceae). C. dianthifolia germ. in 3-5 d at 70D.

Conospermum (Proteaceae). C. taxifolium several years old rotted.

Convolvus (Convolvulaceae). C. tricolor seeds DS 1 y germ. 100% on 3rd d in 70D comparable to fresh seeds (1st Suppl.). Seeds DS 2 y germ. 70D(12% on 3rd d) indicating a half life of 1.5 y.

Coprosma (Rubiaceae). Light or GA-3 did not stimulate germination. Although the samples were very small, the consistency between all four species makes it fairly certain that all three have a 70-40-70 germination pattern.

C. acerosa germ. 70D-40-70D(1/17 in 3rd w).

C. atropurpurea germ. 70D-40-70D(2/3 on 4th d).

C. petriel germ. 70D-40-70D(1/2 on 4th d)-40-70D(1/2 on 8th d).

C. rhamnoides germ. 70D-40-70D(1/3 on 4th d)-40-70D(2/3 in 2nd w).

Cordyline (Liliaceae). C. pumilio seeds DS 1 y germ. 70L(2/4 in 4th w) and none in 70D or 40-70D. The sample was small and there were many empty seed coats so that the results need confirmation.

Cornus (Cornaceae).

C. canadensis required GA-3 for germination and none germ. in other treatments even after 4 y of DS. Germination in 70 GA-3 was 100% in 3-17 w (fresh seeds), 65% in 2-5 w (seeds DS 1 y), 60% in 3-5 w (seeds DS 2 y), and 22% (seeds Ds 4 y). The seeds were WC for 7 d before storage or any treatment. Storing seeds in the dried berries had no advantage over storing seeds in the WC state.

C. florida has been reinvestigated and germ. 70D(2%)-40-70D(18% on 4th d) and 40-70D(52% in 2-8 w) which is similar to that found before (2nd Ed.). The same seeds DS 1 y failed to germinate and were dead.

C. mas germ. 70(GA-3)-40(4/6 in 9th w), however the seedlings all rotted. It also germ. 2/10 in March 1997 after being placed in OT in October 1995. There is no germination as yet after 2 y in in 3 m alternating cycles starting at either 40 or 70.

Corokia (Cornaceae). C. cotoneaster has failed to germinate.

Correa (Rutaceae).

C. aquae-gelidae all rotted in 70D, 70L, or 70 GA-3.

C. cordifolia failed to germinate in 70D.

Corydalis (Fumariaceae).

C. sempervirens germ. 70L(1/9 in 2nd w), 70D(0/8), and 40-70D(2/10 in 2-8 d). Seeds DS 6 m germ. 70D(20% in 3-6 w). Seeds DS 1 y were dead.

Corylus (Betulaceae). C. avellana DS 1 y germ. 70D(2/5 in 4th w) which was about the same percentage as fresh seeds, but these DS seeds germ. directly at 70 and did not need a prior 3 m at 40. Seeds were dead after DS 2 y at 40 or 70.

Cosmos (Asteraceae). C. bipinnatus DS 1 y germ. 70D(50% in 2nd w). HC reported that germination was the same from 50-80 but dropped to about half at 85.

Costus (Zingiberaceae). C. guanaiensis germ. 1/25 in 9th w in 70D and 1/25 in 5th w in 70L. After 1 y DS none germ.

Cotoneaster (Rosaceae). The germination of C. microphyllus was described in the 1st Suppl. for both fresh seeds and seeds DS 2 y. Seeds DS 3 y germ. 70D(2/22)-40-70D(1/22 in 2nd w) and 40-70D(4/19 in 5-8 w). Seeds of C. integerrimus (DS 6 y), C. sp. (DS 3 y), and C. zagelii (DS 3 y) failed to germinate.

Crambe (Brassicaceae). C. cordifolia germ. 40-70D(2/5 in 2nd w), 70L(1/2 in 4th d), and 70D(0/2). Seeds DS 1 y germ. 70D(1/5 in 4th w), 70L(1/5 in 2nd w), and 40(1/5 in 3rd w) indicating no significant dying. Seeds DS 2 y (2 seeds) failed to germinate and appear dead.

Croton (Euphorbiaceae). C. alabamensis has failed to germinate in 70D even if the seed coat was punctured.

Cryptantha (Boraginaceae). C. paradoxa germ. 70D(100% in 1-7 w) for fresh seed and 70D(85% in 2-6 w) for seeds DS 1 y. Seeds DS 2 y were dead.

Cryptotaenia (Apiaceae). C. japonica atropurpurea seeds DS 6 m germ. 70D-40-70D-40-70D(3/5 on 4th d).

Cucumis (Cucurbitaceae). The following forms of C. melo germ. 100% in 2-5 d the same as fresh seeds: netted DS 1 y or 2 y, smooth orange DS 1 y, big yellow honeydew DS 1 y, and honeydew DS 2 y. A sample of the Casaba form still germ. 100% in 4-6 d at 70 after 3 y of DS, but after 5 y the percent germination dropped to 26% indicating a half life 4 y.

Cucurbita (Cucurbitaceae).

C. melo (horned melon) germ. 100% in 2-4 d in 70D for either fresh seeds or seeds DS 2 y. Seeds DS 3 y were dead.

C. maxima (acorn squash) had DS cause disappearance of the light requirement (1st Suppl.). After 3 y of DS dying was evident and the percent germination dropped to 30% and after 5 y of DS the seeds were dead.

C. maxima (butternut squash) DS 2 y germ. 70% in 2-5 d in 70D.

C. pepo (pumpkin) DS 1 y germ. 100% in 2-4 d in either 70D or 70L unlike fresh seeds that germ. only in 70L (1st Suppl.).

Cuphea (Lythraceae).

C. ignea germ. the same from 55-85 but zero at 50 (HC).

C. llavea germ. 40-70D-40-70D(6/6 in 3rd w) and 70D-40-70D40-70D(none).

Cyathodes (Epacridaceae). C. empetrifolia germ. 1/5 at 70 after 2 y of alternating 3 m at 70 and 3 m at 40. C. robusta has failed to germinate. Light or GA-3 was not tried on the small samples.

Cymbalaria (Scrophulariaceae). C. muralis required light and germ. 100% in 3-10 w in 70L and none in 70D or 40-70D. When the sample in 70D was shifted to 70L after 12 w only 3% germ. Seeds DS 1 y were dead.

Cymopteris (Apiaceae). C. aboriginism data is now more complete. Seeds germ. 70D-40(2/5 in 8th w) and 40(1/8)-70D-40(2/5 in 8th w).

Cynanchum (Asclepediaceae). C. acutum germ. 70D(3/7 in 2nd w)-40-70D(1/7 on 2nd d) and 70L(4/5 in 2nd w).

Cynoglossum (Boraginaceae). C. amabile germ. the same from 50-85 (HC).

Cyperus (Cyperaceae).

C. alternifolium DS 6 y germ. 70L(100% in 2nd w) and 70D(none).

C. papyrus still germ. 100% in 70L after 4 y of DS, but the rate slowed slightly so that germination occured in 9-18 d instead of 5-7 d. Another sample DS 3 y germ. 100% in 70L in 4-6 d and none in 70D.

Cyrtanthus (Amaryllidaceae). C. parviflorus has failed to germinate in 70D or 70L.

Cythomandra (Solanaceae). Fresh seeds WC of C. betacea required light or GA-3 to germinate (1st Suppl.). Seeds DS 2 or 3 y still required light to germinate and showed little signs of dying.

Dahlia (Asteraceae). Dwarf hybrids germ. the same from 50-85 (HC).

Darlingtonia (Sarraceniaceae). D. californica germ. 70D-40-70D(100% in 3rd w). Light had no effect.

Darwinia (Myrtaceae). D. citriodora several years old rotted.

Datura (Solanaceae).

D. metaloides germ. 70D(5/11 in 2nd w)-40-70D(4/11 on 3rd d). Light had no effect. This data is more complete than that in the 1st Suppl.

D. sp. (Andros Is.) seeds DS 2 y germ. 70L(2/20) and 70D(1/28) which is not significantly different from fresh seeds (1st Suppl.).

Daucus (Apiaceae). D. carota (carrot) germ. in 4-8 d at 70D (HC).

Davidia (Nyssaceae). D. involucrata continues to give an occasional germination after 3 y of alternating cycles.

Decaisnea (Lardizabalaceae). A second sample of D. fargesii failed to germinate suggesting that DS may not be tolerated.

Delonix (Fabaceae). D. regia seeds DS 1 y or 2 y germ. 3/3 on 6th d in 70D if punctured and 0/2 if not. This is similar to fresh seed.

Delphinium (Ranunculaceae). D. grandiflorum (Larkspur) germ. in 5-7 d at 70D using fresh seeds. Seeds DS 1 y germ. 70D(75% in 1-3 w), and seeds DS 2 y germ. 70D(7% in 4th w). A sample of hybrid seed DS 3 y was dead.

Dendranthema (Asteraceae). D. arctica has failed to germinate in 70D-40-70D.

Dendrocalamus (Poaceae). These are bamboos. Temperatures of 40 either in OS treatment or as a prior 3 m at 40 were deleterious and largely fatal and GA-3 was also deleterious. Light had no significant effect.

D. asper germ. 70L(40% in 1-4 w) and 70D(26% in 1-3 w). Seeds DS 2 y were dead.

D. membranaceous germ. 70L(44% in 2nd w) and 70D(60% in 2nd w). Seeds DS 2 y were dead.

D. strictus germ. 70L(75% in 2nd w) and 70D(70% in 2nd w). Seeds DS 3 y germ. 25% indicating a half life of about 2 y. A series of experiments using five different conditions of DS is described in the section on seed storage. Germination was about the same as for fresh seed after DS for 6 and 13 months in all five storage conditions.

Desmodium (Fabaceae). D. canadense had an impervious seed coat and germ. 100% in 2nd w at 70D if the seed coat were punctured. There was no sign of dying after 2 y of DS, but after 4 y of DS germination dropped to 50%.

Dianella (Liliaceae). D. intermedia required light and exhibited an unusually long induction period. Seeds germ. 70L(40% in 12-14 w)-40-70L(8%). Germination was not induced by GA-3, and prior periods in 70D or 40 were deleterious and caused germination to be delayed into the 4th and further cycles.

Dianthus (Caryophyllaceae).

D. barbatus germ. in 3-5 d in 70D.

D. carthusianorum germ. 70D(100% in 4-9 d) for fresh seeds and 70D(80% in 4-9 d) for seeds DS 1 y.

D. caryophyllus (Carnation) germ. best at 55-70 and less at 50 and 75-85 in one hybrid strain and best at 50-80 and lower at 85 in a second strain (HC).

D. chinensis germ. the same from 50-85 (HC).

D. gratianopolitanus germ. 70D(100% in 4-9 d) and 90% in 2-4 d after 1 y DS.

D. knappii germ. 100% on the 7th d in either 70D or 70L either fresh or DS 2 y.

D. spiculifolius DS 3 y germ. 70D(100% in 4-11 d).

Diascia (Scrophulariaceae). D. barberae germ. 100% on 4th d in either 70D or 70L. A prior 3 m at 40 was somewhat deleterious, 40-70D(50% in 2nd w). Seeds DS 1 y germ. 70D(5% in 3rd w) indicating a half life of about 6 m.

Dichelostemma (Liliaceae).

D. ida-maia seeds DS 3 y germ. 40(30% in 3rd w) which with the earlier results indicates a half life of 2 y in DS. Seeds DS 4 y germ. 40(1/8 in 8th w).

D. multiflorum DS 4 y germ. 40(6/10 in 11th w).

Dietes (Iridaceae).

D. grandiflora data is now more complete. Light is required for germination. Seeds germ. 70L(100% in 2-5 w), 70D(15%), 40-70D(7%), and 40-70L(40% in 2-4 w). When the sample in 70D was shifted to 70L, 70% germ. in the 4th w. Two other samples gave identical results. Seeds DS 1 y germ. 70L(80% in 1-7 w) and 70D(20% in 2-9 w), and seeds DS 2 y germ. 70L(6/7 in 5th w) and 70D(2/8 in 5th w) showing no significant dying or change in the light requirement.

D. indioides germ. 70L(2/2 in 7th w) and 70D(none).

Digitalis (Scrophulariaceae).

D. grandiflora germ. 70D(25% on 6th d) and 40-70D(26% in 3-8 d). Seeds DS 1 y were dead.

D. lutea germ. 70D(100% on 4th d) and 40-70D(100% in 3-6 d). Seeds DS 1 y were dead. Another sample DS 6 y was dead.

D. purpurea (Foxglove) germ. in 3-10 d at 70. Three samples were obtained that had been DS 4 y, 5 y, and 8 y. All germination was in the 2nd w in 70D. The respective percent germinations were 60%, 35%, and 5%. The gradual dying of the seeds is evident.

D. viridiflora germ. 70D(100% in 2-5 w) and 40-70D(100% on 3rd d). Seeds DS 1 y germ. 70D(84% in 3-5 d) showing a minor decline in percent germination, but a significant increase in the rate of germination.

Dimorphotheca (Asteraceae). D. aurantiaca germ. in 2nd w at 70. HC found that it germ. the same from 50-80 but germination dropped in half at 85.

Dioscorea (Dioscoreaceae). D. battatus germ. 70D(100% in 1-3 w).

Diospyros (Ebenaceae).

D. rhomboidalis germ. 100% in 3-6 w in either 70D or 70L. A prior 3 m at 40 or OS treatment had no effect. The seedlings produced a 4-6 inch radicle. At this point they rot off at the neck unless the seedling is planted with the neck in the air above the soil line. The latter send up a stem with leaves about a month after germination. The cotyledons do not develop.

D. virginiana germ. 40-70D(50-60%) from 1992 seed but only 40-70D(1/15) from 1995 seed. Seeds from 1993 germ. 100% in 3rd w in 70 GA-3 and seeds from 1995 germ. 50% in 4-6 w in 70 GA-3. Both of the latter required GA-3 for germination.

D. texana germ. 70D(50% in 5th w) (KR). Gibberellins increased this percentage to 83%.

Dipcadi (Liliaceae).

D. fulvum seeds DS 6 m germ. 100% in 4th d in 70D and in 8th d in 70L.

D. serotinum seeds DS 6 m germ. 100% in 4-10 d in 70D and in 8-10 d in 70L. A prior 3 m at 40 had no effect. Seeds DS 2 y germ. 12% showing that most had died.

D. viride DS 1 y germ. 70D(1/12) on 10th d.

Diplarrhena (Iridaceae). Light is required in both species.

D. latifolia germ. 70L(9/11 in 2-11 w)-40-70D(2/11 on 8th d) and 70D(1/9)-70L(none). A second sample all rotted.

D. moraea germ. 70L(100% in 8-16 w) and 70D(1/16). Seeds DS 1 y germ. 70D(2/14 in 3rd w) and 70L(2/12 in 8-10 w) indicating extensive dying of the seeds along with a disappearance of the light requirement.

Dipsacus (Dipsacaceae).

D. fullonum fresh or DS 2 or 4 y germ. 70L(100% on 7th d), 40-70L(100% in 2-6 d), and 70D(none). When the sample in 70D was shifted to 70L after 4 w, 100% germ. on the 6th d. A sample DS 4 y germ. 70L(50% in 2nd w) and 70D(2%).

D. pilosus DS 5 y was dead.

D. strigosus data is now more complete. Seeds germ. 70D-40-70D-40(30% in 11th w)-70D(35% in 2-5 d) and 40-70D-40-70D-40(38% in 4th w)-70D(16% in 2-4 d). Seeds DS 1 y germ. 70D-40(75% in 10-12 w) and 40(5%)-70D(20% on 3rd d). The 1 y DS treatment led to faster germination. Seeds DS 2 y germ. all rotted and were dead.

Dirca (Thymelaceae). D. palustris had germ. 2/2 after 7 alternating 3 m cycles and seeds of this sample held an additional year in DS rotted. A presumption was made that the seeds may have been old. This presumption was in error. Darrell Kromm informs me that the seed was fresh. His experiences are as follows. Seeds collected in summer are enclosed in a pale green berry which turns black within a day of collection. The seeds are WC and immediately sown. The best germination (20% at most) occurs if the seeds are kept at temperatures around 32 all winter after which germination occurs in spring. If the seeds are kept outdoors and experience much lower temperatures, they all rot. Even in wild stands seedlings are rare.

Discaria (Rhamnaceae). D. toumatou germ. 70D-40-70D(1/3 in 2nd w)-40-70D(2/3 on 4th d) and 70L(0/2).

Dodecatheon (Primulaceae). D. pulchellum germ. 70D(50%) and 40-70D(50%)(2nd Ed.). The sample studied by KR required GA-3 or GA-4 with CK for best germination (55% in 3rd w), and none germ. without gibberellins. The discrepancy is possibly due to the use of oscillating T (50-80) by KR. There is also a question of the identity of her commercial sample.

Dodonea (Sapindaceae). D. viscosa germ. 70D(5/8 in 2-10 w)-40-70DD(1/8in 11th w) and 40-70(1/3 on 3rd d). Light had no significant effect.

Doligloglottis (Asteraceae). D. schorzeneroides was all chaff.

Dorotheanus (Aizoaceae). Both species require GA-3 for germination. Addition of zeatin cytokinin, Bioform, and/or compost extracts reduced the percent germination from 40-60% to below 20% (KR).

D. bellidiformis germ. 5/10 with GA-3 (500 ppm), 6/10 with GA-4 (5 ppm), and 1/10 in the control. All germinations were in 3-8 d in 70D. The seedlings from GA-4 treatment seemed the healthiest (KR).

D. rourkei germ. 3/7 in 3-5 d in 70D with 500 ppm GA-3 and none in the control. Although GA-3 treatment is optimum, 2/7 germ. in the 4th d when treated with zeatin cytokinin alone (KR).

Draba (Brassicaceae). D. ventosa germ. 70L(3/30 in 9th w), 70D(none), and OT(30% in late March through April). All rotted in 70 GA-3. When the sample started in 70D was shifted to 70L after 70D-40-70D treatment, 5/15 germ. in 4-6 w.

Dracophyllum (Epacridaceae). D. uniflorum failed to germinate in 70D.

Dracunculus (Araceae).

D. canariensis data is more complete. Seeds germ. 100% in 2nd w in two separate samples.

D. vulgaris germ. 70D(1/6 in 11th w)-40(3/6 in 5th w)-70D-40-70D-40(1/6 in 8th w)-70D(1/6 on 2nd d).

Drosera (Droseraceae). D. capensis germ. 100% in 10-12 d in 70L and 70D(none) for seeds up to 2 y DS. Seeds DS 3 y and 4 y germ. 70L(50% in 4th w) and 70D(none). About half the seeds appeared to have died between 2 and 3 y DS, but it is difficult to get acccurate percent germinations with such small seeds. The slowing of the germination rate is accurate and is a more reliable indicator that there has been some deterioration in the seeds.

Drymophila (Liliaceae). D. cyanocarpa germ. 70D-40(1/3 in 11th w).

Dyosma (Berberidaceae). D. versipelle germ. 70 GA-3(90% in 4-7 w), 40(90% in 11-13 w), 70D-40(90% in 10-12 w), 70L-40(90% in 10-12 w). All rotted in OT presumably because the seeds could not survive the temperatures of -10 F which were experienced. The seedlings died of fungal infection if placed immediately in soils. However, if the seedlings were kept in the moist paper towels in light in polyethylene bags until the cotyledons completely developed, nearly all survived. Seeds DS 6 m were dead.

Edraianthus (Campanulaceae). E. pumilio germ. 70L(7/8 in 7-9 w) and 70D(none) confirming the light requirement found with an earlier sample (2nd Ed.). Seeds DS 1 y germ. 70L(9/9 in 2nd w) and 70D(none) showing no sign of dying or of disappearance of the light requirement.

Eleagnus (Eleagnaceae). E. angustifolia 70D(50% in 4th w) and 40-70D(50% in 3-5 d). Neither GA-3 nor OT had any favorable effect. Germination was more extended in seeds DS 1 y, and these germ. 70D-40-70D(40% in 2 d-8 w).

Eleocharas (Cyperaceae). E. sphacelata germ. 56% at a fairly constant rate from 4-20 w in 70L and none in any dark treatment including GA-3. Prior treatments such as GA-3, 70D-40, 70D-40-70D-40, and 3 m at 40 lowered the percent germination in 70L to 30-50% but light was always required. Seeds DS 2 y germ. 70L(18% in 1-6 w) and 70D(none) showing extensive dying and retention of the light requirement.

Embothrium (Proteaceae). A new sample of E. coccineum germ. 70L(2/6 in 5-9 w) and 70D(none). An earlier sample was empty seed coats.

Ennealophus (Campanulaceae). E. euryandus failed to germinate in 70D or 70L.

Ephedra (Ephedraceae). E. minima germ. 70D(100% in 3rd w) similar to the three other Ephedra studied earlier (2nd Ed.). The seeds were removed from the red berries and WC one day and started immediately. The berries may simply be protecting the seeds from moisture and/or oxygen.

Epilobium (Onagraceae).

E. angustifolium germ. in oscillating 50-70 (53% in 2nd w).

E. rigidum all rotted.

Eremophila (Myoporaceae). Paul Rezl has studied the germination of eighteen species. The seeds are enclosed in woody fruits. Germination does not take place unless the seeds are released from the impervious woody fruits. The ease of removal of the seeds ranges from very easy with E. eriocalyx where the fruit is relatively soft and corky to very difficult with E. longifolia where the fruit is very hard and woody. The released seeds germinated in 2-3 w at 70D. With E. maculata it also seemed necessary to peel off the testa.

In my work freshly collected seeds of eleven species all gave at least one germination in 70D. Seeds of seven other species were received after they had been DS for various times. Three of these gave no germination and two gave only a single germination in 70D. A further collection of seeds of E. aricantha, E. cuneifolia, E. laanii, and E. macdonaldii were received after DS for several years. The only germination was 1/6 in 6th w in 70L with E. cuneifolia. Storage life in DS seems limited.

Eremurus (Liliaceae). E. robustus DS 1 y germ. much the same as fresh seeds. Seeds DS 2 y were dead.

Erigeron (Asteraceae).

E. flabellifolius germ. 70D(4/19 in 4-7 w)-40(3/19 in 4th w)-70D(1/19 on 3rd d) and 40-70D(1/22 on 4th d).

E. flettii had germ. 100% in 70D for either fresh seed or seed DS 2 y, however seed DS 3 y was dead.

Erinus (Scrophulariaceae). E. alpinus alba germ. 70D(100% in 4-11 d) similar to E. alpinus. Seeds DS 1 y germ. 70D(25% in 1-6 w) indicating a half life of about 6 m. A sample DS 6 y germ. 70D(5% in 2nd w).

Eriogonum (Polygonaceae). E. bicolor had germ. 40(2/9 in 2-7 w)-70D(4/9 on 3rd d) and 70D(1/7, rest rotted). Seeds DS 1 y germ. 40(3/6 in 3rd w) and 70D(all rotted).

Eriostemon (Rutaceae). E. myoporoides several years old rotted.

Ermannia (Brassicaceae). E. papryoides DS 6 m germ. 70D(2/5 in 3-5 w)-40-70D(1/5 in 4th w) and 70L(2/2 in 3rd w). Seeds DS 1 y all rotted and were dead. It is possible that half of the seeds DS 6 m had died.

Eryngium (Apiaceae). The placing of this genus in Fabaceae in the 2nd Ed. was a typographical error. E. agavifolium DS 3 y and 4 y were dead. E. planum DS 6 y was dead.

Eschscholzia (Papaveraceae). E. californica germ. in 3-7 d in 70D.

Euceliopsis (Asteraceae). E. covellei DS 1 y germ. 100% in 2-3 d in 70D which is better than fresh seeds which germ. only 3/9 in 2nd w (1st Suppl.). Seeds DS 2 y germ. only 1/4 indicating significant dying.

Eucomis (Liliaceae).

E. bicolor germ. 100% in 3rd w in 70D and in 3-7 w in 70L.

E. pole-evansii DS 1 y or 2 y germ. 70D(7/7 in 4th w).

E. zambesiaca DS 1 y or 2 y germ. 70D(8/8 in 3-5 w).

Eucryphia (Eucryphiaceae). E. glutinosa DS 3 y and 4 y were dead.

Euonymus (Celastraceae).

E. phellomanus germ. 70D-40-70D(1/8 in 2nd w) and 40-70D-40(1/8 in 11th w)-70D-40(1/8 in 10th w). The seedlings rotted suggesting that the seeds had deteriorated in the unknown duration of DS. GA-3 did not initiate germination.

Euphorbia (Euphorbiaceae).

E. myrsinites germ. only in 70 GA-3(100% in 2-4 w) and none in 70D or 70L. Seeds DS 1 y germ. 70D(4/6 on 5th d) and 70 GA-3(3/6 in 4-6 d) indicating that half the seeds had died and the GA-3 requirement had disappeared. Seeds DS 2 y were dead.

E. pulcherrima germ. the same from 50-85 (HC).

E. wulfenii germ. 70D-40-70D(3/3 on 2nd d) and none in 70L or 70 GA-3.

Exacum (Gentianaceae). E. affine required light and temp. 60-80 (HC).

Exocarpos (Santalaceae). E. sparteus seeds DS several years germ. 70 GA-3-40(2/8 in 4th w) and 40-70 GA-3(1/10 in 8th w). All ultimately rotted in the other treatments.

Fedia (Valerianaceae). F. cornucopia germ. 1/1 on 17th d in 70D. A second sample was empty seed coats.

Ferraria (Iridaceae). F. crispa germ. 70D(5/7 in 3-12 w) and 70L(0/7). Seeds DS 1 y germ. 70D(7/8 in 3-6 w). Seeds DS 2 y germ. 70D(2/5 in 6th w).

Ficus (Moraceae). F. carica fresh and WC had germ. 70L(40% in 3-7 w). Seeds DS 2 y germ. 70L(25% in 4-8 w).

Foeniculum (Apiaceae). F. vulgare DS 4 y germ. 70L(9% in 3rd w) and 70D(1%). The light requirement is still present (1st Suppl.), but the percent germination is much reduced.

Forskohlea (Urticaceae). The complexities of the germination pattern of F. angustifolia were described in the 1st Suppl. Seeds DS 3 y still germ. 100%, but seeds DS 5 y were dead.

Forstera (Stylidaceae). F. bidwillii were empty seed coats.

Fortunella (Rutaceae). The expts. reported in the 1st Suppl. have now been carried further. Seeds germ. 90% in 2-4 w in 70D whether rinsed or WC 7 d.

Francoa (Saxifragaceae). In the three species studied GA-3 or a prior 3 m at 40 were deleterious.

F. appendiculata DS 6 m germ. 70D(91% in 3-11 w), 70L(5% in 4th w), and 40-70D(15% in 2nd w). Seeds DS 1 y all rotted and were dead.

F. ramosa DS 1 y rotted and were dead.

F. sonchifolia DS 6 m germ. 70D(100% in 3-5 w), 70L(15% in 4th w), and 40-70D(17% in 4-6 d). Seeds DS 1 y rotted and were dead.

F. sp. DS 6 m germ. 100% in 10-14 d in either 70D or 70L and 40-70D(11% in 4-6 d).

Franklinia (Theaceae). F. alatahama DS 1 y germ. 70L(1/11 in 2nd w) and 70D(none) indicating that the light requirement (1st Suppl.) was probably still present.

Fraxinus (Oleaceae). Data on the three following species is now nearly complete.

F. americana DS 2 y or 3 y germ. 50% in 1-4 in 70D or 70L showing that the promoting effect of light had disappeared and there was some dying.

F. anomala germ. 70D-40(36% in 8-12 w)-70D(57% in 3-12 d) and 40-70D(20% on 3rd d)-40(50% in 6-11 w)-70D(10%). Seeds DS 1 y germ. 40(1/7)-70D(1/7)-40(4/7) and 70D-40(4/5 in 11th w)-70D(1/5 on 3rd d) which is similar to the fresh seeds. Seeds DS 2 y germ. 40(4/9 in 10-12 w)-70D(2/9 in 2nd w).

F. cuspidata (KR) germ. 71% in 11-17 d if the temperature oscillated between 50 and 70 each day. GA treatments increased the percent germination to 100%.

F. quadrangulata DS 18 m germ. 70D-40-70D-40-70D-40(23% in 4-12 w)-70D(23% in 2 d-7 w)-40(17% in 12th w)-70D(47% in 1-3 d) and 40-70D-40-70D-40-70D-40-70D-40(3/6 in 12th w)-70D(3/6 in 3rd d). Light had no significant effect and GA-3 led to total rotting. Seeds DS 4 y were dead. It would have been of interest to study fresh seeds.

Freesia (Iridaceae). F. hyb. germ. at 55-65 and near zero at 50 or 70-85 (HC).

Fritillaria (Liliaceae). F. imperialis germ. better when DS 1 y relative to fresh seeds (1st Suppl.), but seeds DS 2 y and seeds of a separate sample DS 5 y were dead.

Gahnia (Cyperaceae). Both species had an absolute light requirement. Both samples were kept in 70L for longer than the usual 3 m because germination was continuing. Any treatment prior to placing in 70L either had no effect or was deleterious.

G. clarkei germ. 70L(99% in 3-18 w). A prior 3 m at 40, 70D-40, 70D-40-70D-40, or 40-70D-40 had little effect. None germ. in any dark treatments including OS and GA-3. Seeds DS 1 y germ. 70L(88% in 3rd w) similar to fresh seeds.

G. sieberiana germ. only in light. The data were 70L(59% in 5-18 w), 40-70L(21% in 6-16 w)-40-70L(26% in 6th w), 40-70D-40-70L(70% in 3-8 w)-40-70L(30% in 4th w), and 70D-40-70L(34% in 4-12 w)-40-70L(11% in 2nd w). None germ. in 70D-40-70D, 70 GA-3, OS, or 40-70D. When the sample in 70 GA-3 was shifted to 70L after 3 m, it germ. 71% in 3-11 w. Seeds DS 1 y germ. 70L(42% in 4-15 w) and 70D(none) showing little if any deterioration.

Gaillardia (Asteraceae). G. aristata germ. in 3-6 d at 70D. HC found germination the same from 55-85 but dropping below 10% at 50.

Galax (Diapensaceae). G. urceolata failed to germinate in 70D, 70L, 40, or 70 GA-3, and the tiny seeds appeared to be empty seed coats.

Galeopsis (Lamiaceae). G. speciosa germ. 40-70D(2/6 in 3rd w) and none in 70D-40-70D or 70L-40-70D. A second sample germ. 70D-40-70D(2/6 on 2nd d).

Galtonia (Liliaceae). G. candicans (JS) germ. 70D(100% in 2-3 w). This confirms the earlier result (2nd Ed.) and is on a much larger sample. The earlier sample germ. 1/6 suggesting that the seed was old and that seeds die rapidly in DS. This was confirmed by a sample DS 6 y which was dead.

Gaultheria (Ericaceae). G. hispida germ. 70D(20% in 1-7 w) and 70L(23% in 7th w).

Gazania (Asteraceae). G. hyb. germ. best at 55-75 and lower at 50 and 80-85 (HC).

Geissorhiza (Iridaceae). Except for G. juncea the germination pattern was predominantly 70-40 with light having little effect. All seeds had been DS 6 m.

G. aspera germ. 40(71% in 4-6 w), 70D-40(100% in 4-6 w). Light had no effect. Seeds DS 1 y germ. the same as the fresh seeds.

G. fulva germ. 70D(10% in 7-9 w)-40(71% in 5th w) and 70L-40(96% in 4-6 w).

G. inequalis germ. 70D-40(95% in 5-8 w) and 70L-40(95% in 4-6 w).

G. juncea germ. 70D(70% in 3-8 w)-40(8% in 5th w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 93% germ. in 1-6 w.

G. monantha germ. 70D-40(40% in 4-6 w) and 70L-40(88% in 4th w). Seeds DS 1 y germ. 40(85% in 4-8 w), 70D-40(74% in 6th w), and 70L-40(92% in 3-8 w). In view of the latter results fresh seeds would have undoubtedly germ. at 40.

G. rochensis DS 1 y germ. 70D-40(100% in 4th w).

G. rochensis spithamaea germ. 70D(7% in 5-8 w)-40(23% in 4-10 w) and 70L-40(95% in 4th w). Seeds DS 1 y germ. 40(54% in 2-6 w) and 70D(27% in 8-10 w)-40(73% in 4th w), and seeds DS 2 y germ. 40(80% in 4-10 w) and 70D(none). The fresh seeds would presumably have germ. best if placed directly at 40.

G. secunda germ. 70L-40(100% in 3rd w) and 70D-40(100% in 4-6 w). Seeds DS 1 y germ. 40(100% in 3rd w) and 70D-40(95% in 4th w). In view of the latter results fresh seeds would have undoubtedly germ. at 40. Seeds DS 2 y germ. 70D(none) and 40(90% in 4th w).

G. splendissima germ. 70L-40(2/2 in 3rd w) and 70D-40-70D(1/5 on 3rd d). Seeds DS 1 y germ. 40(2/5 in 6th w), 70D-40(1/4 in 6th w). The germination pattern is probably the same as G. secunda, but the small sample prevents definitive results.

Gelasine (Iridaceae). G. azurea germ. 70L(100% in 3-6 w) and 70D(5%), and a second sample germ. similarly.

Gentiana (Gentianaceae).

G. asclepediae DS 3 y and 4 y were dead.

G. asclepediae rosea germ. 70L(100% in 8-11 d), 70 GA-3(100% in 6-9 d), 70D(20% in 6-9 d), 40-70D(100% in 2nd w), and 40-70L(100% on 7th d). This pattern was confirmed by JS. Seeds DS 1 y were dead.

G. ciliata were very tiny seeds and failed to germinate. They may have been empty seed coats.

G. grombezewskii seeds germ. 70L(100% in 1-3 w), 70 GA-3(100% in 8-11 d), 70D(100% in 2-5 w), and 40-70D(100% in 2nd w). Seeds DS 1 y germ. 100% in 70D and 70L the same as fresh seeds .

G. scabra required light or GA-3 (2nd Ed.). Seeds DS 1 y were dead.

G. sceptrum germ. 70 GA-3(2/11 in 4th w) and none in 70D or 70L.

G. sp. blue DS 2 y germ. 70L(34% in 2-4 w) and 70D(10% in 2-4 w).

Geranium (Geraniaceae). G. sylvaticum DS 1 y germ. 70D-40(1/7)-70D(3/7 in 2-9 d) which is comparable to the germination of fresh seeds.

Geum (Rosaceae). G. montanum DS 1 y rotted and were dead.

Gilia (Polemoniaceae). G. formosa DS 1 y germ. 70D(2/12 on 5th d) and 40(rotted). Fresh seed had germ. 70D(rotted) and 40(2/5 in 3rd w).

Gingidium (Apiaceae).

G. decipiens were empty seed coats.

G. montana DS 6 m germ. 70D-40(4/6 in 6-12 w), 70L(2/5 in 5-9 w)-40(1/5 in 10th w), and 40(6/6 in 10-14 w). Seeds DS 1 y rotted and were dead.

Globularia (Globulariaceae). Eight more samples have been received. These had been DS about 6 m. Four of these were chaff. Some seem to require light and other do not.

G. nudicaulis germ. 70D(100% in 5-8 d).

G. repens germ. 100% in 2nd w in either 70D or 70L.

G. sp. germ. 70L(5/8 on 10th d) and 70D(none).

G. sp. germ. 70L(100% in 2nd w), 70D(100% in 3-5 w), and 40-70D(3/9 on 5th d).

G. trichosantha germ. 95% in 10-19 d in 70D when fresh. Seeds DS 1 y germ. 76% in 5-8 d and seeds DS 2 y germ. 38% in 4-5 d. The half life is about 2 y.

Glyphosperma (Liliaceae). G. palmeri data is now complete. Seeds germ. 70D(3/4 on 11th d) and 70L(none). When the sample in 70L was shifted to 70D after 9 w, 1/3 germ. in 5th d.

Godetia (Onagraceae). G. grandiflora germ. 100% in 3-11 d in 70D. Seeds DS 1 y germ. 78% in 2-8 d, and seeds DS 2 y germ. 36% in 2-3 d. The half life is 1.5 y.

Gomphrena (Amaranthaceae). G. globosa germination has been complex and further investigation is needed. Fresh seeds germ. in 90D but not 70D whereas seeds DS 6 m germ. in 1-3 d in 70D. HC reported that germination was best in dark and best at 60-85 and dropped below 10% at 50-55, but he was probably studying seeds that had been DS for at least 6 m, and if so, our work is in agreement. Seeds DS 4 y germ. 70% in 2-4 w in 70D. There was some evidence germination was faster if the husks were removed.

Grevillea (Proteaceae). The first two were seeds that had been DS for several years.

G. buxifolia germ. best (4/4 in 3rd w at 70) if both the outer seed coat and the inner testa were removed.

G. pulchella rotted and were presumed dead.

G. robusta germ. best at 75 and less at higher or lower temp. (HC).

Greyia (Melianthaceae). The data under Grayia spinosa in the 1st Suppl. is possibly a species of Greyia.

Gynandriris (Iridaceae).

G. setifolia germ. 70D(2/13 in 3rd w)-40(5/13 in 4th w)-70D-40(1/13)-70D-40(1/13 in 11th w) and 70L(1/9 in 4th w)-40(8/9 in 4th w). A second sample germ. 70D(31% in 8th w)-40(35% in 2-4 w)-70D-40(3%). Light delayed germination and reduced percent germination in this second sample.

G. simulans germ. 70D(100% in 3-5 w) and 70L(none). When the sample in 70L was shifted to 70D, 100% germ. in 2-11 d.

Gypsophila (Caryophyllaceae). G. elegans germ. the same from 50-85 (HC)

Halesia (Styracaceae). The extended patterns found for H. caroliniana that had been found earlier (2nd Ed. and 1st Suppl.) have been confirmed by JS.

Halgania (Boraginaceae). H. cyanea DS for several years rotted.

Halimium (Cistaceae).

H. atroplicifolium germ. 70D(3/10 in 5th w), 70L(6/7 in 3-5 w), and 40(8/9 in 3-6 w). Germination is at the same rate at 40 as at 70. Seeds rotted in 70 GA-3.

H. alyssoides failed to germinate in 70D or 70L.

H. ocymoides germ. 70D(1/25 on 6th d) and 70L(none).

Haloragis (Asclepediaceae). H. erecta germ. was subjected to 40-70D-40-70D. At this point half were punctured, half kept as control, and the experiment continued. The punctured seeds germ. 40-70D(1/4 in 2nd w) and none has germ. as yet in the control. The sample size is too small to draw definitive conclusions, but the single germination was a healthy seedling.

Haplocarpha (Asteraceae). H. scaposa was chaff.

Haplopappus (Asteraceae). H. bradegei was chaff.

Heimia (Lythraceae). H. salicifolia germ. 100% in 2-5 w in either 70D or 70L. Seeds DS 1 y germ. 70D(5%) indicating a half life of perhaps 3 m.

Helichrysum (Asteraceae). H. bracteatum germ. in 2-6 d in 70D. HC found that germination was best at 55-80 and less at 50 and 85.

Heliotropium (Boraginaceae). H. arborescens germ. in 2-7 w in 70D and germination dropped to zero at 50 (HC).

Helleborus (Ranunculaceae). H. foetidus seeds DS 4 y were dead.

Helonias (Liliaceae). H. bullata seeds DS 1 y were dead. Germination data on fresh seeds is in the 1st Suppl.

Heptacodium (Caprifoliaceae). H. jasminoides is reported to germinate in 70D, but only after a five month induction period (G. Koller, Arnoldia 46, 2 (1986)).

Hesperantha (Iridaceae). Germination at 40 is by far the best although some germination will occur at 70D before a shift to 40.

H. bachmannii DS 6 m germ. 70D(38% in 2-9 w)-40(62% in 2-4 w), 70L(24%)-40(52% in 3rd w), and 40(100% in 4-8 w). Seeds DS 2 y germ. 40(7/14 in 4-7 w) and 70D(none).

H. baurii (mossii) DS 6 m germ. 70D(100% in 2-4 w), 70L(100% in 3-12 w), and 40(100% in 5-6 w). Seeds DS 2 y germ. 40(67% in 4-9 w)-70D(15% in 2-11 d) and 70D(27% in 4-7 w).

H. cucullata DS 6 m germ. 70D(1/8 in 11th w)-40(7/8 in 3rd w), 70L-40(80% in 2-6 w), and 40(100% in 4-7 w). Seeds DS 2 y germ. 40(9/9 in 5th w) and 70D-40(8/9 in 2-4 w) and showed no sign of dying.

H. falcata DS 6 m germ. 70D(100% in 6th w), 70L-40(100% in 3rd w), and 40(100% in 4-8 w). Seeds DS 2 y germ 40(90% in 4th w) and 70D-40(95% in 2-4 w).

H. pauciflora DS 6 m germ. 70D-40(100% in 4th w) and 40(100% in 4-6 w).

H. pearsoni DS 1 y germ. 40(95% in 8-12 w) and 70D-40(95% in 6th w). Seeds DS 2 y germ. 40(12/17 in 4-7 w) and 70D-40(7/14 in 4th w).

H. sp. DS 1 y germ. 70D(5% on 4th d)-40(95% in 3rd w) and 40(95% in 3-8 w). Seeds DS 2 y germ 40(6/8 in 4-7 w) and 70D-40(6/6 in 4th w).

Hibiscus (Malvaceae).

H. esculenta (Okra) germ. in 2-3 d in 70D.

H. lasiocarpus germ. 100% in 4-10 d in either 70D or 70L.

H. moscheutos samples DS 1 y and 5 y were dead.

H. trionum DS 2 y or 3 y germ. 70D(30% on 2nd d) the same as seeds DS 1 y.

Hieracium (Asteraceae). H. olafii seeds DS 2 y were dead. See 1st Suppl. for germination of fresh seeds and seeds DS 1 y.

Hierochloe (Poaceae). The family was not given in the 1st Suppl.

Homeria (Iridaceae). In view of the results below, germination should have been tried at 40. Light had no effect in either species.

H. breyniana DS 6 m germ. 70D(10%)-40(90% in 3rd w). Seeds DS 1 y germ. 40(100% in 4th w) and 70D(10%)-40(90% in 2nd w).

H. collina DS 6 m germ. 70D(10%)-40(86% in 3-5 w).

Hulsea (Asteraceae). H. algida germ. 70D(1/13 in 5th w) and 40(6/27 in 6-8 w)-70(1/27). Seeds DS 1 y germ. 40(95% in 2-7 w) and 70D(none).

Hunnemania (Papaveraceae). H. fumarifolia germ. in 3rd w in 70D (and presumably 60-85) and germination dropped below 10% at 50-55 (HC).

Hyacinthella (Liliaceae). H. azurea DS 6 m germ. 40(67% in 9-12 w)-70D(10% on 2nd d)-40(3%)-70D(3%), and 70D-40(70% in 7-11 w)-70D(8% on 3rd d)-40(10% in 6-8 w)-70D(4% on 2nd d). Light had no effect. Germination fell to under 5% if treated with GA-3.

Hymenanthera (Violaceae). H. alpina germ. 70D-40-70D-40-70D(2/4 in 1-9 w)-40-70D(1/4 on 2nd d). Light did not initiate germination.

Hylomecon (Papaveraceae). H. japonicum germ. 70 GA-3(40% in 4-7 w). Germination in 70D, 70L, or 40-70 was 0-5%. The seeds split and expand a week or two before radicle development begins.

Hymenolepis (Asteraceae). H. paraviflora was chaff.

Hypericum (Hyperiaceae). Fresh seeds of H. olympicum had germ. only in 70 GA-3 and were dead after DS 6 m (1st Suppl.). A new sample DS 3 y germ. 70D(47% in 2nd w) and 70L(45% in 2nd w). The results are not consistent.

Hyssopus (Lamiaceae). H. officianalis DS 3 y germ. 70D(87% in 2-4 d) confirming the report of RC cited in the 1st Suppl.

Iberis (Brassicaceae). I. umbellata germ. 100% in 3-5 d in 70D for either fresh seed or seed DS 1 y. HC reported similar germination from 50-85. Seeds DS 2 y germ. 70D(60% in 3-5 w). The lower percentage and particularly the markedly slower rate of germination show that significant deterioration had occurred in 2 y DS.

Ibicella (Martyniaceae). I. lutea seeds DS 2 y rotted and were dead. The germination of fresh seeds is described in the First Suppl.

Ilex (Aquifoliaceae). I. aquifolium and I. montana like I. opaca are a mystery. None has germ.

Impatiens (Balsaminaceae).

I. balfouri germ. 40(100% in 10th w) and 70D-40(80% in 11th w). Light had no effect and GA-3 led to total rotting of the seeds. Germination has been reported to be difficult, but the above results indicate that it is simply a matter of not recognizing a 40 germinator.

I. balsamina germ. 70D(7/16 in 2-12 d)-40-70D(3/16 in 5-10 d) in agreement with observations of Jan Goodwin. This is not in agreement with literature reports that light is required (HC). HC reported that germination was best at 55-80 and near zero at 50 and 85, however, his data were not consistent.

Inula (Asteraceae). I. helenium DS 2 y germ. 70D(3/17 in 2-6 w)-40-70D(1/17) and seeds DS 3 y germ. 70D(1/16 in 4th w).

Ipomoea (Convolvulaceae). I. tricolor (Morning Glory) germ. best at 55-85 and lower at 50 (HC).

Ipomopsis (Polemoniaceae). O. rubra germ. 70D(90% in 2nd w).

Iris (Iridaceae).

I. stolonifera DS 1 y had germ. 2/5 at 40 after 2 y of alternating cycles (1st Suppl.). Another sample germ. at 40 after 4 y of alternating cycles.

Isatis (Brassicaceae). I. tinctoria germination in 70D was affected by 2 y DS whereas the germination in 40 was not. In 70D seeds DS 2 y germ. 100% in 2-4 d whereas fresh seeds germ. only 5%. This would apper to be a classic D-70 pattern except that seeds germ. 65-96% at 40 whether fresh or DS up to 2 y. After 3 y DS the seeds germ. 65% in 5-14 d in 70D indicating a half life of 3-4 y.

Isoplexis (Scrophulariaceae). I. canariensis had germ. 100% in 8-16 d in either 70D or 70L (1st Suppl.). It is now found that a prior 3 m at 40 is deleterious as shown by 40(12%)-70D(6%).

Isotoma (Lamiaceae). I. axillaris germ. 74-85% in 8-14 d in either 70D or 70L (1st Suppl.). A prior 3 m at 40 is deleterious as shown by 40-70D(5%). Seeds DS 1 y germ. 24% in 2-5 w and seeds DS 2 y germ. 70D(28% in 1-10 w).

Ixia (Iridaceae). The seeds were all DS 6 m unless otherwise indicated.

I. paniculata germ. 70D-40(3/3 in 4-6 w) in one sample and in a second sample all 9 rotted.

I. pumilio germ. 70D(100% in 3rd w) and 70L(1/18). When the sample in 70L was shifted to 70D after 10 w, 83% germ. in 2-11 d. It also germ. 40-70D-40-70D(22% on 7th d)-40(50% in 5-8 w). This is one of the rare examples where a treatment, 3 m at 40 in this instance, appears to produce germination inhibitors (induced dormancy in the old terminology). After 1 y DS the germination in 70L dropped to 72% (still in 3rd w) suggesting that the half life will be 1-2 y.

I. pycnostachys DS 1 y germ. 70D(90% in 4-6 w) and 70L(none). Seeds DS 2 y germ. 40(8/8 in 4th w) and 70D-40(9/9 in 2-4 w).

I. viridiflora germ. 70D(77% in 2-9 w)-40(4%), 70L(none), and 40(100% in 5-8 w). When the sample in 70L was shifted to 70D after 9 w, 45% germ. in 2 d-4 w.

Jatropha (Euphorbiaceae). J. macrocarpa is manihot, the source of tapioca. Both fresh seeds and seeds DS 1 y have failed to germinate in 70D. The seeds are large with a hard seed coat, however, puncturing this seed coat led to immediate rotting of the seeds.

Juncus (Juncaceae).

J. effusis DS 3 y germ. 70D(1%) and 70L(100% in 6-10 d) similar to fresh seeds.

J. tenuis DS 3 y germ. 70D(none) and 70L(90% in 6-10 d) similar to fresh seeds.

Juno (Iridaceae). This genus was discussed in detail in a Chapter devoted to Aril Iris in the 1st Suppl. Four procedures were described for initiating germination. One of these was to collect the seeds as soon as the pod started to turn tan and to place the seeds immediately in moist towels at 40. Note that the seeds must immediately be placed at 40 for this procedure to work best. This procedure can be termed the "green seed" method. This method has now been confirmed with J. bucharica and found to work with J. magnifica. Germination begins after 2-3 m, and the seeds are kept at 40 beyond the usual 3 m because germination continues. This behavior was not recognized in the earlier work and the shift to 70 after 3 m at 40 in this earlier work was confusing. A prior 3 m in 70D is of no advantage in J. bucharica and was deleterious with J. magnifica.

J. bucharica (green seeds) germ. 40(79% in 11-18 w) and 70D-40(44% in 7-10 w) for the first sample and 40(100% in 13-23 w) and 70D-40(92% in 6-10 w) for the second sample. Seeds DS 1 y germ. 70D-40(20% in 2nd w) and 40-70D-40(none) indicating that they were largely dead and seeds DS 2.5 y were dead.

J. magnifica (green seeds) germ. 40(95% in 10-22 w) and 70D-40(26% in 4-12 w)-70-40(4% in 6-8 w).

J. sp. (J. Halda coll. in Tazekhistan), four seeds were started at 70 in Dec. 1991 and subjected to alternating periods of 3 m in 70D and 3 m in 40. One seed germ. in 40 in July 1994, one in 40 in November 1994, one in 70D in January 1997, and one in 70D in July 1997. These results again show the extended germination characteristic of dried seeds of Juno Iris.

Kalanchoe (Crassulaceae).

K. flammea germination required light and temp. 60-85 (HC).

K. grandiflora (KR) germ. 64% in 2-5 d in 50-70 oscillating temperatures. This is similar to the immediate germination of K. hybrids in 70D (2nd Ed.).

Kedrostis (Cucurbitaceae). The family to which this genus belongs was not given in the 1st Suppl.

Kelseya (Rosaceae). K. uniflora had germ. 70D(2/5) but after DS 1 y a test of 8 seeds failed to germinate. This suggests a half life of under 6 m but the sample was too small for a definitive conclusion.

Kochia (Chenopodiaceae). K. scoparia germ. the same from 50-85 (HC).

Lachenalia (Liliaceae). Data is much more complete than given in the Suppl., and now 22 species have been studied. In 17 of these light blocked germination dramatically, and when the sample was shifted from 70L to 70D, germination commenced as if the period in 70L had not occurred.

L. algoensis germ. 70D(100% in 3rd w) and 70L(70% in 4th w). When the sample in 70L was shifted to 70D after 4 w, the remaining 30% germ. in 1-5 w.

L. aloides germ. 70D(100% in 1-4 w) and 70L(none). When the sample in 70L was shifted to 70D after 4 w, 100% germ. in 1-5 w (confirmed with a second sample).

L. arabuthnotiae germ. 70D(100% in 1-4 w) and 70L(none). When the sample in 70L was shifted to 70D after 4 w, 100% germ. in 1-5 w.

L. bulbifera germ. 70D(90% in 1-7 w) and 70L(none). When the sample in 70L was shifted to 70D after 4 w, 90% germ. in 1-5 w. These results were confirmed with a second sample.

L. capensis germ.70D(1/4 in 5th w)-40(3/4 in 3-7 w). The sample in 70L was shifted to 70D after 8 w whereupon 1/8 germ. in 6th w. This sample was then shifted to 40 after 3 m at 70D whereupon 7/8 germ. in 3-5 w.

L. elegans germ. 70D(1/8 in 11th w)-40(6/8 in 3-5 w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 1/7 germ. in 5th w. It was then shifted to 40 after 12 w whereupon 6/7 germ. in 2-5 w.

L. fistulosa germ. 70D(6/14 in 5-11 w)-40(5/14 in 3rd w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 4/6 germ. in 2-5 w. It was then shifted to 40 after 12 w whereupon 2/6 germ. in 2nd w.

L. gillettii germ. 70D(100% in 1-3 w) and 70L(50% in 3-5 w). When the sample in 70L was shifted to 70D after 8 w, the remaining 50% germ. in 1-3 w. A second sample germ. 70D(100% in 1-3 w) and 70L(none)., and when this sample in 70L was shifted to 70D after 6 w, 15% germ. in 2-4 w.

L. glaucina germ. 70D(2/7 in 7th w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 1/4 germ. in 6th w.

L. glaucina pallida germ. 70D(100% in 1-3 w) and 70L(none). When the sample in 70L was shifted to 70D after 4 w, 100% germ. in 2nd w. This was confirmed with a second sample.

L. latifolia germ. 70D(100% in 2nd w) and 70L(none). When the sample in 70L was shifted to 70D after 6 w, 80% germ. in 2-4 w.

L. latiflora germ. 70D(100% in 1-4 w) and 70L(6/7 in 3-6 w).

L. liliflora germ. 70D(10% in 2-5 w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 90% germ. in 1-8 w. Note that this is another example of a delayed light effect.

L. mediana germ. 70D(100% in 1-5 w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 100% germ. in 1-4 w. This was confirmed with a second sample.

L. orchioides germ. 70D(83% in 3-10 w)-40(11% in 4th w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 50% germ. in 2nd w. A second sample germ. 70D(100% in 2nd w) and 70L(none), and when this sample in 70L was shifted to 70D after 6 w, 6/7 germ. in 4-10 d.

L. orthopetala germ. 70D(100% in 2-5 w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 1/9 germ. in 2nd w.

L. pallida 70D(100% in 2nd w) and 70L(none). When the sample in 70L was shifted to 70D after 6 w, 81% germ. in 4-26 d. A second sample germ. 70D-40(100% in 4th w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 35% germ. in 4-9 w.

L. postulata germ. 70D(100% in 6-10 d) and 70L(2%). When the sample in 70L was shifted to 70D after 8 w, 4/6 germ. in 2-5 w. This was confirmed with a second sample.

L. reflexa germ. 70D(100% in 3-10 w) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 100% germ. in 2-9 w. A second sample germ. 70D(70% in 4-9 w) and 30% in 4th w in 70D if preceded by 6 w in 70L. This second sample appears to have deteriorated partially probably due to DS.

L. rosea germ. 70D(100% in 4th w) and 70L(none). When the sample in 70L was shifted to 70D after 4 w, 100% germ. in 2nd w. This was confirmed with a second sample.

L. unicolor germ. 70D(100% in 8-12 d) and 70L(none). When the sample in 70L was shifted to 70D after 8 w, 1/6 germ. in 2nd w.

Lactuca (Asteraceae). L. sativus (Lettuce) germ. in 2nd w in 70D.

Lagunaria (Malvaceae). L. patersonii DS 2 y germ. the same as fresh seed or seeds DS 1 y (about 50% in 4-10 d in 70D).

Lallemantia (Lamiaceae). L. iberica germ. 2/5 in 4th w in 70D. A pulpy black covering on the seeds was removed and the seeds rinsed before placing in the moist paper towels.

Lapeirousia (Iridaceae). A new sample of L. (Anomatheca) laxa germ. 100% in 70D, 70L, and 70 GA-3 with germination in 70L being a little slower (6th w) than in the other two treatments (4th w). This is similar to an earlier sample (2nd Ed.). A prior 3 m at 40 had little effect. Seeds DS 1 y or 2 y germ. 70D(90% in 2nd w) indicating no significant dying.

Larrea (Zygophyllaceae). L. tridentata had germ. 80% in 1-5 d in 70D for seeds fresh or seeds DS 6 m or 1 y. Seeds DS 3 y germ. only 10% in 70D.

Lathyrus (Fabaceae).

L. latifolius DS 6 y germ. 8/10 in 3rd w in 70D showing that the seeds were still largely alive after this 6 y of DS.

L. odoratus (Sweet Pea) germ. in 3-5 d in 70D. HC found germination lower below 55 and above 75.

Laurentia (Campanulaceae).

L. axillaris rotted and were dead.

L. gasparrinii germ. 100% in 3rd w in 70D for either fresh seeds or seeds DS 1 y or 2 y. Light had no effect on germination of the fresh seeds.

Lavatera (Malvaceae). Seeds of commercial hybrids DS 2 y were dead.

L. araborea germ. DS 6 y germ. 70D(60% in 2-4 d).

L. thuringiaca germ. 100% in 2-3 d in 70D for either fresh seeds or seeds DS 1 y. Seeds DS 2 y were dead.

Lavetia (Apiaceae). L. (Azorella) compacta germ. 70D(1/2 in 6th w)-40(1/2 in 8th th w) and none in 70L.

Lechenaultia (Goodeniaceae). L. biloba were empty seed coats.

Legousia (Campanulaceae).

L. patagonia germ. 70L(100% on 5th d) and 70D(38% in 1-3 w)(1st Suppl.). It is now found that if the sample in 70D is shifted to 70L after 7 w the remaining 62% germ. in the 2nd w. Seeds also germ. 40(62% 5-8 w). Seeds DS 1 y germ. 65% on the 6th d in either 70D or 70L showing that the light effect was disappearing and that the seeds were also dying with a half life of a little over a year.

Leonitis (Lamiaceae). L. dysophilla (JS) germ. 70D(80% in 4 d) similar to L. leonurus (1st Suppl.). A prior 4 w at 40 had no effect.

Leontondon (Asteraceae). L. autumnalis germ. 100% in the 2nd w in 70D for seeds DS 2 y whereas fresh seeds had shown at least a partial light requirement. Seeds DS 4 y germ. 70D(20% in 2nd w) indicating a half life of 3 y.

Leontopodium (Asteraceae). L. pallginianus germ. 70D(65% in 1-6 w) and 70D(32% in 3rd w) for seeds DS 1 y indicating a half life of 1 y.

Leopoldia (Liliaceae). L. comosa alba germ. 70D-40(3/3 in 5-7 w) and 70L-40(50% in 3rd w)-70D-40. A sample of L. comosa was dead.

Leptinella (Asteraceae). L. (Cotula) pyrethifolia germ. 70D(5/5 in 2-5 w) and 70L(3/5 in 2-5 w).

Leptodactylon (Polemoniaceae). L. watsonii germ. 70D(4/8 in 2nd w) using fresh seeds (1st Suppl.). Seeds DS 1 y germ. 70D(8% on 5th d) indicating a half life of about 6 m.

Leptosiphon (Polemoniaceae). P. hybrids germ. in 2nd w in 70D.

Leptospermum (Myrtaceae). L. petersonii and L. scoparium were chaff.

Leucaena (Fabaceae). L. leucocephala had an impervious seed coat and germ. 100% on 6th d at 70 if punctured. Seeds DS 2 y were dead

Leucopogon (Epacridaceae). L. fraseri seeds germ. 70L-40-70L-40-70L(1/5 in 3rd w), 70D-40-70D-40-70D-40(2/7 in 11th w), and 40-70D-40-70D-40-70D(2/3 on 4th d). Germination was not initiated by GA-3.

Leucospermum (Proteaceae). L. formosum rotted and were dead.

Lewisia (Portulacaceae). L. cotyledon had germ. largely at 40 in a number of qualitative experiments (2nd Ed.). A sample DS 4 y germ. 70D(2% in 4-12 d) and 40(none).

Leycesteria (Caprifoliaceae). Data on L. formosa is now complete. It germ. 70L(100% on 9th d), 70D(87% in 1-4 w), 70 GA-3(10% in 9-11 d), and 40-70D(100% in 2nd w), confirmed by JS.

Liatris (Asteraceae). L. spicata germ. 70D(30% in 6-9 w) and 40-70D(80% in 4-10 d).

Libertia (Iridaceae). L. caerulescens and L. tricolor have failed to germinate in 70D, 70L, or 40 after 7 m.

L. formosa germ. 70D(70% in 3-12 w)-40(5%), 70L(45% in 5-7 w), and 40-70D(50% in 2nd w). Seeds DS 1 y germ. 70D(1/5 in 6th w)-40(1/5 in 12th w) and 40-70D(1/9 on 2nd d)-40(2/9 in 10th w).

L. grandiflora germ. 70D-40(none), 70L-40(3/10 in 8-12 w), 40-70L(1/4 in 2nd w), and 40-70D(none). Seeds DS 1 y germ. 70D-40(1/8 in 11th w) and 40-70D(3/11 in 2-7 d).

L. perecrinans germ. 70L-40-70D(1/15 in 11th w) and none in 70D-40-70D, 40-70D, or 40-70L.

L. ixioides germ. 70D-40(1/33 in 9th w), 70L(15% in 4-12 w)-40(50% in 3rd w)-70D(6%), 40-70D-40-70D(2/13), and 40-70L-40(2/7). A sample DS 3 y germ. 70D(38% in 4-12 w) and 40(18% in 8th w)-70D(18% in 1-7 w).

Lignocarpa (Apiaceae). L. carnosula (3 samples) failed to germinate in 70D, 70L, and 70 GA-3.

Lilium (Liliaceae). Seeds of L. martagon (DS 3 y) and L. pyrenaicum (DS 4 y) were dead. The germination of fresh seeds of these was described in the 2nd Ed.

L. centifolium hyb. DS 3 y were dead in accord with results in the Second Edition which found the seeds to have a half life of about 1 y.

L. michauxii pink form germ. 70D-40(2/8 in 6th w) and the red form germ. 70D-40(2/7 in 5th w). After the 3 m at 40 and the shift to 70, the single true leaf formed.

L. occidentale germ. in 40 when fresh (1st Suppl.), but were dead after DS 1 y.

L. pumilum seeds DS 1 y germ. 70D(12% in 2nd w) indicating a half life in DS of about 6 m.

L. regale DS 3 y or 6 y were dead confirming the results of L. Barton which were described in the section on Storage of Seeds.

L. szovitsianum germination in 70D dropped from 95% in 2-12 w for fresh seed to 70% in 3-7 w for seeds DS 1 y to 20% in 4-8 w for seeds DS 2 y.

Limonium (Plumbaginaceae). L. sinuatum (Statice, Sea Lavender) germ. in 2nd w in 70D. HC found germination the same from 50-85.

Limnanthes (Limnanthaceae). L. douglasii germ. in 2-3 d in 70D.

Linanthrastum (Polemoniaceae). Modest germinations had been found in several treatments of L. nuttallii (1st Suppl.). It is now found that the best treatment is 70D-40(100% in 3-5 w).

Linanthus (Polemoniaceae). L. grandiflorus germ. in 3-7 d in 70D.

Linum (Linaceae). L. alpinum DS 1 y were dead. For germination of fresh seeds see 1st Suppl.

Livistonia (Palmaceae). L. chinensis seeds DS 1 y failed to germinate and were dead.

Lobelia (Lobeliaceae).

L. erinus (Annual Lobelia) germ. in 4-5 d in 70D. HC reported that it germ. best at 60-85 and this decreased to 36% at 55 and zero at 50.

L. pendula germ. 100% in 3-5 d, 60% in 5-10 d, and 4% in 2-4 w in 70D for seeds fresh, DS 1 y, and DS 2 y, respectively. The half life is 1 y.

Luetkea (Rosaceae). L. pectinata germ. 70D(100% in 5-18 d), 70L(100% on 8th d), 70 GA-3(100% in 3rd w), and 40-70D(100% on 4th d).

Lupinus (Fabaceae). L. polyphyllus germ. the same from 50-85 (HC).

Lycene (Caryophyllaceae). L. kubotai germ. 70L(100% on 5th d), 70D(95% in 3-13 d), and 40(15% in 3rd w)-70D(2%). After 2 y of DS germination was 85% in 3rd w in 70D.

Lychnis (Caryophyllaceae).

L. alba germ. 70L(100% in 4-9 D) for either fresh seeds or seeds DS 2 y. After DS 4 y this dropped to 80% (still in 4-8 d) indicating a half life of over 4 y. Light was required throughout.

L. chalcedonica DS 1 y germ. 100% in 3-8 d in 70D. After 5 y DS germination dropped to 55% in 2nd w indicating a half life of about 5 y. A second sample DS 3 y germ. 70(46% in 4-20 d) in close agreement with the previous result.

L. coronaria DS 4 y germ. 20% in 2nd w in 70D. A second sample DS 3 y germ. 70D(77% in 4-6 d).

L. flos-jovis DS 4 y germ. 70D(29% in 4-20 d).

L. hyb. germ. 70D(17% in 1-3 w).

L. hyb. Arkrightii DS 6 m germ. 95% in 2-4 d in 70D.

L. viscaria DS 5 y germ. 70D(30% in 6-18 d).

L. yunnanensis germ 70D(100% in 1-5 w). After 1 y of DS germination was 80% in 3-13 d in 70D.

Lycopersicon (Solanaceae). L. esculentum germination occurred in 70D. Data are presented for commercial samples of Beefsteak, Pixie, and Rutgers. The seeds appeared to have been WC. The data is presented with the time of DS given and the percent germination and germination time given in parentheses. Note that seeds of Pixie showed no change with up to 4 y of DS whereas seeds of Beefsteak and Rutgers showed some decline in percent germination, but more striking was the slowing of the rate of germination.

Beefsteak: 6 m (100% in 3-5 d), 3 y (90% in 1-4 w), and 4 y (65% in 4th w).
Pixie: 6 m (100% in 3-5 d), 3 y (100% in 2-4 d), and 4 y (100% in 2-3 d).
Rutgers: 6 m (100% in 3-5 d), 3 y (50% in 1-5 w), 4 y (98% in 4 d-5 w).

Lysimachia (Primulaceae). L. punctata required light for germination. There was no disappearance of the light requirement after 3 y of DS. The time of DS is given with the percent germination and time of germination in parentheses: fresh (100% in 1-4 w), DS 1 y (83% in 1-4 w), DS 2 y (50% in 2-6 w) and DS 3 y (50% in 2-4 w).

Machaeranthera (Asteraceae). M. tanacetifolia germ. in 3-10 d in 70D.

Magnolia (Magnoliaceae). M. grandiflora DS 1 y were dead. For germination of fresh seeds see 1st Suppl.

Malabaila (Apiaceae). M. involucrata germ. 30% in 2nd w in 70D, 70L, and 70 GA-3. Seeds DS 1 y germ. the same in 70D, but seeds DS 2 y germ. 70D(10% in 3-5 w) indicating a half life of 2 y.

Malleostemon (Myrtaceae). M. roseus seed rotted and were dead. The seeds were several years old.

Malope (Malvaceae). M. trifida DS 1 y or 2 y germ. 100% on the 6th d in 70D similar to fresh seeds.

Malus (Rosaceae). M. hupenensis seeds DS 3 y or 6 y were dead. M. robusta DS 4 y were dead. M. "Yellow Delicious" germ. 100% in 8th w at 40.

Mandevilla (Apocyanaceae). M. suaveolens data is now more complete. Fresh seeds germ. 70L(8/8 in 4 d-3 w) and 70D(5/7 in 1-3 w)-40-70D-40-70D(2/7 on 8th d). Seeds DS 1 y germ. 70D(1/3 in 2nd w) indicating a half life of about 6 m, and seeds DS 2 y were dead.

Mathiola (Brassicaceae).

M. bicornis (Stocks) germ. in 2nd w at 70. HC found germination the same from 50-85.

M. fruticulosa germ. 70D-40(1/9 in 8th w) and 70L(1/10 in 12th w)-40.

Mazus (Scrophulariaceae). M. reptans germ. 100% in 2-4 w in either 70D or 70L. Seeds DS 1 y were dead.

Medeola (Liliaceae). M. virginiana failed to germinate under all treatments after 1 y. The seeds remain firm and unrotted suggesting that some untried or unknown gibberellin is required.

Melaleuca (Myrtaceae).

M. diosmafolia seeds DS 4 y continued to germinate 100% in 2nd w in 70D.

M. huegellii germ. in increasing percentages for DS 0, 1, and 2 y (1st Suppl.). However, seeds DS 4 y were dead.

Melanoselinum (Apiaceae). M. decipiens germ. 100% in 2-5 w in either 70D or 70L.

Melia (Meliaceae). Germination of M. azederach was rather erratic (1st Suppl.). A much larger sample of seeds collected fresh has now been studied. All seeds were WC 7 d. One to three (usually two) seeds are enclosed in each capsule. It is difficult to remove these seeds from this capsule, and it does not seem to be necessary in order to get the light induced germination. Presumably the light enters through the hole in the end of the thick outer seed coat. Fresh seeds germ. 70L-40-70L(80% in 2nd w), 70D-40-70D(none), and 40-70D-40-70L(10%)-40-70L(50%). After DS 1 y they germ. 70L(90% in 4-9 w), 40-70L(100% in 2nd w), and 70D(none). After 2 y of DS they germ. 70L(90% in 2-4 w) and 70D(10% in 5th w).

Melilotus (Fabaceae). M. alba has an impervious seed coat and unpunctured seeds give little germination (1st Suppl.). There is no sign of dying after 2 y DS. After 4 y of DS germination dropped from 100% in 2-4 d at 70 to 30% indicating a half life of about 3 y.

Melissa (Lamiaceae). M. officinalis germ. 70L(100% on 4th d) when fresh (1st Suppl.). Seeds DS 3 y were largely dead and germ. 70L(4%) and 70D(none).

Melospermum (Apiaceae). Data on M. peleponnesius is more complete, and it germ. 70D-40-70D(3/5 in 1-4 w)-40(2/5 in 12th w).

Mentha (Lamiaceae). M. requenii germ. 70D(25% in 3-6 w), 70L(100% largely on 4th d), and 70 GA-3(100% in 4-9 d). When the sample in 70D was shifted to 70L after a 70D-40-70D treatment, and additional 38% germ. in 4-7 w.

Mentzelia (Loasaceae). M. aurea data is more complete, and it germ. 70D(50% in 2-10 d)-40(50% in 2-8 w). Seeds DS 1 y germ. 27% in 2-3 d in 70D with the rest rotting indicating a half life of about 1 y. M. lindleyi seeds rotted.

Merremia (Convolvulaceae). M. tuberosa DS 2 y germ. 70D(3/3 in 1-3 w).

Mertensia (Boraginaceae). M. maritima DS 1 y germ. 10% in 2nd w in either 70D or 70L. The light requirement has disappeared but most of the seeds have died indicating a half life of about 6 m.

Mesembryanthemum (Aizoaceae). M. nodiflorum (KR) germ. 36% in 2-6 d in 32-75 oscillating temperatures.

Mesperula (?). M. graminae roscoae germ. 70D-40(100% in 7th w).

Micromeria (Lamiaceae). Data is now more complete on the two species.

M. juliana DS 6 m germ. 70D(75% in 2nd w) and 70L(100% in 3-14 d). After DS 1 y this sample germ. 70D(50% in 1-3 w) indicating a half life of 1-2 y. However, a second sample germ. 100% in 70D after DS 1 y.

M. thymifolia DS 6 m germ. 70L-40-70D(52% in 4-8 d), 70 GA-3(18% on 10th d), 40-70D(30% on 8th d), 40-70L(100% in 1-3 d), and none in 70D-40-70D.

Milligania (Liliaceae). M. densiflora germ. 100% in 2-5 w in 70D or 70L.

Mimulus (Scrophulariaceae).

M. Calypso Hybrids germ. in 4-5 d in 70D for fresh seeds or seeds DS 1 y.

M. cusickii germ. 70L-40-70L(3/14 on 3rd d), 70D-40-70D(none), 40-70D-40(none), and OT(3/11 in early April).

Mirabilis (Nyctaginaceae).

M. jalapa (Four O'Clocks) germ. in 5-7 d at 70.

M. longiflora (JS) germ. 70D(1/1 in 4 d) and 40-70D(1/1 in 3 d).

Misopates (Scrophulariaceae). Data on M. oronticum is more complete. Seeds germ. 70L(100% in 5-9 d) and 70D(23% in 3-5 d). When the sample in 70D was shifted to 70L after 4 w, 21% more germ. in 5-16 d. A prior 3 m at 40 had no effect.

Moehringia (Caryophyllaceae). M. muscosa were empty seed coats.

Molucella (Lamiaceae). M. laevis germ. in 2-3 d in 70D.

Momordica (Cucurbitaceae). See 1st Suppl. for germination pattern of M. rostrata. The seeds still germ. 100% in 70L after 4 y DS.

Monarda (Lamiaceae).

M. citriodora (JS) germ. 70D(91% in 3 d) confirming earlier work (2nd Ed.).

M. fistulosa had a half life of about 2 y (1st Suppl.). In accord with this it is found that seeds DS 4 y were dead.

M. menthifolia had germ. 100% in 10-12 d in either 70D or 70L. It is now found that a prior 3 m at 40 does not affect this.

M. punctata had a half life of about 1 y (1st suppl.). In accord with this it is now found that seeds DS 4 y were dead.

Montbretia (Iridaceae). M. securigera germ. 70D(100% in 2-4 w) and 70L(100% in 3-6 w).

Montia (Portulacaceae). M. sibirica DS 2 y were dead. For data on fresh seeds and seeds DS 1 y see 1st Suppl. The half life is about 1 y.

Montiopsis (Portulacaceae). M. (Calandrinia tricolor) andicola was dead.

Moricanda (Brassicaceae). M. arvensis data is now complete. Seeds germ. 70D(2% in 2-4 d), 70L(31% in 2-22 d), and 40(50% in 3-8 w). Seeds DS 1 y germ. 70D(8%). The light requirement disappeared, but the seeds were largely dead.

Morina (Dipsicaceae). M. longifolia DS 3 y (two separate samples) germ. 100% in 4th d at 70 the same as fresh seed (1st Suppl.). A sample DS 6 y germ. 40% in 8-14 d at 70. Light had no effect on any of these germinations.

Mosla (Lamiaceae). M. punctalata seeds rotted and were dead.

Muscarimia (Liliaceae).

M. ambrosiacum germ. 70D(5/6 in 4th w).

M. macrocarpum germ. 70D-40(3/5 in 3rd w).

Musella (Musaceae). M. lasiocarpa has failed to germinate under all conditions including puncturing of the seeds and DS 1 y.

Musa (Musaceae). M. punctata (recd. as Musia ?) germ. 70D(1/5 in 2nd w) and 70L(1/5 in 6th w).

Musschia (Campanulaceae). M. aurea DS 6 y germ. 100% in 8-10 d in 70.

Mutisia (Asteraceae). M. latifolia germ. 40(100% in 4-6 w) and 70D(1/12 in 3rd w)-40(11/12 in 7-11 w).

Myoporum (Myoporaceae). This genus is now placed in Eremophila and has the same impervious woody fruits as that genus.

Myositidium (Boraginaceae). M. hortensia germ. 40-70D(1/2 in 2nd w) and none in 70D. Seeds DS 1 y were dead.

Myosotis (Boraginaceae). M. arvensis germ. best 50-75 and lower at 80-85 (HC).

Nardophyllum (Asteraceae). N. obtusifolium rotted.

Nebelia (Bruniaceae). N. paleacea was chaff.

Nectaroscordum (Liliaceae). N. siculum DS 6 m germ. 70D-40(3/4 in 6-9 w), 70L-40(1/3 in 11th w)-70D(2/3 in 4th w), and 40(1/5 in 12th w)-70D-40(2/5 in 7-9 w). A second sample rotted perhaps due to dying in DS.

Nemesia (Scrophulariaceae). Data is now complete on the following.

N. sp. mixed germ. 70L(54% in 6-9 d) and 70D(28% in 8-10 d). It is now found that a prior 3 m at 40 killed the seeds. Seeds DS 1 y germ. only 14% in 2nd w at 70 indicating a half life in DS at 70 of about 9 m.

N. strumosa germ. 100% in 4-6 d in either 70D or 70L.

N. umbonata germ. 100% in 4-10 d in either 70D or 70L. It is now found that it also germ. 40(100% in 4th w).

Nemophila (Hydrophyllaceae). N. menziesii germ. in 3-5 d in 70D.

Nepeta (Lamiaceae). Seeds of N. sp DS 2 y and seeds of N. subsessilis DS 3 y were dead.

N. grandiflora DS 3 y germ. 70D(97% in 3-5 d) and 70L(85% in 3-5 d).

N. siasessois DS 3 y germ. 70D(10% in 1-4 w) and 70L(40% in 7th d).

Nicandra (Solanaceae). N. physalodes DS 4 y germ. identically to seeds DS 6 m showing that the half-live is over 4 y.

Nicotiana (Solanaceae).

N. affinis germ. 50% in light at 70 or dark at 90 but only 15% in dark at 70. HC reported that it germ. best at 60-80 and less at 50-55 and 85.

N. tabacum DS 7 y germ. 100% in 6-8 d in either 70D or 70L.

Nierembergia (Solanaceae). N. caerulea germ. best at 60-85 and lower at 50-55 (HC).

Nigella (Ranunculaceae). Data is now more complete.

N. damascena germ. 70D(88% in 6-8 d)-40(5%)-70D(4%), 70L(62% in 1-10 w)-40(15% in 4th w), and 40(90% in 3-6 w). HC reported that it required light and temp. 60-85. Clearly his results are not in accord with mine.

N. damascena hybrid germ. 70D(40% in 1-12 w)-40(30% in 4-12 w), 70L(70% in 1-10 w)-40(30% in 8th w), and 40(32% in 3-12 w)-70D(10% in 1st w).

N. hispanica germ. 70D(6%)-40(75% in 3-5 w), 70L(100% in 1-3 w), and 40(100% in 3-8 w).

N. orientalis germ. 70D(6/7 in 1-5 w, 5 on 10th d)-40(1/7 7th w), 70L(100% mainly on 9th d), and 40(100% in 4th w).

Nivenia (Proteaceae). N. stokoei germ. 70D-40-70D(2/22 in 1-6 w) and none in 70L, 70D, GA-3, 40, or OS. The seeds remain unrotted after 1 y.

Nolana (Nolanaceae).

N. paradoxa germ. in 2-4 d in 70D.

N. sp. DS 7 y germ. 60% in 1-3 w in 70D indicating a half-life in DS of over 7 y.

Nolina (Agavaceae). N. parryi DS 4 y germ. 70D(1/15 in 10th w)-40(3/15 in 1-12 w). Earlier work (1st Suppl.) had shown that there was significant dying after 2 y DS and this DS 4 y sample shows further dying after the 4 y DS.

Nomocharis (Liliaceae). N. mixed sp. (JS) germ. 70D(3/7 in 27 d) and 40-70D(1/7 in 16 d) confirming earlier observations (2nd Ed.).

Nothoscordum (Liliaceae).

N. bonariensis DS 6 m germ. 70D(12% in 8-12 w)-40-70D(12% in 2nd w)-40-70D(18% on 6th d)-40-70D(30% in 1-3 d) and 40-70D(1/7 on 3rd d)-40-70D(4/7 on 3rd d). Light had no effect.

N. inodorum DS 6 m germ. 70D-40(3/3 in 9th w), 70L-40(2/2 in 8-12 w), and 40(2/2 in 7th w). Seeds DS 1 y germ. 70D(1/10 in 4th w)-40(3/10 in 3rd w) and 40(4/9 in 7th w)-70D.

N. nerinifolium DS 1 y germ. 70D(4/8 in 4th w) and 40(4/11 in 8th w).

Nyssa (Nyssaceae). The many failures were reported in the 1st Suppl. A sample received in fall 1996 germ. 40-70D(4/15 in 3rd w), 70D-40-70D(1/15 in 2nd w), and OT(5/15 in April-May). It also germ. 70 GA-3(3/10 in 3rd w), however, all three of these from GA-3 treatment rotted in the following week. Kromm reports that N. sylvatica seeds overwintered outdoors have germinated as high as 60% the following spring. It seems likely that the earlier samples were non-viable seeds or empty seed coats. The viable sample DS 1 y germ. 70 GA-3(3/11 in 3rd w).

Ochna (Ochnaceae). Seeds are reported to die quickly in DS which probably accounts for the failure to germinate seeds in past samples.

Odontostomum (Liliaceae). O. hartwegii germ. 100% in 3rd w in 70D. Seeds DS 2 y germ. 50% in 7-10 w. Both the lower percentage and the longer germination time indicate deterioration of the seed.

Oenothera (Onagraceae). O. speciosa germ. 70D(100% on 3rd d) for either fresh seeds or seeds DS 1 y. Seeds DS 2 y germ. 70D(70% in 4-14 d) indicating a half life of 2-3 y.

Olea (Oleaceae). O. cuspidata germ. 40-70D-40(1/27 in 6- w) and none in other treatments.

Olsynium (Iridaceae). O. chrysochromum failed to germinate in 70D, 70L, 40, and OS.

Omalotheca (Asteraceae).

O. norvegica DS 2 y or 3 y germ. 70D(100% in 2nd w) the same as fresh seeds.

O. supina had given complex behavior with fresh seeds. Seeds DS 1 y germ. 70D(56% in 10-20 d) (1st Suppl.). Seeds DS 2 y germ. about 50% in 2nd w in either 70D or 70L showing no significant signs of death. The percent germinations are not reliable because of the small seeds and chaff.

Omphalodes (Boraginaceae). Four species had germ. 100% on 4th d in 70D (1st Suppl.).

O. cappadocica germ. 70D(100% in 4th w) and 40(100% in 6th w).

O. linifolia germ. 70D(100% in 2-4 d) when fresh and 73% after 2 y DS.

O. linifolia alba germ. 70D(100% in 2-4 d) either fresh or after 2 y DS.

O. luciliae alba germ. 70D(100% on 4th d) when fresh and 63% after 2 y DS.

Ononis (Fabaceae). O. rotundifolia had an impervious seed coat and germ. 100% in 4-20 d in 70D if the seed coat was punctured and none otherwise. Seeds were dead after 2 y DS.

Onopordum (Asteraceae). O. acanthum DS 5 y germ 70L(3/9) and 70D(none).

Onosmodium (Boraginaceae). O. molle was reported to germinate over 5-8 years in outdoor conditions (Baskin and Baskin, Natural Areas J., 11, 190 (1991)). A large sample of seeds were received on 10-5-96. To date they have germ. 70 GA-3(1 in 10th w)-40(2 in 3-12 w)-70D(2 in 1-3 w), 40-70D-40(1 in 11th w), and OT(2 in April). Light had no effect. Seeds DS 6 m germ. 70 GA-3-40(4/20 in 8th w) and none as yet in the other treatments.

Origanum (Lamiaceae). O. vulgare (Marjoram) germ. the same from 50-80 but dropped to near zero at 85 (HC).

Orthrosanthus (Iridaceae). O. chimboracensis DS 2 y or 3 y germ. 70L(90% in 3-5 w) and 70D(none) similar to fresh seeds.

Orychophragmus (Brassicaceae). O. violacens fresh seeds had germ. 20-50% in 70D or 70L. Seeds DS 1 y were dead indicating a half life of about 6 m.

Osmaronia (Rosaceae). O. cerasiformis DS 6 m rotted.

Ourisia (Scrophulariaceae). O. polyantha germ. 70L(50% in 2nd w) and none in 70D, 70 GA-3, 40-70D, or 40-70L.

Oxytropis (Fabaceae). Seeds of O. chiliophylla DS 4 y still germ. 100% on 3rd d at 70 if punctured and 20% if unpunctured.

Pachystegia (Asteraceae). P. insignis minor DS 2 y had germ. about the same as fresh seed (1st Suppl.), but seeds DS 4 y were dead.

Paonea (Ranunculaceae). P. suffruticosa germ. 70D(50% in 6-10 w), 40-70D(82% in 10-36 w), and 70 GA-3(6/8 in 6-10 w). The GA-3 not only speeded up germination, but 3/6 sent up a leaf within a month of germination while still at 70. Neither OS or OT had any favorable effect. Seeds DS 1 y germ. 70D(90% in 4-9 w) showing that DS for 1 y had a favorable effect on germination percent and rate. Seeds DS 2 y germ. 70D(9/11 in 5-11 w). The 1-2 y DS improves germination.

Pancratium (Amaryllidaceae). P. maritimum germ. 100% in 2-4 w in either 70D or 70L for either fresh seeds or seeds DS 1 y. Fresh seeds also germ. 40-70D(100% in 4-9 d). Seeds DS 2 y germ. 70D(2/5 in 6-8 d).

Pandorea (Bignoniaceae). P. jasminoides germ. 70D(4/6 in 2-4 w) for fresh seeds. Seeds DS 1 y were dead.

Papaver (Papaveraceae).

P. degenii germ. readily in 70D (1st Suppl.). It is now found that a prior 3 m at 40 was fatal.

P. ecoanense germ. readily in 70D (1st Suppl.). It is now found that it also germ. 40(70% in 8th w).

P. kluantense were empty seed coats.

P. nudicaule germ. the same from 50-85 (HC).

P. sendtueri germ. 70L(5/12 in 2-12 w), 70D(none), and 70 GA-3(all rotted). The light requirement disappeared after DS 1 y and such seeds germ. 40% in 2nd w in either 70D or 70L.

Parochetus (Fabaceae). P. communis has an impervious seed coat and germ. 100% on 3rd d in 70D if the seed coat was punctured.

Patersonia (Iridaceae). P. sp. were empty seed coats.

Pavonia (Malvaceae). P. lasiopetala has a brittle outer seed coat and an impervious inner seed coat. When the outer seed coat is removed and the inner seed coat punctured, germination is 100% on 3rd d in 70D. Seeds DS 2 y were dead.

Pelargonium (Geraniaceae). P. hybrids have more or less of an impervious seed coat. The seeds sold commercially have generally been treated with sulfuric acid to soften the seed coats and such seeds germ. 100% in 2-3 d in 70D either fresh or after 2 y DS. This was true for both Cheerio pink and Cheerio Scarlet.

Penstemon (Scrophulariaceae). Some of the following data are updates on species reported in the 1st Suppl. As noted in the 2nd Ed. and 1st Suppl., there is a wide range of germination behaviors in this genus ranging from requirements for light, oscillating temperatures, low temperatures, and GA-3.

P. cobaea germ. 70 GA-3(9/10 in 1-3 w) and 70(1/10 in 2nd w) (KR). This is out of accord with earlier data which showed germination in 2-6 w at 70 (2nd Ed.).

P. cyathophorus germ. 70 GA-3(100% in 2-4 w), 40(1/9 8th w), OT(8/12 in March-April), and none in 70D or 70L. Seeds DS 2 y germ. 40-70(3/14 on 3rd d) and 70(none).

P. duchesuensis germ. 70D-40(85% in 5-12 w) and 40(25%)-70D(15%)-40(20% in 3rd d)-70D-40(15%)-70D-40(7% on 4th d). Light had no effect. Seeds DS 1 y germ. the same as fresh seeds. The data were 40(40% in 8-11 w)-70D-40-70D(15%) and 70D-40(75% in 1-4 w)-70D. Seeds DS 2 y germ. 40(6/15 in 4-12 w).

P. flowersii germ. 70D-40(2/2 in 6th w) and 40(7/11 in 5-8 w)-70D(2/12 on 3rd d). Seeds DS 1 y germ. 40(3/19 in 7-11 w)-70D(2/19 on 3rd d) and seeds DS 2 y germ. 40(3/14 in 8-11 w) and 70D(none).

P. harbouri germ. 70L(100% in 1-3 w), 70D-40(1/7)-70D(1/7), and 40-70D(3/13 in 4-10 w)-40-70D(7/13 in 2nd w). Seeds DS 1 y were dead.

P. heterophyllus germ. 70D(65% in 1-3 w)-40(15% in 4-12 w) and 40(95% in 8-10 w). Light had no effect. Seeds DS 1 y germ. 70D(67% in 1-3 w). Seeds DS 2 y germ. 40(5/5 in 4-8 w) and 70D(1/9) which shows virtually no dying.

P. lyallii (JS) germ. 70L(100% in 20 d) and 40(100% in 60 d). Unfortunately 70D was not done. Light is probably not required.

P. mensarum germ. 70 GA-3(100% in 2nd w), 40(2/14 in 9th w), OT(100% in March), 70L-40-70L(1/15) and 70D-40-70D-40(1/16 in 5th w). Seeds DS 1 y germ. 40(4/9 in 6th w). Seeds DS 2 y germ 40(4/9 in 6th w)-70D(1/9 on 5th d).

P. monoensis germ. 70L-40(5/5 in 8-12 w) and 40(2/9 in 6th w). The sample in 70D all rotted, but the sample was not large enough to be certain that light was the significant factor. Seeds DS 1 y germ. 40(7/9 in 4-12 w)-70D-40(1/9) and 70D-40(5/9 in 6-11 w)-70D-40-70D(1/9 on 2nd d). Seeds DS 2 y germ. 40(5/7 in 4-8 w) and 70D(none).

P. montanus ssp. idahoensis germ. 70 GA-3(1/7 in 4th w), 40-70D(1/7), OT(6/13 in March) and none in 70D or 70L. When the sample started in 70L was shifted to OT on June 1 (7 m after starting), 20% germ. in the 2nd w. See P. uintahensis for comments on this effect.

P. retroceus seeds DS 1 y or 2 y failed to germinate, but the fresh seeds germ. 40(1/2 in 6th w) and none in other treatments so that more data is needed.

P. scapoides seeds DS 2 y germ. 40(1/15), but the fresh seeds germ only 40-70(2/15 in 3rd w) so that more data is needed.

P. Scarlet Queen germ. 70D(90% in 3-6 d) when fresh. Seeds DS 3 y were dead.

P. uintahensis germ. 40(1/5 in 10th w), 70 GA-3(all rotted), OT(5/5 in March and early April), and 70D-40-70D-40-70D(3/5 in 4-6 d). When a sample started in 70L was shifted to OT on June 1 (7 m after starting), 100% germ. in the 2nd w. It appears that the daily temperature oscillations of around 50 to 70 each day were enough to initiate germination. A similar effect was found with P. montanus ssp. idahoensis confirming the reality of this unusual and unexpected effect. Seeds DS 2 y germ. 70D(5/7 in 4-8 w) and 40(2/12 in 11th w)-70D(1/12 on 3rd d).

Perilla (Lamiaceae). P. frutescens required light and temp. 55-75 with germ. lower at 50 and 80-85 (HC).

Pernettya (Ericaceae). P. macrostigma had a half-life of about 3 y (1st Suppl.). In accord with this seeds DS 5 y were dead.

Perovskia (Lamiaceae). P. atriplicifolia germ. in 3-5 d in 70D.

Petrorhagia (Caryophyllaceae). P. saxifraga fresh seeds had germ. 100% in 3-7 d in 70L and only 15% in 70D. Seeds DS 1 y germ. only 10% in 6-8 d in either 70D or 70L indicating extensive dying and loss of light requirement.

Petroselinum (Apiaceae).

P. crispum DS 4 y germ. 70D(55% in 1-3 w).

P. hortense (Parsley) germ. in 4th w in 70D confirming an earlier report (2n Ed.). This confirmation is reported because there are numerous popular articles claiming that parsley is difficult to germinate. A sample DS 4 y germ. 72% in 10-18 d in either 70D or 70L and 40(71% in 19-25 d).

Petunia (Solanaceae). P. hybrids germ. in 2-8 d in 70D. HC reported that germination required light and temp. 60-80. Our results are not in accord.

Phacelia (Hydrophyllaceae). P. bipinnatifida germ. 70,GA-3(3/9 in 4th w), 70D(1/12 in 3rd w), and none in 70L, 40-70D, or 40-70L. The 70D sample was carried through the 3 m at 70, 3 m at 40, and 2 w at 70D. After this it was treated with GA-3 whereupon 6/12 germ. in 1-5 w.

Phalolepis (Asteraceae). P. nigricans germ. 70L-40-70L-40-70L(1/4 in 11th w) and 70D-40-70D-40-70D(none).

Phaseolus (Fabaceae). P. vulgaris (Beans) germ. in 3-5 d in 70D.

Phoenicaulis (Brassicaceae). P. cheiranthoides data is now complete. It germ. 70D(4/5 in 2-11 d) and 40(2/6 in 3rd w)-70D(4/6 in 2nd w), 40-70L(4/7 in 3rd w), and 40-70D(7/7 in 3rd w). The 3 m at 40 eliminated the light effect. Seeds DS 1 y germ. 70D(4/19 in 2nd w) indicating a half life of about 9 m.

Phoenix (Palmaceae). P. dactylifera after 2 y DS germ. 4/5 in 3rd w in 70D similar to fresh seeds.

Phormium (Liliaceae). Definitive conclusions cannot be drawn because of the small numbers of seeds.

P. colensoi failed to germinate in 70D or 70L.

P. cookianum germ. 70L(1/1 in 9th w) and 70D(none). Seeds DS 1 y germ. 70D(3/5 in 2-4 w).

P. tenax germ. 70L(1/3 in 4th w) and 70D(none). Seeds DS 1 y germ. were dead.

P. tenax variegatum DS 1 y germ. 70D(1/32) and 70L(none).

Photinia (Rosaceae). Data on P. villosa is now complete. Seeds germ. 40-70D(100% 9-18 d) and 70D-40(30% in 12th w)-70D(70% on 2nd d) confirming the earlier conclusion that the blocking mechanism requires 3 m at 40 after which it germinates at either 40 or 70. Seeds DS 1 y germ. 40(96% in 7-16 w) and 70D-40(16% in 12th w)-70D(84% in 2-6 d). Seeds DS 2 y germ. 40(33% in 12th w)-70D(43% in 2-21 d) and 70D(none).

Phuopsis (Rubiaceae). P. stylosa germ. 100% in 3rd w in 70D. Light or a prior 3 m at 40 had no effect.

Phygelius (Scrophulariaceae). Data is now complete on P. aequalis and P. capensis. Both germ. 70L(100% on 8th d) and 70D(100% in 1-3 w). A prior 3 m at 40 had little effect.

Phylica (Rhamnaceae). P. pubescens failed to germinate in 70D.

Phyllostachys (Poaceae). P. pubescens (a bamboo) germ. 70D(50% in 1-4 w), 70L(60% in 2-4 w), and 40-70D(none). Seeds DS 1 y germ. the same in 70D, but seeds DS 2 y were dead.

Picea (Pinaceae). P. pungens (KR) germ. 70D(none) and 70 GA-3(20% on 12th d). An earlier sample had given 4% (fresh seed) and 10% (seed DS 6 m) germination in 70D, but GA-3 had not been tried (2nd Ed.).

Pieris (Ericaceae). P. formosa DS 4 y germ. 2% in 3rd w in either 70D or 70L. The light requirement has disappeared but the seeds are nearly dead.

Plantago (Plantaginaceae). P. lanceolata had germ. 75% in 70L and the other three 100% using fresh seeds (1st Suppl.).

P. coronopus DS 4 y germ. 70L(100% in 4-11 d) and 70D(2% in 2-4 w).

P. lanceolata DS 4 y germ. 70L(3% in 2nd w) and 70D(10% in 2nd w).

P. major DS 4 y germ. 70L(15% in 1-4 w) and 70D(none).

P. purshii DS 3 y germ. 70L(80% in 6-9 d) and 70D(12% in 2nd w).

Pleiospilus (Aizoaceae). P. bolusii DS 1 y germ. 70D(75% in 1-9 w) and 70L(90% in 1-3 w). Fresh seeds germ. only in 70L showing that DS 1 y almost completely eliminated the light requirement. Seeds DS 2 y germ. 70D(50% in 2nd w).

Plumbago (Apocyanaceae). P. capensis germ. best at 55-85 and zero at 50 (HC).

Podocarpus (Podocarpaceae). P. nivalis germ. 1/5 after 2 1/2 y of alternating 3 m cycles. The seedling was vigorous. Reports have been received that the seeds die quickly in DS and germinate in a 40-70D pattern (Paul Rezl).

Polemonium (Polemoniaceae). P. caeruleum and P. pauciflorum DS 4 y germ. under 3% and were nearly dead.

P. chartaceum germ. 70(GA-3)-40(4/15 in 8th w) and 40-70D(1/32). None germ. starting in 70D-40 or 70L-40.

P. vanbruntiae DS 1 y germ. 40-70D(62% in 4-9 d) which is nearly as high as the 40-70D(90%) found with fresh seed (2nd Ed.). Seeds DS 2 y germ. 40-70D(26% in 3rd w) which shows significant dying.

Polygonum (Polygonaceae). Only 3-5% germination had been achieved with P. orientale (2nd Ed., 1st Suppl.). JS and others have been unable to achieve satisfactory germinations confirming my work.

Polyxena (Liliaceae). The following updates the data in the 1st Suppl.

P. corymbosa germ. 70D(4/7 in 2-8 d)-40(2/7 in 4th w) and 40-70D(2/5 in 2-4 d).

P. ensifolia germ. 100% in 6-30 d in 70D.

P. odorata germ. 70D(100% in 4-17 d) and 40(90% in 4-8 w)-70D(10%).

Pontederia (Pontederiaceae). P. cordata seeds are enclosed in a corky covering which is probably designed to allow the seeds to float. After two months this corky covering was removed leaving the shiny brown seeds. None have germ. after 1 y in any of the treatments.

Portulaca (Portulacaceae).

P. grandiflora germ. in 2-5 d in 70D. HC reported that it germ. best at 60-85 with germination falling to zero at 50-55.

P. mundula (KR) germ. control (none) and GA-4 (12% on 4th d) in 32-75 OS.

Potentilla (Rosaceae).

P. recta had a complex behavior with fresh seeds germinating only in 70 GA-3. As DS progressed the seeds began germinating in 70L and then gradually in 70D as DS progressed to 3 y. Seeds DS 4 y germ. 70L(47% in 1-4 w) and 70D(30% in 1-6 w) showing that these trends continued as well as the gradual dying.

P. rupestrus DS 6 y germ. 70D(3% in 1-3 w) and 70L(7% in 1-3 w).

Prasophyllum (?). P. colensoi failed to germinate in 70D or 70L.

Pratia (Campanulaceae). P. angulata germ. 70L(90% in 4-12 w), 70D(5%), 40-70L(60% in 3rd w), and 40-70D(100% in 3rd w). Seeds DS 1 y germ. 70D(21% in 2-6 w) and 70L(80% in 3-8 w).

Primula (Primulaceae). The following seed samples were dead: P. bulleyana DS 5 y, P. forrestii DS 7 y, P. florindae DS 3 y, P. frondosa DS 6 y, and P. polyneura DS 6 y.

P. malacoides required light and temp. 60-75 (HC).

P. nevadensis DS 1 y germ. 70D(40% on 6th d) and 40(17% in 4th w)-70D(45% in 2-6 d).

P. specuicola DS 1 y germ. 70D(10% in 3rd w) and 40-70D(60% 4-9 d).

Protea (Proteaceae). P. repens seeds DS several years germ. 40(2/2 in 12th w) and 70D-40(1/2 in 10th w), but all three seedlings rotted on shifting to 70. None germ. in the other treatments including 70 GA-3. P. longifolia and P. mundii seeds which had been DS for several years rotted.

Prunus (Rosaceae).

P. "Bing Cherry" germ. 70D-40-70D(2/14 in 2nd w). After this 2nd w, half were opened and half were left as controls. The opened seeds germ. 4/5 in 2nd w whereas the controls did not germinate. More work is needed, but it does seem that seeds germinate better if the shell is cracked open.

P. "Golden Beauty" DS 1 y germ. 40-70D-40-70D(4/4 in 11th w). This germination is more delayed than with fresh seeds (1st Suppl.).

Pseudomuscari (Liliaceae). P. azureum germ. 40(100% in 2-8 w) and 70D-40(6/9 in 11th w)-70D(1/9 on 3rd d)-40(2/9 in 7th w). Light had no effect. Seeds DS 1 y gave similar results and seeds of P. azureum album also gave similar results. Seeds DS 2 y germ. 40(7/8 in 6-10 w) and 70D(none).

Psidium (Myrtaceae). P. guajava (KR) germ. 70D(65% in 3-5 w), and GA's had no effect.

Psychotria (Rubiaceae). P. nervosa had germ. 70D(6/7 in 6-23 w) and 40-70D(3/6 in 5-12 w)(1st Suppl.). Seeds DS 1 y germ. 70D(2/7 in 8th w). Seeds DS 2 y failed to germinate in 70D after 4 m and appear dead.

Ptelea (Rutaceae). P. trifoliata had shown little change in germination after DS 2 y, but after DS 3 y the seeds were dead.

Pulsatilla (Ranunculaceae). P. grandis germ. 70D(10% in 2nd w). P. alba and P. montana rotted confirming the relatively short life of Pulsatilla seed in DS.

Punica (Puniaceae). Data on P. granatum is now complete. A membrane adhers tightly to the seeds, and it makes a difference if this is scraped off in the first day or two of WC. Seeds scraped and WC 7 d germ. 60% in 3-10 w in 70D wheras unscraped seeds germ. only 20%. A prior 3 m at 40 was beneficial and raised percent germination in 70D to 90% in 1-3 w for seeds either rinsed or WC 7 d and either scraped or not scraped. The 3 m at 40 appears to allow time for the adhering membrane to rot away. Seeds DS 1 y germ. 10% indicating a half life of 6 m.

Putoria (Rubiaceae). P. calabrica germ. 70D-40-70D(2/16 on 5th d) with the rest rotting and 70L-40-70D-40-70D(7/8 in 3-6 d). Seeds DS 1 y were dead.

Pyrosia (Asteraceae). P. serpens were empty seed coats.

Pyrus (Rosaceae).

P. calleryana DS 1 y germ. 40(88% in 4-10 w) and 70D-40(75% in 8th w)-70D(25% on 3rd d). Seeds DS 2 y germ. 40(88% in 4-11 w) and 70D(35% in 2-8 w).

P. pyrifolia germ. 70D-40(1/3 in 12th w)-70D(1/3 on 3rd d) and 40(2/3 in 9-11 w)-70D(1/3 on 2nd d).

Ranunculus (Ranunculaceae). R. semiverticillatus failed to germinate in 70D, 70 GA-3, 40, or 40 GA-3. This genus generally has a short lifetime in DS.

Raphanus (Brassicaceae). R. sativus (Radish) germ. in 2-4 d in 70D.

Ratibida (Asteraceae).

R. columnifera red form germ. 80% in 3-9 d in 70D for seeds DS 1 y. This drops to 60% in 4-18 d after 4 y DS.

R. columnifera yellow form DS 1-3 y germ. 50% in 3-15 d in 70D. After 4 y of DS this dropped to 4% indicating a half life of about 3 y.

R. hybrids germ. in 3-9 d in 70D.

Rehmannia (Scrophulariaceae). R. elata DS 2 y germ. 70D(30% in 2nd w).

Reseda (Resedaceae). R. odorata (Mignonette) germ. in 2-10 d in 70D. HC reported that it germ. the same from 50-85. Seeds DS 2 y germ. 70D(88% in 2nd w) similar to fresh seeds.

Rhinephyllum (Aizoaceae). R. broomii germ. 30-40% in 2nd w in either 70D or 70L(1st Suppl.). It is now found that a prior 3 m at 40 was largely fatal. Seeds DS 1 y germ. 70D(21% in 2nd w), and seeds DS 2 y germ. 70D(2%) indicating a half life of 1 y.

Rhododendron (Ericaceae). R. hyb. seeds DS 4 y germ. 70D(none) and 70L(5% in 3rd w) showing that the light requirements (2nd Ed.) were still present although the seeds had nearly all died.

Ribes (Saxifragaceae). R. hirtellum germ. in a 40-70 pattern.

Rivina (Phytolaccaceae). R. humilis DS 3 y germ. 70L(80% in 2nd w) and 70D(44% in 2nd w).

Romneya (Papaveraceae). R. trichocalyx had an interesting pattern in which germination required GA-3, but the percent germination reached 100% only after the seeds had been DS 6 m. Seeds DS 2 and 3 y showed no signs of dying, but seeds DS 4 y germ. only 6% in GA-3 with the rest rotting. This indicates a half life of about 3.5 y.

Rosa (Rosaceae). Germinations are characterized by two features. First is that germinations begin after several cycles and continue over several years. Second is that light or GA-3 have no effect. Germination may occur in either 70D or 40, but when germination occurs at 70 it is usually within a few days after the shift to 70.

R. alba "Suaveolens" germ. 70D-40-70D-40-70D(1/3 on 9th d)-40-70D(1/3 in 3rd d).

R. canina germ. over several years (see 1st Suppl.) with little difference between fresh seeds or seeds DS up to 18 m. Seeds DS 2 y germ. only 6% in 2nd y which is markedly lower and indicates a half-life in DS of about 2 y.

R. eglanteria germ. 1/9 after 15-18 m of 3 m cycles starting either at 40 or 70D.

R. gallica "Tuscany Superba" germ. 70D-40-70D-40-70D(1/3 on 3rd d) and 40-70D-40-70D(1/4 on 3rd d)-40-70D(1/4 on 2nd d).

R. hybrid "Dornroschen" germ. 70D-40(1/10 in 12th w)-70D-40(1/10 in 5th w)-70D-40(1/10 in 12th w)-70D(1/10 in 5th d)-40-70D(1/10 on 4th d).

R. hybrid "Sheilers Provence" data is now more complete. It germ. 70D(2/9 in 8th w)-40-70D(2/9 on 2nd d)-40-70D(2/9 in 3-5 d).

R. palustris DS 2 y germ. the same 70D-40-70D(60%) showing no deaths.

R. paulii rosea germ. 70D-40-70D-40-70D-40-70D(1/12 on 3rd d)-40-70D(1).

R. rubrifolia has failed to germinate after 1 y starting in 70 or OT.

R. sp. South Dakota 6' germ. 70D-40-70D-40-70D(2/4 in 2-5 d) and OT(1/3 in April 18 m after starting).

R. sp. South Dakota 15-18" germ. 70D-40(1/4 in 11th w)-70D-40-70D-40(1/4 in 11th w)-70D(1/4 in 3rd d)-40-70D(1/4 on 4th d) and OT(2/5 in April 18 m after starting), and 40-70D-40-70D(1/5 on 3rd d).

Roscoea (Liliaceae). R. alpina germ. 70D(72% in 3rd w) and 40-70D(75% in 3rd w). Seeds DS 1 y germ. 70D(75% in 2nd w), and seeds DS 2 y germ. 70D(50% in 2-4 w)..

Roystonia (Palmaceae). R. regia DS 2 y were dead. Germination of fresh seeds were reported in the 1st Suppl.

Rubus (Rosaceae). R. argutus germ. best in OT and using seeds that have been DS at least 6 m. In the following Table germinations always occured in April and May. Empty seed coats were not counted as seeds, but this introduced some uncertainties into the data because with R. argutus it is not easy to distinguish empty seed coats from viable seeds.

Time of DS	% Germination in					
	1st Spring	2nd Spring	3rd Spring	4th Spring	5th Spring	Total
0	0	33%	15%	8%	1%	57%
6 m	0 (a)	49%	26%	6%	1%	82%
1 y	0	65%	16%	2%		83%
2 y	8%	19%	15%			42%
3 y	6%	47%				53%

(a) These seeds were placed in OT on March 15 whereas the other seeds were placed in OT in the fall. However, this does not seem to have changed the general pattern.

Rudbeckia (Asteraceae).

R. hybrids germ. 70D(42% in 4 d-4 w) for fresh seeds or seeds DS 1 y. HC reported that germination was the same from 55-85 but dropped to zero at 50. Both of our studies are not in accord with reports that temperatures of 82-90 are optimum.

R. occidentalis germ. 70D(71% in 4-10 w) for fresh seeds and 70D(88% in 4-15 d) for seeds DS 1 y.

Rumex (Polygonaceae). Germinations for the first six were about the same for seeds DS 3 y as for fresh seeds (see1st Suppl. for data on fresh seeds).

R. acetosa DS 3 y germ. 70D(90% in 2nd w) and 70L(100% in 2nd w).

R. acetosella DS 3 y germ. 70D(40% in 4-5 d) and 70L(90% ion 5th d).

R. alpinus DS 3 y germ. 70D(100% in 2-4 w) and 70L(100% in 3rd w).

R. crispus DS 3 y germ. 70D(none) and 70L(100% in 2nd w).

R. obtusifolius DS 3 y germ. 70D(none) and 70L(100% in 2nd w).

R. patientia DS 3 y germ. 70D(10% in 2nd w) and 70L(100% in 2nd w).

R. scutatus DS 3 y were dead. These had germ. 70L(100%) abd 70D(38%) for fresh seeds showing that the 3 y of DS was fatal.

Rupicapnos (Papaveraceae). R. africana germ. 70D(1/12 in 9th w)-40, 70L(2/13 in 6-10 w)-40(3/13 in 4th w), and 70 (GA-3)-40(5/10 in 2-8 w). Seeds DS 1 y were dead.

Ruta (Rutaceae). Data is now complete.

R. corsica germ. 70D(100% in 2-7 w).

R. graveolens germ. 70D(100% in 2-4 d) and 40(100% in 4-6 w).

Sabal (Palmaceae). S. palmetto DS 1 y germ. identically to fresh seeds (70-80% in 3-8 w in 70D). Seeds DS 2 y germ. 70D(41% in 4-9 w) and 40-70D(63% in 4-11 w) indicating a half life in DS of the order of 2 y. Seeds DS 3 y germ. 70D(27% in 2-6 w) and 40-70D(6% in 4th w).

Sagina (Caryophyllaceae). S. selaginoides DS 2 y germ. 70D(50% in 2nd w) and 70L(75% in 2nd w) confirming the continuing elimination of the light requirement as DS continued.

Sagittaria (Alismataceae). S. latifolia germ. 70L(2/3 in 2-8 w), 70D(none), 40-70L(1/1 in 2nd w), and 40-70D(none).

Saintpaulia (Gesneriaceae). S. ionantha (African Violet) required light and temp. 65-80 (HC).

Salpiglossis (Solanaceae). S. sinuata germ. in 2nd w in 70D. HC reported that it germ. the same 55-85 but lower at 50.

Salvia (Lamiaceae).

S. cyanescens (JS) germ. 100% in 3 d in 70 GA-3 and failed to germinate in other conditions including 70L.

S. fulgens (Annual Red Salvia) germ. in 4-8 d in 70D. HC reported that it germ. the same from 55-85 but lower at 50.

S. sclerea turkestanica DS 3 y germ. 70D(40% in 2nd w). A sample DS 6 y germ. 70D(6% in 2nd w).

S. superba DS 3 y germ. 70D(3% in 2nd w).

S. verticillata DS 3 y were dead.

Sandersonia (Liliaceae). The one successful method for S. aurantiaca was OT with germination occurring in July (GZ, 1st Suppl.). A variety of other treatments have failed to give significant germination even though the seeds remain firm for years and do not rot. JS and several other people have reported similar experience.

Sanguisorba (Rosaceae). S. minor germ. 90% in 3-6 d in 70D for either fresh seeds or seeds DS up to 3 y. Seeds DS 5 y germ. 70D(75% in 4-6 d) indicating perhaps a small amount of dying.

Santolina (Asteraceae). S. pectinata DS 3 y germ. 70D(5/11 in 1-4 w) and 70L(4/11 in 1-3 w).

Saponaria (Caryophyllaceae). S. ocymoides had germ. 70D(50% in 1-3 w) for fresh seeds or seeds DS 1 y. Seeds DS 2 y germ. 70D(30% in 2nd w) indicating a half life of 2-3 y.

Sassafras (Lauraceae). Kromm reports that S. varifolium has given 90% germination on a small sample when the seeds were overwintered outdoor with germination the following spring.

Saxifraga (Saxifragaceae). S. chrysantha germ. 70L-40-70L(8/13 in 5th w), 40-70D(2/7 on 3rd d), and none in other treatments.

Scabiosa (Dipsaceae).

S. atropurpurea germ. the same from 55-85 but near zero at 50 (HC).

S. farinosa DS 5 y were dead.

Schivereckia (Brassicaceae). S. doerfleri DS 6 m germ. 70D(100% in 7-9 d) and 40(100% in 3rd w). Seeds DS 1 y were largely dead.

S. monticola germ. 70D(44% in 1-6 w) and 40-70D(18% in 1-3 w). Seeds DS 1 y were largely dead.

Schizanthus (Solanaceae). S. hybrids germ. in 3rd w at 70.

Schizopetalon (Brassicaceae). S. walkeri data is now complete. Seeds germ. 70(100% in 2-14 d) for seeds DS either 6 m or 1 y and 40(100% in 4th w) for seeds DS 6 m. Light had no effect. Seeds DS 2 y germ. 70D(15% on 4th d) indicating extensive dying.

Schizophragma (Saxifragaceae). S. integrifolium DS 6 m germ. 70L(100% in 4th w), 70D(25% in 4-9 w), 40-70L(100% in 2-4 w), and 40-70D(50% in 6th w). The seeds are very small so that percent germinations are questionable. The somewhat positive effect of light is more evident in the faster rate of germination. Seeds DS 1 y were dead

Scilla (Liliaceae). S. chinensis germ 70D(60% in 4-9 w, 1st Suppl.). Seeds DS 1 y rotted and were dead.

Scirpus (Cyperaceae). S. holoschoenus DS 2 y germ. 70L(85% in 1-3 w) and 70D(none). The conclusion given in the 1st Suppl. is revised. It is now concluded that there has been no significant dying or disappearance of the light requirement in seeds DS of up to 2 y. Seeds DS 3 y germ. 70L(70% in 2nd w) and 70D(none).

Scleranthus (Caryophyllaceae).

S. biforus germ. 40-70D-40-70D(1/93 in 8th w) and none in 70D-40-70D-40-70D.

S. uniflorus germ. 70D(70% in 2-6 w) and 40(30% in 7th w)-70D(10% in 6th d). Seeds DS 1 y were dead.

Scrophularia (Scrophulariaceae). S. nodosa had a light requirement when fresh and this disappeared after 1 y DS (1st Suppl.). Seeds DS 1 and 2 y germ. 92% and 22% in 4-10 d in 70D respectively indicating a half life of about 18 m. In accord with this seeds DS 3 y germ. 5%.

Scutellaria (Lamiaceae).

S integrifolia DS 2 y were dead. The germinations of two samples of seeds DS 1 y were reported in the 1st Suppl. and gave different patterns.

S. resinosa germ. 70D(100% in 4-7 w), 40(20% in 7th w)-70D(80% IN 4-12 d), OT(60% in late March), and 70 GA-3(all rotted). Light had no effect.

Selenomeles (?). S. lechleri germ. 70D-40-70D(3/6 on 5th d)-40-70D and none in 70L-40-70L and 40-70D-40-70D.

Semiaquilegia (Ranunculaceae). S. elcalcarata germ. 70 GA-3(70% in 1-5 w), OT(20% in April), and none in 70D-40-70D-40 or 40-70D-40-70D. This is similar to most of the Aqullegia. Seeds DS 1 y germ. the same.

Senecio (Asteraceae). S. cruentus (Cineraria) germ. the same from 55-85 but dropping below 10% at 50 (HC).

Sesamum (Pedaliaceae). S. orientalis DS 2 y or 3 y germ. 70D(90% in 2nd w) similar to fresh seeds.

Sesbania (Fabaceae). S. tripetii germ. 100% on 3rd d at 70 but only if punctured. Seeds DS 2 y germ. the same.

Seseli (Apiaceae). S. gummiferum germ. 100% in 2-5 w in either 70D or 70L and 40-70D(80% in 1-5 d).

Silene (Caryophyllaceae). The following are updates.

S. californica germ. 100% in 2-7 d in 70D or 70L and 40-70D(100% in 3-20 d).

S. caroliniana germ. 100% in 2-7 d in 70D or 70L and 40(100% in 3rd w).

S. colorata germ. 100% on 3rd d in 70D or 70L and 40(100% in 3rd w). Seeds DS 1 y and 2 y germ. identically showing no trace of dying.

S. gallica DS 2 y or 3 y germ. 100% in 2-4 d showing no dying and confirming the elimination of any light effect after 1 y of DS.

S. schafta seeds DS 6 y were dead.

S. uniflora seeds DS 2 y were dead. This plus the earlier data indicates a half life of about 1.5 y.

Sinningia (Gesneriaceae). S. speciosa (Gloxinia) required light and temp. 65-85 (HC).

Sisyrinchium (Iridaceae).

S. laetum (2 samples) has failed to germinate after 2 y under all treatments. The seeds do not rot suggesting that some gibberellin is required for germination.

S. littorale germ. 70D-40(95% in 7th w). None germ. in 70L, 40, or 70 GA-3.

Sollya (Pittosporaceae). S. heterophylla germ. 70 GA-3(50% in 4th w), 70D(16% in 5th w), 70L(17% in 7th w), and none in 40-70D. If the 70 GA-3 treatment was preceded by 3 m at 40, germination dropped to 15%.

Sophora (Fabaceae). JS has studied S. mollis, S. prostrata, S. secundiflora, and S. tetraptera. Samples were small but the general result was that the seeds had an impervious seed coat and had to be punctured to get germination in 70D. Note that S. japonica had an impervious seed coat if the seeds were dried, but "green seeds" germ. immediately in 70D (2nd Ed.).

Sorbus (Rosaceae). S. americana germ. 40-70D(26% in 1-8 w), 70D-40-70D(16% in 1-3 w), and OT(80% in April). Germination was not initiated by GA-3. Seeds DS 6 m germ. 40-70D(29% in 1-3 w).

Spartium (Fabaceae). S. junceum DS 3 y germ. 5/7 in 2-9 d in 70D if punctured and 1/7 otherwise.

Spergularia (Caryophyllaceae).

S. rubra germ. 70D(15% in 1-4 w) and 70L(93% in 2-11 d). Seeds DS 1 y germ. about the same showing no disappearance of the light requirement.

S. rupicola germ. 70L(100% in 4th d) for seeds DS 0-2 y. Germination in the dark in 70D was 10% in 2nd w for fresh seed, 40% in 2nd w for seeds DS 1 y, and 30% in 3-8 d for seeds DS 2 y.

Sphaeralcea (Malvaceae).

S. ambigua DS 6 m germ. 70D(12% in 1-5 w), 70L(16% in 2nd w), and 40(20% in 6th w)-70D(20% on 2nd d).

S. incana data is now complete. Seeds germ. 70L(100% in 2 d-6 w), 70D(50% in 2-14 d), and 40(8%)-70D(15% in 2nd w). After 1 y DS the seeds germ. 70L(27% on 6th d) and 70D(10% on 7th d) showing significant dying.

Spigelia (Loganiaceae). S. marilandica samples were so small that reliable results have not been possible. One sample germ. 1/3 in May from seeds placed outdoors in February (2nd Ed.). A new sample failed to germinate in 70D or 70 GA-3, but did germinate 2/6 by giving OS for 2 w and shifting to 40. Germination occurred in 14th w after the shift to 40, and a stem and leaves developed 2 w after germination.

Sprekelia (Amaryllidaceae). S. formosissima germ. 100% on 4th d in 70D.

Stachys (Lamiaceae).

S. alpina DS 1 y were dead. Germination of seeds DS 6 m was low suggesting that the half life is less than 6 m.

S. lanata DS 6 m germ. 100% in 2-7 d in 70L or 70 GA-3 and in April from seed placed OT in mid-March. Germination in 70D was only 15% in 2nd w. After 1 y of DS germination was 70D(65% in 4-15 d) and 70L(100% in 5-14 d) and after 2 y of DS germination was 70D(80% in 4-8 d) and 70L(90% on 5th d). The percentage germination increases markedly after 2 y DS and the light requirement disappears.

S. macrantha DS 3 y germ. 70D(4% in 2nd w).

Stachyurus (Stachyuraceae). S. chinensis data is now more complete. Seeds germ. 70L(41% in 5-11 w)-40-70L(32% in 2-7 w), 70 GA-3(36% in 4-7 w), and 70D-40-70D(none). This last sample was kept for 2 y in alternating 3 m dark cycles. In the next two cycles in 70D 20% germ., but the light effect was still strong since when this sample was then shifted to 70L, 20% more germ. in 3rd w.

Stapelia (Asclepediaceae). S. leendertzii germ. 100% on 4th d in 70D or 70L. The germination in 70D drops to 3/7 in 2nd w for seeds DS 1 y and 2/10 after 2 y of DS indicating a half life of about 1 y.

Stenanthium (Liliaceae). S. occidentale data is now complete. Seeds germ. 70D(100% in 2-11 w) and 70L(100% in 2-7 w).

Stirlingia (Proteaceae). S. latifolia DS several years were dead.

Strelitzia (Musaceae). S. reginae DS 1 y germ. 4/5 in 2-4 w in 70D and seeds DS 2 y germ. 2/2 in 2nd w and 10th w in 70D. In contrast fresh seeds failed to germinate under these conditions. This calls into question a report that S. nicolae and S. reginae had impervious seed coats (1st Suppl.).

Streptocarpus (Gesneriaceae). S. hyb. (Cape Primrose) required light and temp. 60-75 (HC).

Streptopus (Liliaceae). S. rosea data is now more complete. Seeds germ. 70D-40-70D(2/6 on 8th d) and 40-70D(1/4 in 3rd w)-40-70D(1/4 on 7th d).

Stylomecon (Papaveraceae). S. heterophylla germ. 50% in 1-3 w in 70D. Seeds DS 1 y germ. 70D(6%) indicating a half life of about 6 m.

Styrax (Styracaceae). S. obassia has now germ. excellently. Seeds germ. 40-70D(100% in 3rd w) and 70D-40-70D(80% in 2-5 w). Puncturing the seed coats leads to rotting. The seeds swell and split a week or two before forming the radicle, and another two weeks are required before developement of the cotyledons.

Sutherlandia (Fabaceae). Data is more complete on S. montana and three more species have now been studied. Impervious seed coats are frequent.

S. frutescens prostrata germ. 100% in 2-4 w in 70D.

S. montana germ. 100% in 4-6 d in 70D if punctured and 70D(2/8 in 4th d)-40(1/8)-70D(1/8). These latter seeds were punctured after which the remaining seeds germ. by the 2nd d.

S. prostata germ. 70D(1/5 on 8th d).

S. sp. germ. 70D(100% on 2nd d) if punctured and 70D(22% in 2nd w) if not.

Symphoricarpos (Caprifoliaceae). S. albus both fresh seeds and seeds DS 1 y have failed to germinate under all conditions. They may be empty seed coats.

Synnotia (Iridaceae). Their is some indication that 3 m in 70L before shifting to 40 gives better germination than either 40 direct or 70D-40. Also DS for 1 y improved germination in the one species in which it was tried. More work is needed to confirm these provisional conclusions.

S. parviflora DS 6 m germ. 70D(1/9 in 12th w)-40(1/9 in 3rd w).

S. variegata DS 6 m germ. 70D-40(30% in 5-7 w) and 70L-40(60% in 5-7 w). A second sample failed to germinate in either of the above two treatments.

S. variegata kamphiae DS 6 m germ. 70D-40(55% in 5-7 w) and 70L-40(4/4 in 7th w).

S. variegata metelerkampiae DS 1 y germ. 70D(35% in 4-8 w)-40(10%) and 40(30% in 6-8 w)-70(20% in 4-8 d)-40(30% in 4-9 W). Seeds DS 2 y germ.,70D-40(5/6 in 3rd w) and 40(2/6 in 5th w).

S. villosa DS 6 m germ. 70L-40(100% in 4-9 w) and 70D(8% in 6-9 w)-40(4%)-70D-40-70D-40(5%). Seeds DS 2 y germ. 40(100% in 3-6 w) and 70D-40(90% in 4th w) indicating that no dying had occurred and that fresh seeds would probably have germ. directly at 40.

Tacitus (Crassulaceae). T. bellus failed to germinate in 70D or 70L.

Tagetes (Asteraceae). T. hybrids germ. in 2-4 d in 70D. HC reported it germ. the same from 50-85.

Talinum (Portulacaceae).

T. brevifolium germ. 70D(2/7 in 2nd w), 70L(4/6 in 2nd w), 40-70D(1/4 in 2nd w), and OT(2/5 in April).

T. sp., the inference in the 1st Suppl. that germination declined on DS for T. sp. is incorrect. Seeds germ. only in 40-70D(in 2nd w) and the percent germinations for fresh seed, seed DS 2 y, and seed DS 3 y were 12%, 38%, and 10% respectively.

Tamarindus (Fabaceae). T. indica has an impervious seed coat and germinates 100% in 3-12 d in 70D if punctured. Seeds DS 2 y germ. the same.

Tecoma (Bignoniaceae). T. stans germ. 100% in 3-7 d in 70D or 70L, and a prior 3 m at 40 had no effect. Seeds DS 1 y germ. 50% and seeds DS 2 y germ. 15% indicating a half life of 1 y.

Teesdaliopsis (Brassicaceae). T. conferta germ. 70D(100% in 3rd w) and 40(3/4 in 4th w).

Telephium (Caryophyllaceae). T. imperati failed to germinate in 70D.

Telesonix (Saxifragaceae). T. jamesii was found to require light for germination (2nd Ed.). A new sample behaved differently and germ.40-70D(1/10)-40-70D-40(3/10), 70D-40-70D-40-70D(5/13 in 2nd w), and none in 70L. The second sample may have undergone extensive DS and had the light requirement die away.

Thomasia (Sterculiaceae). T. quercifolia seeds several years old germ. 70D(2% in 7th w)-40(20% in 4th w) and 70L-40(36% in 8th w). The seeds largely rotted in 70 GA-3 or 40.

Thrysostachys (Poaceae). T. siamensis germ. 2% in 2nd w in 70D. Light or GA-3 had no effect, and the ungerm. seeds rotted. The low percent germination may be due to extensive DS as seeds DS 3 y further gave no germination.

Thunbergia (Acanthaceae). T. alata germ. the same 55-85 and near zero at 50 (HC).

Tibouchina (Melastomaceae). T. grandiflora, it is now clear that light is required for germination. Seeds germ. 70L(4/4 in 3rd w) and 70D(none). When the seeds in 70D were shifted to 70L after 8 w, 4/4 germ. in 3rd w. The seeds are very small, and initially there was difficulty in distinguishing seed from chaff.

Tilingia (Apiaceae). T. tachiroei germ. 70D-40-70D(3/3 in 4th w).

Tillandsia (Bromeliaceae). T. sp. seed was collected in Florida. In the 7th week the seeds in 70L and 70 GA-3 turned green and began photosynthesizing whereas the seeds in 70D did not. However, no further growth developed. This needs more study.

Torenia (Scrophulariaceae). T. hyb. germ. in 4-5 d in 70D. HC reported that it germ. the same at 70-85 but near zero at 50-65.

Trachelium (Campanulaceae). T. caeruleum germ. in 1-3 w in 70L and none in 70D.

Trachymene (Apiaceae). T. caerulea germ. 95% in 2nd w at 70 but only in light (1st Suppl.). After 1 y and 2 y DS the seeds germ. 70% in 2nd w in either 70L or 70D showing elimination of the light requirement. and some dying of the seeds. The half life is about 1 y. HC did not find this light effect and reported it germ. the same from 65-80 and lower at 50-60 and 85. It is likely that the seeds in his experiments had been DS a year.

Trachyspermum (Apiaceae). T. ammi DS 2 y germ. 70D(70% in 4-8 d) and DS 3 y 70D(60% in 4-10 d). This is nearly as high as seeds DS 0-1 y.

Tribeles (Saxifragaceae). T. australis has failed to germinate in 70D, 70L, 70 GA-3, and 40.

Trifurcia (Iridaceae). T. lahue caerulea germ. 70L(100% in 5-18 w) and 70D(none). When the sample in 70D was shifted to 70L after 9 w, 15% germ. in the 6th w. A prior 3 m at 40 did not change this light requirement, but germination was reduced from 100% to 40%. Seeds DS 1 y germ. 70D(100% in 8th w) and 70L(1/20). When the sample in 70L was shifted to 70D after 10 w, 2/20 germ. in 3rd w. Seeds DS 2 y germ. 90% in 2nd w if placed 10 w in 70L and then shifted to 70D, and none germ. directly in 70D. The results are so confusing that the experiments need to be repeated.

Trillium (Liliaceae).

T. grandiflorum was much studied (2nd Ed.) and found to require GA-3 for germination. A large sample was received which contained 26% dead seeds which started rotting in a few days in 70D. This large amount of rotting caused the remaining seeds to start germinating. This is interpreted as due to gibberellins being produced by the decay, because seeds left in the rot germ. 44% in 8-15 w in 70D and 40-70(80% in 8th w) whereas none germ. if washed every few days.

T. undulatum germ. 70D(7/50 in 12th w)-40(1/50) and 70 GA-3(all rotted).

Triosteum (Caprifoliaceae). T. perfoliatum failed to germinate in 70D or 40-70D. Puncturing the seeds coats had no effect.

Tripetaleia (Ericaceae). T. paniculata DS 6 m germ. 70L(100% in 3rd w), 70D(none), 40-70L(100% in 3-11 d), and 40-70D(none). When the seeds in 70D were shifted to 70L after 4 w, 58% germ. in the 2nd w. Seeds DS 1 y were dead.

Triteleia (Liliaceae). T. laxa germination was described in the 2nd Ed. A sample DS 4 y was dead.

Trollius (Ranunculaceae). T. pumilus DS 3 y and 4 y were dead.

Tropaeolium (Tropaeolaceae).

T. azureum germ. 40 (2/2 in 5th w) comparable to earlier samples.

T. major (Nasturtium) germ. in 4-8 d in 70D.

Tuberaria (Cistaceae). T. lignosa DS 6 m germ. 70D(5% in 8th w) and 40(5% in 3-12 w)-70D(5% in 3 d-7 w). Light or GA-3 did not have any effect. Seeds DS 1 y were dead. It is suspected that the low percent germinations are the result of rapid dying of the seeds in DS and that the half life might be under 6 m.

Tussilago (Asteraceae). The death rate on DS has been studied, and the seeds found to be dead after 4 w of DS at 70.

Uncinia (Asteraceae). Samples received under this name are possibly the genus Ursinia. U. rubra germ. 70D-40-70D(4/10 in 3rd w). U. uncinnata was chaff.

Urginea (Liliaceae). U. secunda germ. 100% in 2nd w in 70D or 40.

Urospermum (Asteraceae). U. delechampii was chaff.

Vaccaria (Caryophyllaceae).

V. hispanica (Saponaria vaccaria) rotted and were dead.

V. pyrimidata germ. 100% on 3rd d in 70D for seeds fresh or DS 2 y or 3 y.

Veltheimia (Liliaceae). V. bracteata germ. 75% in 2nd w in 70D (1st Suppl.). It is now found that a prior 3 m at 40 was fatal. Seeds DS 2 y were dead.

Verbena (Verbenaceae).

V. "Quartz Hybrids" germ. 70D(35% in 2nd w), 70L(65% on 6th d), 70 GA-3(35% in 2nd w), and 40(50% in 7-11 w).

V. "Wings Hybrids" germ. 70L(100% in 2nd w) and 70D(5% in 2nd w). The 70D sample was shifted to 70L after 3 w after which 75% germ. in 2-14 d.

V. mcdouglii germ. 70L(45% in 2nd w, 1st Suppl.). Seeds DS 3 y were dead.

Veronica (Scrophulariaceae). V. fruticans DS 1 y were dead. The complex germination patterns of fresh seeds are described in the 1st Suppl.

Veronicastrum (Scrophulariaceae). V. virginica germ. 70L(62% in 2nd w, 1st Suppl.). Seeds DS 2 y were dead.

Verticordia (Myrtaceae). V. chrysantha var. preissii and V. aff. ovalifolia seeds were DS several years when received and were all dead.

Viburnum (Caprifoliaceae). V. setigerum germination is now found to be speeded up by GA-3 although germination is in a second cycle at 40. Seeds germ. 70 (GA-3)-40(100% in 12th w), 70D-40-70D-40(40% in 8-12 w)-70D-40(40% in 3-12 w), and 40-70D-40-70D-40(50% in 4-8 w)-70D(10% in 1-12 w)-40(10% in 3-7 w). OT germ. 75% in Sept.-Oct. one year after being set outside in spring. Seeds DS 1 y germ. 70 GA-3(4/12 in 9th w) and 70D(none), and seeds DS 2 y were dead.

Vicia (Fabaceae). V. cracca from Iceland had an impervious seed coat. Fresh seeds or seeds DS 2 y germ. 100% on 3rd d in 70D if punctured.

Viguiera (Asteraceae). V. porteri data is now complete. Seeds germ. 70% in 6-14 d in 70D and 90% in 3-12 w at 40. Light or GA-3 had no effect.

Vinca (Apocyanaceae). V. rosea germ. in 3-7 d in 70D.

Vincatoxicum (Asclepediaceae). Germinations of V. hirundinaria and V. nigrum were described in the 1st Suppl. After 3 y DS seeds of V. hirundaria were nearly all dead and seeds of V. nigrum were about 50% dead. After 4 y DS they were both dead.

Viola (Violaceae). Eight samples of rosulate Viola had been studied (2nd Ed.) and found to germinate with GA-3 at 40. This was unchanged by 4 y of DS at 70, and there was no sign of dying. It thus came as a surprise to receive seeds of seven species all of which rotted completely in either 70D, 70 GA-3, 40, or 40 GA-3. I have no explanation for this. The seven species were V. coronifera, V. cotyledon, V. dasyphylla, V. fluehmannii, V. maculata, V. philippii, and V. aff. rosulata.

V. arborescens germ. 70 GA-3(100% on 6th d), 70L(6%)-40-70D(94% in 3rd w), 70D-40-70D(none), 40-70D(45% in 2nd w)-40-70D(20% on 2nd d), and OT(15% in April). Seeds DS 1 y germ. 40-70D(3/8 on 5th d) and 70D(all rotted).

V. odorata germ. 70 GA-3(4/10 in 2-5 w) and 70D(none) (KR).

V. tricolor hybrids (six samples) had complex behaviors but generally germ. best under oscillating temperature conditions. A sample freshly collected germ. 40(6/22 in 4th w), 70L(6/22 in 5th w), and 70D(none).

Vitaliana (Primulaceae). V. primuliflora germ. 100% in 2nd w in 70D for seed DS 6 m. Seeds DS 1 y were dead.

Vitex (Verbenaceae). V. agnus-castus DS 3 y germ. 70D-40-70D-40-70D(1) and 40-70D-40-70D(5/33 in 2nd w).

Wahlenbergia (Campanulaceae). Generally light was required for germination. It would help if this could be studied as a function of time of DS.

W. congesta DS 6 m required light for germination. One sample germ. 70L(40% in 3rd w), 70D(none), 40-70L(100% on 8th d), and 40-70D(none). An earlier sample was similar (1st Suppl.). After DS 1 y seeds germ. 70L(97% in 1-3 w) and 70D(20% in 2nd w). There is no indication as yet of dying but the light requirement is slowly disappearing. After 2 y of DS seeds germ. 70D(35% in 2nd w) confirming the gradual disappearance of the light requirement.

A sample labelled W. congesta hybrid also showed a light requirement though less dramatic. This germ. 70L(80% in 3rd w), 70D(19% in 2nd w), 40-70L(100% in 5-8 d), and 40-70D(4%).

W. gloriosa DS 6 m germ. 31-43% in 70D, 70L, and 70 GA-3 (1st Suppl.). It is now found that this was unchanged by a prior 3 m at 40. A second sample germ. 70L(20% in 2-4 w), 70D(17% in 2-5 w), 40-70L(100% in 5-8 d), and 40-70D(18% in 8-11 d). When this last sample was shifted to 70L after 5 w, 6% more germ. in 5-9 d. After 1 y DS seeds germ. 70L(60% in 1-3 w) and 70D(15% in 2nd w). The seeds are small, and it is difficult to detect empty seed coats making germination counts unreliable. My final conclusion is that there is some initiation of germination by light, and this conclusion is in accord with the more clear cut results on the other species studied.

W. saxicola DS 6 m germ. 70L(70% in 2nd w), 70D(3%), 40-70L(70% in 2nd w), and 40-70D(none). Seeds DS 1 y germ. 70L(70% in 1-3 w) and 70D(11% in 2nd w) which is similar to the seeds DS 6 m. Seeds DS 2 y were dead.

W. sp. DS 6 m germ. 70L(100% in 3rd w) and 70D(6%). Seeds DS 1 y germ. 70L(90% in 1-3 w) and 70D(none).

W. trichogyna DS 6 m germ. 100% in 3rd w in 70D or 70L.

Waitzia (Asteraceae). W. citrina was chaff.

Watsonia (Iridaceae). The data is now complete.

W. beatricis germ. 70D(3/4 in 4-8 d) and 70L(1/1 in 3rd w).

W. sp. germ. 100% in 1-5 w in 70D or 70L.

Withania (Solanaceae). W. somnifera data is now complete. It has been shown that light was required for germination (1st Suppl.). It is now found that this light requirement is unchanged after over a year of moist treatments.

Xanthoceras (Sapindaceae). X. sorbifolium germ. 70D(70% in 1-3 w). Seeds DS 6 m germ. similarly, but this dropped to 3/7 in 2nd w for seeds DS 2 y. Seeds DS 3 y germ. 70D(7/15 in 2nd w).

Xerophyllum (Liliaceae). X. tenax rotted and were dead.

Zaluzianskya (Scrophulariaceae). Z. capensis germ. in 3rd w at 70.

Zea (Poaceae). Seeds germ. 70D(100% in 2-6 d) but this drops to 35% in 2-9 d after 3 y DS and 3% on 4th d after DS 5 y.

Zenobia (Ericaceae). Z. pulverulenta were empty seed coats.

Zephyra (Haemodoraceae). The family was not given in the 1st Suppl.

Zinnia (Asteraceae). Z. elegans germ. in 2-4 d at 70. HC reported that it germ. the same from 55-85 but only 50% at 50.

CACTACEAE

The following updates the extensive data on Cactaceae which appeared in the First Supplement. The new results continue to support the general conclusion that 60-70% of all species of cacti require GA-3 for initiation of germination. All the data on cacti appear in this section.

Data were presented in the First Supplement that showed that in certain species the rate and percent germination in GA-3 treatment could be increased if the seeds were first subjected to dry storage. The most extensive study has been with Opuntia tuna, and two years of dry storage was clearly the optimum. In some species the GA-3 requirement dies off with dry storage. Superimposed on these effects is the death rate which is significant in these cacti so that the final result is that there is an optimum period for the dry storage. It would take extensive investigations on each species to determine this optimum time of dry storage.

The following observations support the effect of dry storage in promoting germinations. A collection of 56 species had been subjected to GA-3 treatment with varying amounts of germination. After three months at 70 the paper towel and enclosed seeds were dried and kept that way for a year. They were then remoistened. Eight of the species gave some germination in the 4th week. These eight species were Echinofossulocactus dichroacanthus, Lobivia acanthophlegma oligotricha, Mamillaria aurihamata, Opuntia basilaris v. woodburyi, two sample of Opuntia humifusa, Oreocereus celsianus, and Turbinocarpus lophophoroides.

The germination of commercial seeds are apt to vary erratically due to varying amounts of dry storage before distribution. Where sufficient seeds and time are available, it would be wise to retain half and dry store for a year before planting and compare the results with direct planting.

Most of the following data is from experiments of KR. Her experiments that are listed as at 70 actually had the temperature vary from night to day over 10-20 degrees so that her results are not directly comparable to mine at a constant temperature of 70. This is important because KR found that some species that required GA-3 for germination at 70 would also germinate at temperatures oscillating between 32 and 75. This effect of oscillating temperatures needs to be studied on more of the species.

Light effects have not been found in Cactaceae so that later experiments have omitted the 70L treatment.

Browningia. B. candelaris required GA-3 or GA-4 (but not GA-7) for germination and germ. 33-42% in 1-3 w at 50-70 (KR).

Cephalocereus. C. senilis germ. significantly (24-72%) under all conditions with 70 GA-4 being best (72% in 1-22 d)(KR). These results are more in line with other cacti than the meagre results reported in the 1st Suppl.

Copiapoa. C. bridgesii germ. 70 GA-3(1/5 on 4th d) and 70(1/5 on 23 rd d)(KR).

Echinocereus. Seventeen species had been studied (1st Suppl.). Of these nine required GA-3 for germination, four had germination improved by GA-3, two germ. with or without GA-3, and two failed to germinate. The notation 50-70 and 32-75 means that temperatures oscillated between these temperatures every 24 hours. Examples were found in which germination occurred at these oscillating temperatures or with GA-3 at 70, but not in 40 or 70. The following are results of KR.

E. pectinatus had germination improved with GA-3. A second sample germ. equally at 50-70 (64% in 1-3 w) with or without GA-3.

E. pectinatus v. wenigeri had germination improved with GA-3. A second sample germ. equally at 50-70 (100% in 1-3 w) with or without GA-3.

E. reichenbachii had germ. only with GA-3. A second sample germ. in comparable percentages at 32-75 (55-85% in 1-3 w) with or without GA treatments.

E. reichenbachii v. perbellus germ. at 32-75 somewhat better with various GA treatments similar to that reported before for germination at 70.

E. x roetteri germ. at 32-75 (48-80% in 1-6 w). Some of the GA treatments gave increased rate and percentage germinations with GA-4 being the best (80% in 5-10 d).

Eriosyce. E. ihotzkyana had required GA-3 (1st Suppl.), but GA's had only minor effects on the two following.

E. ceratistes (KR) germ. in oscillating 32-80(61% in 6-10 w).

E. sandillon (KR) germ. in oscillating 32-80(23% in 2-6 w). At temperatures around 70 it germ: 70 GA-3(3/5 in 3-5 w) and 0/5 in 70 or 70 GA-3.

Ferocactus. F. acanthoides had required GA-3 for germination and the percent germination had increased from 14% to 62% as the seeds were DS from 6 m to 3 y. Seeds DS 5 y germ. 70 GA-3 (40% on 10th d) and 70D(none).

Frailea. F. lepida germ. 70 GA-3 (2/5 in 1-5 w) and 70(none)(KR).

Gymnocalycium.

G. gibbosum (KR) germ. in oscillating 50-70 (69% in 1-3 w). GA's had little effect.

G. multiflorum DS either 2 y or 3 y had germ. 70 GA-3(100% in 3rd w) and 70D(20% in 2nd w). Seeds DS 5 y germ. 70 GA-3(5% in 1-3 w) and 70D(23% in 2-4 w) indicating significant dying.

Lobivia. L. bruchii fresh or DS 1 y had germ. 95% in 1-4 w in either 70D or 70 GA-3. Seeds DS 5 y germ. 70D(20% in 1-4 w) and 70 GA-3(4% in 2nd w).

Maihuenia. M. patagonica DS 2 y or 3 y germ. best with GA-3, 6/7 on 3rd d. Seeds DS 5 y germ. 70 GA-3(50% in 4-12 d) and 70D(none).

Mamillaria. Of the eleven species studied earlier (1st Suppl.) seven germ. with or without GA-3, three required GA-3, and one failed to germinate. Six more have now been studied by KR. Of the five described now GA's did not have much effect in four of the species and no conclusion can be drawn from the single germination in M. goldii. The germinations in 32-75 oscillating temperatures were M. aurihamata (68% in 1-3 w), M. theresae (100% in 2nd w), and M. wrightii (100% in 5-10 d). Treatment with GA-3 did not have much effect on these germinations.

M. lasiacantha germ. 40% in 1-3 w in 32-75 oscillating temperatures, 70 GA-3(2/5) and 70(0/5)(KR).

M. napina germ. 70 GA-3(4/6 in 4-7 d) and 70(0/6)(KR).

Neoporteria. Data of KR

N. engleri germ. 70 GA-3(1/5 in 5th w) and 70(none).

N. napina miris germ. 70 GA-3(4/5 in 4-7 d) and 70(2/5 in 1-5 w).

N. villosa germ. 70 GA-3(4/6 in 4-7 d) and 70(5/6 in 1-3 w).

Opuntia.

O. basilaris (S. Utah) DS 3 y germ. 70D(2/7) and 70 GA-3(3/11) both in 2nd w. Fresh seeds had failed to germinate under these conditions (1st Suppl.).

O. basilaris var. Woodburyi DS 3 y germ. 70D(3/11) and 70 GA-3(1/11) both in 2nd w. These germinations are in lower percentage than seeds fresh or DS 2 y, but the differences are small and the sample size is small.

O. humifusa was reported in the 1st Suppl. to germinate only with GA-3. This has now been confirmed many times. It was also reported that germination was over 90% if the seeds had been DS 1 y at 70, but fresh seed had much lower percent germination with spring collected seeds germinating 25% and fall collected seeds failing to germinate. The percent germination declined after 2 y DS and fell to 5% after 3 y DS. It does not seem to make much difference whether the seeds are collected in October, January, April, or June as long as the seeds are given about 1 y DS.

O. macrorhiza germ. 70 GA-3(4/5 in 3-5 w) and 70(3/5 in 4th w)(KR).

O. phaecantha DS 3 y germ. failed to germinate the same as fresh seeds.

Parodia.

P. comarapana had germ. 70 GA-3(8/15 in 2nd w) and 70(none). KR now finds that a new sample germ. 70 GA-3(7/10 in 1-6 w) and 70(4/10 in 1-6 w). Again the differences could be due to different amounts of dry storage.

P. microthele (KR) germinations were all conducted in 32-75 oscillating temperatures and occurred in 1-3 w. The percent germinations were control(4%), GA-3(20%), and GA-4(20%). Curiously CK alone gave 32% which should be checked because this is the rare example where CK alone initiated germination.

A COMPLETE LIST OF THE FAMILIES AND GENERA THAT HAVE BEEN STUDIED. DATA IN THE SECOND EDITION IS LABELLED (B), DATA IN THE FIRST SUPPLEMENT IS LABELLED (1), AND DATA IN THE SECOND SUPPLEMENT IS LABELLED (2).

ACANTHACEAE: Acanthus(1,2), Barleria(2), Ruellia(B), Thunbergia(1,2)

ACERACEAE: Acer(B,1)

AGAVACEAE: Agave(B), Beschorneria(1,2), Nolina(1,2)

AIZOACEAE: Aethephyllum (1,2), Argyroderma(1), Delosperma(B), Dorotheanthus(1,2), Mesembryanthemum(B,2), Pleiospilos(1,2), Rhinephyllum(1,2)

ALANGIACEAE: Alangium(1,2)

ALSTROEMERIACEAE (included in Amaryllidaceae)

ALISMACEAE: Alisma(B,2), Sagittaria(2)

AMARANTHACEAE: Amaranthus(1,2), Celosia(2), Gomphrena(B,1,2)

AMARYLLIDACEAE: Alstroemeria(B,2), Bomarea(1,2), Clivia (2), Cyrtanthus(2), Galanthus(B), Habranthus(B), Hymenocallis(B), Hypoxis(B), Ixolirion(B), Leucojum(B), Lycoris(B), Narcissus(B), Pancratium(1,2), Placeae(1), Rhodolirion(B), Rhodophiala(B,1), Sprekelia(2), Ungernia(B), Zephyranthes(B)

ANACARDIACEAE: Cotinus(1), Mangifera(1), Rhus(B)

ANNONACEAE: Annona(1,2), Asimina(B,1)

APIACEAE: Aciphylla(B,1), Aletes(2), Ammi(1), Anethum(B), Angelica(B,1), Anisotome(B), Anthriscus(B,1), Apium(1,2), Astrantia(B,1,2), Athamanta(B), Bupleurum(B,1,2), Carum(1,2), Chaerophyllum(2), Coriandrum(B), Cryptotaenia(2), Cuminium(1), Cymopteris(B,1,2), Daucus(B,2), Erigenia(B), Eryngium(B,2), Ferula(B), Foeniculum(1,2), Gingidium (2), Heracleum(B), Lavetia(2), Levisticium(B,1), Lignocarpa(2), Ligusticum(1), Lomatium(B,1), Malabaila(2), Melanoselinum(2), Melospermum(1,2), Meum(B), Myrrhis(B), Peganum(1), Petroselinum(2), Pimpinella(B), Pleurospermum(1), Porophyllum(1), Pseudotaenidia(B), Sanicula(1), Selinus(B), Seseli(2), Shoshonea(1), Smyrnium(1), Spilanthes(1), Thaspium(1), Tilingia(2), Trachymene(1,2), Trachyspermum(1,2), Zizia(B,1)

APOCYNACEAE: Adenum(B), Amsonia(B,1,2), Catharanthus(1), Mandevilla(1,2), Nerium(B,1), Parsonia(1), Plumbago(2), Plumeria(1), Vinca(2)

AQUIFOLIACEAE: Ilex(B,1,2), Nemopanthus(1)

ARACEAE: Arisaema(B,1), Arum(B,2), Dracunculus(1,2), Eminium(B), Lysichiton(B,1), Orontium(B), Pinellia(B), Sauromatum(1), Symplocarpus(B,1), Zantedeschia(1)

ARALIACEAE: Aralia(B,1,2), Fatsia(1), Kalopanax(1), Panax(B)

ARISTOLOCHIACEAE: Aristolochia(B,1), Asarum(B)

ASCLEPIADACEAE: Araujia(2), Asclepias(B,1,2), Cynanchum(1,2), Haloragis(2), Matelea(B,1), Oxypetalum(1), Periploca(B), Stapelia(1,2), Stephanotis(1), Vincatoxicum(1,2)

ASTERACEAE: Achillea(B), Actinomeris(2), Ageratina(1,2), Ageratum(2), Ajania(B), Allardia(2), Alyssum(2), Ambrosia(2), Anacyclus(B), Anaphalis(B), Andryala(B), Antennaria(B), Anthemis(B), Arctium(1), Argyranthemum(2), Arnica(B), Artemisia(B,1,2), Aster(B,1,2), Asteromoa(B,1,2), Atractyloides(1), Balsamorhiza(B), Berardia(1,2), Berlandiera(1,2), Bidens(2), Brachycome(2), Brachyglottis(1), Calendula(1), Callistephus(2), Carlina(B), Carthamus(B), Celmisia(B), Centaurea(B), Chaenactis(B), Chamaechaenactis(B), Chamaemelum(1), Chilotrichum(2), Chrysanthemum(B,2), Chrysopsis(B), Cicerbita(1), Cichorum(B), Cnicus(1), Coreopsis(B), Cosmos(2), Cremanthodium(B), Crepis(1), Criscoma(1), Dahlia(2), Dendranthema(2), Dimorphotheca(B,2), Doligloglottis(2), Doronicum(B), Echinaceae(1), Echinops(1), Enceliopsis(B), Engelmannia(1), Erigeron(B,1), Eriophyllum(B), Euceliopsis(1,2), Eupatorium(B,1), Gaillardia(B,2), Gamocheta(1), Gazania(2), Gutierrizia(B), Halocarpha(2), Haplopappus(B,2), Helianthus(B), Helichrysum(B,2), Heterotheca(B), Hieracium(1,2), Hippolytica(B), Hulsea(2), Hymenolepis(2), Hymenoxys(B), Inula(B,1,2), Lactuca(1,2), Leontodon(1,2), Leontopodium(B,2), Leptinella(1,2), Liatris(B,2), Ligularia(B,1), Lygodesma(B), Machaeranthera(B,2), Marshallia(B), Matricaria(1), Melampodium(B), Mutisia(B,2), Nardophyllum (2), Olearia(1), Omalotheca(1,2), Onopordum(1,2), Pachystegia(B,1,2), Phalolepis(2), Pilosella(1), Psathyrotes(1), Psychrogeton(B), Pyrosia(2), Ratibida(1,2), Rudbeckia(B,1,2), Santolina(2), ~~Saussurea(B)~~, Senecio(B,1,2), Silybum(1), Solidago(B), Stokesia(B), Tagetes(2), Tanacetopsis(B), Tanacetum(B,1), Taraxacum(B), Townsendia(B), Tussilago(B,2), Uncinia (2), Urospermum(2), Vernonia(B,1), Viguiera(1,2), Waitzia(2), Waldheimia(B), Wyethia(B), Xeranthemum(B), Xylanthemum(B), Zinnia(2)

BALSAMACEAE: Impatiens(B,1,2)

BEGONIACEAE: Begonia(B,1,2)

BERBERIDACEAE: Achlys(2), Berberis(B), Bongardia(B), Caulophyllum(B,1,2), Diphylleia(1), Dyosma(2), Epimedum(B), Gymnospermium(B), Jeffersonia(B), Leontice(B), Mahonia(B), Nandina(B,1), Podophyllum(B)

BETULACEAE: Alnus(B,1), Betula(B,1), Corylus(B,1,2), Ostrya(B)

BIGNONIACEAE: Argylia(B), Campsis(B), Catalpa(B,1,2), Chilopsis(B), Eccremocarpus(1), Incarvillea(B), Jacaranda(B,2), Kigelia(1), Macfadyena(1), Pandorea(1,2), Spathodea(1,2), Tecoma(2), Tecomaria(1)

BIXACEAE: Bixa(B,1)

BOMBACEAE: Bombax(1), Fremontodendron(1)

BORAGINACEAE: Anchusa(B,1,2), Arnebia(B), Borago(B,1), Cerinthe(1,2), Cryptantha(B,1,2), Cynoglossum(B,1,2), Echioides(B), Ehretia(1), Eritrichum(B,1), Hackelia(1), Halgania(2), Heliotropium(1,2), Lindelofia(B), Lithospermum(B,1), Mertensia(B,1,2), Moltkia(1), Myositidium(2), Myosotis(B,2), Omphalodes(1,2), Onosma(B), Onosmodium(2), Pseudomertensia(B), Pulmonaria(B)

BRASSICACEAE: Aethionema(B), Alyssoides(B), Alyssum(B,2), Anelsonia (2), Arabis(B), Aubrieta(B,1), Barbarea(1,2), Biscutella(1), Brassica(B), Braya(1), Cardamine(1), Cheiranthus(B,2), Cochlearia(B,1,2), Coluteocarpus(1), Crambe(1,2), Degenia(B), Dentaria(B,1), Draba(B,2), Ermannia(2), Erysimum(B), Eunomia(B), Fibigia(B), Hesperis(B), Hutchinsia(B), Hymenolepis(2), Iberis(B,1,2), Isatis(1,2), Kernera(1), Lepidium(B), Lesquerella(B), Lunaria(B), Mathiola(B,1,2), Moricanda(1,2), Nasturtium(B), Notothlaspi(1), Orychophragmus(1,2), Parrya(B), Petrocallis(B), Phoenicaulis(1,2), Physaria(B), Physoptychis(1), Ptilotrichum(B,1), Raphanus(2), Rorippa(1), Schivereckia(1,2), Schizopetalon(1,2), Stanleya(B), Teesdaliopsis(2), Thlaspi(B)

BROMELIACEAE: Cryptanthus(2), Tillandsia(2)

BRUNIACEAE: Berzelia(2), Brunia(2), Nebelia(2)

BUTOMACEAE: Butomus(B)

BUXACEAE: Sarcococca(B)

CACTACEAE: See list of 101 genera in Chapter 5 of First Supplement. In this 2nd Suppl. there is an update on a number of these genera.

CALYCANTHACEAE: Calycanthus(B), Chimonanthus(1,2)

CAMPANULACEAE: Adenophora(B), Asyneuma(1,2), Azorina(1,2), Campanula(B,1,2), Codonopsis(B,1,2), Cyananthus(B), Edraianthus(B,2), Ennealophus(2), Jasione(B), Laurentia(2), Legousia(1,2), Michauxia(B), Musschia(2), Ostrowskia(B), Physoplexis(B), Phyteuma(B), Platycodon(B), Pratia(2), Specularia(1,2), Symphyandra(B), Trachelium(B,2), Wahlenbergia(1,2)

CANNACEAE: Canna(B)

CAPPARIDACEAE: Capparis(B,1), Cleome(B,1), Polanisia(1)

CAPRIFOLIACEAE: Heptacodium(2), Kolkwitzia(B), Leycesteria(1,2), Lonicera(B), Sambucus(B,1), Symphoricarpos(B,2), Triosteum(1,2), Viburnum(B,1,2), Weigelia(B)

CARICACEAE: Carica(B,1,2)

CARYOPHYLLACEAE: Acanthophyllum(B), Agrostemma(1), Arenaria(B,1), Cerastium(B,1,2), Dianthus(B,1,2), Gypsophila(B,2), Herniaria(1), Honckenya(1), Lycene(2), Lychnis(B,1,2), Melandrium(B), Minuartia(B,1), Moehringia(2), Paronychia(B), Petrocoptis(B), Petrorhagia(2), Sagina(1,2), Saponaria(B,1,2), Scleranthus(2), Silene(B,1,2), Spergularia(1,2), Stellaria(1), Telephium(2), Vaccaria(1,2)

CASUARINACEAE: Casuarina(1)

CELASTRACEAE: Celastrus(B), Euonymus(B,1,2)

CERCIDIPHYLLACEAE: Cercidiphyllum(B)

CHENOPODIACEAE: Atriplex(1,2), Beta(2), Chenopodium(B,1,2), Kochia(2), Morocarpus(B)

·**CHLORANTHACEAE:** Chloranthus(B)

CISTACEAE: Cistus(B), Fumana(B), Halimium(1,2), Helianthemum(B), Hudsonia(B), Tuberaria(2)

CLETHARACEAE: Clethra(B,1)

CNEORACEAE: Cneorum(1)

COMMELINEACEAE: Commelina(B,2), Tradescantia(B,1)

CONVOLVULACEAE: Argyreia(1), Calonycton(1), Convolvus(B,1,2), Cuscuta(1), Ipomoea(B,1,2), Merremia(1,2), Mina(1)

CORIARIACEAE: Coriaria(B,1)

CORNACEAE: Aucuba(B), Cornus(B,1,2), Corokia(2)

CRASSULACEAE: Aeonium(1), Chiastophyllum(B), Cotyledon(1), Dudleya(B,1), Kalanchoe(B,2), Orostachys(1), Rhodiola(B), Rosularia(1), Sedum(B,1), Sempervivum(B), Tacitus(2), Umbilicus(B)

CUCURBITACEAE: Citrullis(B,1,2), Cucumis(B,1,2), Cucurbita(B,1,2), Echinocystis(B), Kedrostis(1,2), Momordica(1,2), Sicyos(B), Trichosanthes(B)

CUNONIACEAE: Ackama(2)

CUPRESSACEAE: See Pinaceae

CYPERACEAE: Baumea(2), Bolboschoenus(2), Carex(1,2), Cyperus(1,2), Eleocharas(2), Eriophorum(1), Gahnia(2), Scirpus(1,2), Trichophorum(1)

DIAPENSACEAE: Galax(2), Pyxidanthera(B), Shortia(B,1)

DILLENACEAE: Actinidia(B), Hibbertia(1)

DIOSCOREACEAE: Dioscorea(B,2), Tamus(B)

DIPSACACEAE: Cephalaria(B,2), Dipsacus(B,1,2), Jurinella(B), Knautia(1), Morina(1,2), Pterocephalus(1), Scabiosa(B,1,2), Succisa(1)

DROSERACEAE: Dionea(B), Drosera(1,2)

EBENACEAE: Diospyros(B,1,2)

ELAEOCARPACEAE: Arisotella(2), Crinodendron(1)

ELEAGENACEAE: Eleagenus(B,1,2), Hippophae(B), Shepherdia(1)

EMPETRACEAE: Empetrum(1)

EPACRIDACEAE: Cyathodes(1,2), Dracophyllum(2), Leucopogon(1,2)

EPHEDRACEAE: Ephedra(B,2)

ERICACEAE: Arbutus(B,1,2), Arctostaphylos(B,1,2), Bruckenthalia(B), Cassiope(B), Chamaedaphne(1,2), Cladothamnus(2), Daboecia(1), Enkianthus(B), Epigea(B), Gaultheria(B,1,2), Kalmia(B), Ledum(B), Leiophyllum(B), Leucothoe(B), Loiseleuria(1), Lyonia(B), Menziesia(1), Oxydendrum(B), Pernettya(B,1,2), Phyllodoce(B), Pieris(B,2), Pyrola(1), Rhododendron(B,2), Tripetaleia(2), Vaccinium(B,1), Zenobia(2)

EUCRYPHIACEAE: Eucryphia(2)

EUPHORBIACEAE: Croton(2), Euphorbia(B,1,2), Jatropha(1,2), Sapium(1), Securinega(B)

FABACEAE: Acacia(B,1,2), Albizzia(B,2), Amorpha(1,2), Anthyllis(B), Astragalus(B,1), Baptisia(B,1,2), Bauhinia(B), Caesalpina(1,2), Cajanus(1), Carmichaelia(1), Cercis(B), Chamaecytisus(B,1,2), Chamaespartium(2), Chordospartium(1), Cicer(1), Cladastris(B,1,2), Clianthus(B,1,2), Clitoria(1,2), Colutea(B,2), Coronilla(B), Cytisus(B), Dalea(B), Delonix(1,2), Desmanthus(1), Desmodium(1,2), Dorycnium(B), Erythrina(1), Galega(1), Genista(B), Gleditsia(B), Glycyrrhiza(1), Gymnocladus(B), Hardenburgia(B,1), Hedysarum(B), Indigofera(B), Laburnum(B), Lathyrus(B,1,2), Lespedeza(B), Leucaena(1,2), Lotus(B), Lupinus(B,2), Maackia(1), Medicago(1), Melilotus(1,2), Ononis(1,2), Oxytropis(B,1,2), Parochetus(2), Phaseolus(1,2), Piptanthus(B), Pueraria(1), Robinia(B), Sesbania(1,2), Sophora(B,1,2), Spartium(2), Sutherlandia(1,2), Tamarindus(1,2), Tephrosia(B,1), Tetragonolobus(1), Thermopsis(B,1), Trifolium(B,1), Trigonella(1), Vicia(B,1,2), Wisteria(B)

FAGACEAE: Castanea(1), Lithocarpus(1), Quercus(B,1)

FOUQUIERIACEAE: Fouquieria(1)

FRANKENIACEAE: Frankenia(1)

FUMARACEAE: Adlumia(B), Corydalis(B,1,2), Dicentra(B,1)

GENTIANACEAE: Blackstonia(B), Centaurium(B,1,2), Eustoma(B), Exacum(2), Frasera(B,1), Gentiana(B,1,2), Gentianella(B,1), Gentianopsis(B), Lisianthus(B), Lomatogonum(B), Menyanthes(1), Sabatia(B), Swertia(B)

GERANIACEAE: Geranium(B,1,2), Pelargonium(2)

GESNERIACEAE: Briggsia(B), Haberlea(B), Jankae(B), Opithandra(B), Ramonda(B), Saintpaulia(2), Sinningia(2), Streptocarpus(2)

GINKOACEAE: Ginko(B)

GLOBULARIACEAE: Globularia(B,1,2)

GOODENIACEAE: Goodenia(1), Lechenaultia(2)

HAEMADORACEAE: Anigozanthos(1,2), Wachendorfia(1), Zephyra(1,2)

HALORAGIDACEAE: Gunnera(B,1)

HAMAMELIDACEAE: Corylopsis(B), Hamamelis(B,1), Liquidambar(B), Parrotia(B), Parrotiopsis(B)

HIPPOCASTANACEAE: Aesculus(B,1)

HYACINTHACEAE: Daubenya(1)

HYDRANGACEAE: Deinanthe(B)

HYDROPHYLLACEAE: Draperia(1), Hesperochiron(1), Hydrophyllum(1), Nama(1), Nemophila(B,2), Phacelia(B,1,2), Romanzoffia(B), Turricula(1)

HYPERACEAE: Hypericum(B,1,2)

IRIDACEAE: Acidanthera(B), Alophia(2), Aristea(2), Babiana(2), Belamacanda(B,2), Calydorea(2), Chasmanthe(2), Crocosmia(B,1), Crocus(B), Cypella(1), Dierama(B), Dietes(1,2), Diplarrhena(2), Ferraria(2), Freesia(B,2), Geissorhiza(2), Gelasine(2), Gladiolus(B), Gynandiris(2), Hermodactylus(B), Hesperantha(2), Homeria(2), Iris(B,1,2), Ixia(2), Juno(B,1,2), Lapeirousia(B,2), Libertia(1,2), Melasphaerula(B), Montbretia(2), Moraea(B,1), Nemastylis(B), Olsynium(2), Orthrosanthus(1,2), Patersonia(2), Romulea(B), Sisyrinchium(B,1,2), Sparaxis(1), Synnotia(2), Tigridia(B), Trifurcia(2), Tritonia(1), Watsonia(1,2)

JUGLANDACEAE: Carya(1), Juglans(B,1)

JUNCACEAE: Juncus(1,2), Luzula(1)

LAMIACEAE: Acinos(1), Aethiopsis (1,2), Agastache(B,1,2), Ajuga(B), Amethystia(1), Ballota(B), Blephilia(1), Coleus(2), Collinsonia(B), Dracocephalum(B,1), Eremostachys(B), Galeopsis(2), Hedeoma(1), Horminum(B), Hymenocrater(B), Hysoppus(B,1,2), Isotoma(1,2), Lagopsis(1), Lallemantia(B,2), Lamium(B), Lavandula(B,1), Leonotis(1,2), Leonurus(1), Lepechina(1), Lycopus(1), Majorana(B), Marrubium(1), Melissa(1,2), Mentha(B,1,2), Micromeria(1,2), Moluccella(1,2), Monarda(B,1,2), Monardella(B), Mosla(2), Nepeta(B,1,2), Ocimum(B), Origanum(B,2), Pelkovia(B), Perilla(2), Perovskia(1,2), Petroselinum(B), Phlomis(B,1), Physostegia(B), Poliomintha(1), Prunella(B,1), Pycnanthemum(1), Rosmarinus(B), Salvia(B,1,2), Satureia(B), Scutellaria(B,1,2), Sideritis(B), Stachys(B,1,2), Teucrium(B), Thymus(B), Trichostema(B,1), Ziziphora(B)

LARDIZABALACEAE: Akebia(1), Decaisnea(B,2)

LAURACEAE: Lindera(B), Sassafras(B,1,2)

LECYTHIDACEAE: Bertholletia(1)

LENTIBULARIACEAE: Pinguicula(B,1)

LILIACEAE: Agave(B), Agrostocrinum(1), Albuca(1,2), Allium(B,1,2), Androcymbium(B,2), Androstephium(B), Anthericum(B,1), Arthropodium(B,1,2), Asparagus(B,1,2), Asphodeline(B,1,2), Asphodelus(B,1,2), Baometra(2), Bellevalia(B), Bloomeria(1), Brimeura(B,1), Brodiaea(B,2), Bulbine(1,2), Bulbinella(B), Bulbocodium(B), Calochortus(B,1), Caloscordum(B), Camassia(B), Cardiocrinum(B,1,2), Chamaelirium(2), Chionodoxa(B), Chlorogalum(B), Clintonia(B), Colchicum(B,1), Convallaria(B), Cordyline(1,2), Dianella(1,2), Dichelostemma(1,2), Dipcadi(1,2), Disporum(B), Drymophila(2), Eremurus(B,1,2), Erythronium(B,1), Eucomis(1,2), Fritillaria(B,1,2), Gagea(B), Galtonia(B,2), Gloriosa(1), Glyphosperma(1,2), Hastingsia(B), Helonias(B,1,2), Hemerocallis(B), Hesperaloe(1), Hosta(B), Hyacinthella (2), Hyacinthus(B), Ipheion(1), Ixolirion(B), Kniphofia(B), Korolkowia(B), Lachenalia(1,2), Leopoldia(2), Leucocrinum(B,1), Lilium(B,1,2), Liriope(B), Lloydia(B), Maianthemum(B), Manfreda(B), Medeola(2), Merendera(B), Milligania(2), Muscari(B), Muscarimia(2), Narthecium(1), Nectaroscordum(1,2), Nomocharis(2), Notholirion(1), Nothoscordum(B,2), Odontostomum (2), Ophiopogon(B), Ornithogalum(B,1), Paradisea(B,1), Paris(B), Phormium(1,2), Polygonatum(B,1), Polyxena(1,2), Pseudomuscari(2), Puschkinia(B), Rhinopetalum(B), Roscoea(2), Sandersonia(B,1,2), Schoenolirion(B), Scilla(B,1,2), Scoliopus(B), Smilacina(B), Smilax(B), Stenanthium(1,2), Strangweia(B), Streptopus(1,2), Stypandra(1), Theropogon(B), Thysanotus(1), Tofieldia(1), Tricyrtis(B), Trillidium(B), Trillium(B,1,2), Triteleia(B,2), Tulbaghia(1), Tulipa(B,1), Urginea(2), Uvularia(B), Veltheimia(1,2), Veratrum(B,1), Xeronema(B), Xerophyllum(B,2), Yucca(B), Zygadenus(B)

LIMNANTHACEAE: Limnanthes(B,2)

LINACEAE: Linum(B,1,2)

LOASACEAE: Cajophora(B,1,2), Loasa(B), Mentzelia(B,1,2), Petalonyx(1)

LOBELIACEAE: Lobelia(B,1,2)

LOGANIACEAE: Buddleia(B,1,2), Spigelia(B,2)

LORANTHACEAE: Phoradendron(B)

LYTHRACEAE: Cuphea(B,2), Heimia (2), Lawsonia(1), Lythrum(B)

MAGNOLIACEAE: Liriodendron(1), Magnolia(B,1,2)
MALESHERBIACEAE: Malesherbia(B)
MALVACEAE: Abutilon(B,1,2), Alcea(1,2), Althaea(1,2), Anisodontea (2), Anoda(2), Gossypium(1), Heimia(2), Hibiscus(B,1,2), Hoheria(1), Illiamna(B), Kitaibelia(1), Lagunaria(1,2), Lavatera(1,2), Malacothamnus(1), Malope(1,2), Malva(B,1), Malvaviscus(1), Modiola(1), Pavonia(2), Sidalcea(B), Sphaeralcea(B,1,2), Thespesia(1)
MARTYNIACEAE: Ibicella(1,2)
MELASTOMACEAE: Osbeckia(B), Rhexia(B), Tibouchina(1,2)
MELIACEAE: Cedrela(1), Melia(1,2)
MELIANTHACEAE: Greyia(1,2)
MENISPERMACEAE: Calycocarpum(1,2), Cocculus(1)
MESEMBRYANTHEMACEAE: Delosperma(B)
MORACEAE: Broussonetia(1,2), Cannabis(1), Ficus(1,2), Humulus(1), Maclura(B), Morus(B)
MUSACEAE: Musa(1,2), Musella (2), Strelitzia(1,2)
MYOPORACEAE: Eremophila (1,2), Myoporum(1,2)
MYRICACEAE: Myrica(B,1)
MYRSINACEAE: Ardisia(1,2), Myrsine(1)
MYRTACEAE: Callistemon(B,1,2), Calothamnus(B,1), Eucalyptus(B,1), Darwinia(2), Feijoa(1), Kunzea(B,1), Leptospermum(1,2), Malleostemon(2), Melaleuca(B,1,2), Myrtus(1), Psidium(2), Verticordia(2)

NOLANACEAE: Nolana(1,2)
NYCTAGINACEAE: Abronia(B), Mirabilis(B,1,2), Tripterocalyx(1)
NYMPHAECEAE: Nelumbo(B), Nymphaea(B)
NYSSACEAE: Davidia(1,2), Nyssa(B,1,2)

OCHNACEAE: Ochna(1,2)
OLEACEAE: Abeliophyllum(B), Chionanthus(B,1), Forsythia(B), Fraxinus(B,1,2), Jasminum(B), Ligustrum(B), Menodora(B), Nyctanthes(1), Olea(2), Syringa(B)
ONAGRACEAE: Calylophus(1), Circaea(B,1), Clarkia(B,2), Epilobium(B,1,2), Fuschia(B), Gaura(B), Godetia(1,2), Lopezia(1), Oenothera(B,1,2), Zauschneria(B)
ORCHIDACEAE: See Chapter 21 in the Second Edition
OROBANCHACEAE: Orobanche(1)
OXALIDACEAE: Averrhoa(2), Oxalis(B)

PALMACEAE: Butia(1,2), Livistonia(1,2), Phoenix(B,1,2), Roystonia(1,2), Sabal(B,1,2), Serenoa(1), Washingtonia(B,1)
PARNASSIACEAE: See Saxifragaceae

PAPAVERACEAE: Arctomecon(1), Argemone(B,1,2), Chelidonium(B), Dendromecon(1), Dicranostigma(1), Eschscholzia(1,2), Fumaria(1), Glaucium(B,1), Hunnemania(1,2), Hylomecon(2), Macleaya(B), Meconopsis(B,1), Papaver(B,1,2), Romneya(B,1,2), Rupicapnos(2), Sanguinaria(B,1), Stylomecon(1,2), Stylophorum(B)

PASSIFLORACEAE: Passiflora(B,1)

PEDALIACEAE: Cerathotheca(1), Sesamum(1,2)

PHYTOLACCACEAE: Phytolacca(B), Rivina(2)

PINACEAE: Abies(B,1,2), Callitris(1,2), Cedrus(B), Cunninghamia(B), Cupressus(B,1), Juniperus(B,1), Larix(B), Libocedrus(B,1), Picea(B,1,2), Pinus(B,1), Pseudotsuga(B), Sciadopitys(B), Sequoia(B), Sequoiadendron(B,1), Taxodium(B), Thuja(B,1), Tsuga(B,1)

PITTOSPORACEAE: Billardiera(2), Hymenosporum(1), Pittosporum(1), Sollya(1,2)

PLANTAGINACEAE: Plantago(1,2)

PLATANACEAE: Platanus(B)

PLUMBAGINACEAE: Acantholimon(B), Armeria(B,1,2), Dictyolimon(B), Goniolimon(B), Ikonnikovia(B), Limonium(B,2), Popoviolimon(B)

POACEAE: Agrophyron(2), Andropogon(B), Bambusa(2), Bouteloua(B), Brachiaria(1,2), Briza(B), Bromus(B), Calamagrostis(B), Chionochloa(2), Dendrocalamus(2), Eleusine(B), Festuca(B), Hierochloe(1,2), Hymenolepis(2), Hystrix(B), Koeleria(B), Lagarus(B), Melica(B), Miscanthus(B), Panicum(B), Pennisetum(B), Phyllostachys(2), Scleria(B), Setaria(1), Stipa(B), Thrysostachys(2), Zea(1,2), Zizania(1)

PODOCARPACEAE: Podocarpus(1,2)

POLEMONIACEAE: Cobaea(1,2), Collomia(B,1,2), Eriastrum(1), Gilia(B,1,2), Ipomopsis(B,2), Leptodactylon(B,1,2), Leptosiphon(B,2), Linanthrastum(B,1,2), Linanthus(B,2), Phlox(B,1), Polemonium(B,1,2)

POLYGALACEAE: Polygala(B,1)

POLYGONACEAE: Antigon(1), Coccoloba(2), Eriogonum(B,1,2), Koenigia(1), Oxyria(1), Polygonum(B,1,2), Rheum(B), Rumex(B,1,2)

PONTEDERIACEAE: Pontederia(2)

PORTULACEACEAE: Anacampseros(1), Calandrinia(B,2), Calyptridium(B,1), Claytonia(B), Lewisia(B,2), Montia(B,1,2), Montiopsis(2), Portulaca(B,1,2), Spraguea(B), Talinum(B,1,2)

PRIMULACEAE: Anagallis(1,2), Androsace(B,2), Cortusa(B), Cyclamen(B), Dionysia(B), Dodecatheon(B,2), Douglasia(B), Lysimachia(1,2), Primula(B,1,2), Soldanella(B,1), Vitaliana(1,2)

PROTEACEAE: Banksia(1,2), Conospermum(2), Dryandra(B,1), Embothrium(1,2), Grevillea(1,2), Leucospermum(2), Nivenia(2), Protea(2), Stirlingia(2)

PUNICACEAE: Punica(B,1,2)

PYROLACEAE: Pyrola(B)

RANUNCULACEAE: Aconitum(B,1), Actaea(B), Adonis(B,1,2), Anemone(B,1,2), Anemonastrum(B), Anemonella(B), Anemonopsis(B), Aquilegia(B,1,2), Callianthemum(B), Caltha(B,1), Cimicifuga(B), Clematis(B,1,2), Delphinium(B,1,2), Eranthis(B,1,2), Glaucidium(B), Helleborus(B,1,2), Hepatica(B), Hydrastis(B), Isopyrum(B), Nigella(1,2), Paonea(B,1,2), Paraquilegia(B), Pulsatilla(B,2), Ranunculus(B,1,2), Semiaquilegia(2), Thalictrum(B,1), Trollius(B,1,2)

RESEDACEAE: Reseda(1,2)

RHAMNACEAE: Ceanothus(B), Discaria(2), Phylica(2), Rhamnus(B), Zizyphus(1)

ROSACEAE: Acaena(B), Adenostoma(1), Agrimonia(1), Alchemilla(B,1), Amelanchier(B,1,2), Armenaica(B), Aronia(1,2), Aruncus(B,1), Cercocarpus(B,1,2), Chaenomeles(B,1,2), Chamaebatia(1,2), Cotoneaster(B,1,2), Cowania(1), Crataegus(B,1), Dryas(B,1), Duchesnea(1), Exochorda(B), Fallugia(1), Filipendula(B), Fragraria(1), Geum(B,1,2), Gillenia(B,1), Holodiscus(B), Ivesia(B), Kelseya(1,2), Luetkea(2), Malus(B,2), Margyricarpus(1), Osmaronia(2), Petrophytum(B), Photinia(B,1,2), Potentilla(B,1,2), Prinsepia(B), Prunus(B,1,2), Purshia(1), Pyracantha(B), Pyrus(B,1,2), Rhodotypos(B), Rosa(B,1,2), Rubus(B,1,2), Sanguisorba(B,1,2), Sarcopotorum(1), Sibbaldia(B,1), Sorbus(B,1,2), Spiraea(B,1), Stephanandra(B), Stransvaesia(1), Waldsteinia(B)

RUBIACEAE: Asperula(B), Cephalanthus(B), Coffea(2), Coprosma(2), Cruckshanksia(B), Gardenia(1), Hedyotis(B), Houstonia(B,1), Mitchella(B), Mussaenda(B), Phuopsis(2), Psychotria(1,2), Putoria(2)

RUTACEAE: Agathosma(2), Boenninghausenia(1), Boronia(2), Citrofortunella(2), Citrus(B), Correa(2), Crowea(B,1), Dictamnus(B), Eriostemon(2), Evodia(B), Fortunella(1,2), Phellodendron(B), Poncirus(B), Ptelea(B,1,2), Ruta(1,2), Skimmia(B)

SALICACEAE: Populus(B), Salix(B,1)

SANTALACEAE: Exocarpus(2)

SAPINDACEAE: Cardiospermum(B), Dodonea(2), Heterodendrum(1), Koelreuteria(B), Sapindus(1), Ungnadia(1), Xanthoceras(1,2)

SARRACENIACEAE: Darlingtonia(2), Sarracenia(B,1)

SAURURACEAE: Houttuynia(1)

SAXIFRAGACEAE: Astelboides(B), Astilbe(B), Bensoniella(B), Bergenia(B), Boykinia(2), Carpentaria(2), Conimitella(1), Deutzia(B,1), Elmera(B,1), Francoa(1,2), Heuchera(B,1), Hydrangea(B,1), Itea(B), Jamesia(1), Kirengeshoma(B), Leptarrhena(B), Mitella(B), Parnassia(B,1), Peltiphyllum(1), Peltoboykinia(B), Petroragia(1), Philadelphus(B), Ribes(B,1,2), Rodgersia(B), Saxifraga(B,1,2), Schizophragma(2), Telesonix(B,2), Tellima(B,1), Tiarella(B), Tribeles(2)

SCHEUCHZERIACEAE: Triglochin(1)

SCHISANDRACEAE: Schisandra(B)

SCROPHULARIACEAE: Agalinis(B), Alonsoa(B,2), Antirrhinum(B,2), Asarina(B,1,2), Aureolaria(B), Bartsia(1), Calceolaria(B,2), Castilleja(B,1), Chaenorrhinum(B), Chelone(B), Collinsia(1,2), Cymbalaria(1,2), Diascia(1,2), Digitalis(B,2), Diplacus(B), Erinus(B,1,2), Gerardia(B), Hebe(B,1), Isoplexis(1,2), Joveliana(1), Lagotis(B), Libanotis(B), Linaria(B), Maurandia(1), Mazus (2), Melampyrum(B), Mimulus(B,1,2), Misopates(1,2), Nemesia(B,1,2), Ourisia(B,2), Parahebe(1), Paulownia(B,1), Pedicularis(B,1), Penstemon(B,1,2), Phygelius(1,2), Rehmannia(1,2), Rhinanthus(1), Rhodochiton(1), Scrophularia(1,2), Striga(B), Synthyris(B,1), Torenia(2), Verbascum(B,1), Veronica(B,1,2), Veronicastrum(1,2), Wulfenia(B), Zaluzianskya(B,2)

SIMAROUBACEAE: Ailanthus(B)

SOLANACEAE: Acnistus(2), Atropa(B), Browallia(2), Brugmansia(2), Capsicum(B,1,2), Capsicus(1), Cestrum(1), Cyphomandia(1), Cythomandra(1,2), Datura(B,1,2), Hyoscyamus(1), Lycium(1), Lycopersicon(B,1,2), Mandragora(1), Nicandra(1,2), Nicotiana(1,2), Nierembergia(2), Physalis(1), Petunia(B,2), Physalis(B), Salpiglossis(B,2), Schizanthus(B,2), Solanum(B,1,2), Vestia(1), Withania(1,2)

STACHYURACEAE: Stachyurus(1,2)

STERCULIACEAE: Guichenotia(1), Thomasia(2)

STYLIDACEAE: Forstera(2), Stylidium(1)

STYRACACEAE: Halesia(B,1,2), Pterostyrax(1), Styrax(B,1,2)

SYMPLOCACEAE: Symplocos(B)

TAXACEAE: Taxus(B,1)

TAXODIACEAE: See Pinaceae

TECOPHILIACEAE: Conanthera(B)

THEACEAE: Franklinia(B,1,2), Stewartia(B)

THYMELACEAE: Daphne(B,1), Dirca(1,2), Pimelea(B,1), Stellera(B,1)

TILIACEAE: Tilia(B)

TROCHODENDRONACEAE: Trochodendron(1)

TROPAEOLACEAE: Tropaeolum(B,1,2)

TYPHACEAE: Typha(B)

ULMACEAE: Aphananthe(B), Celtis(B), Ulmus(B)

URTICACEAE: Forskohlea(1,2), Urtica(1)

VALERIANACEAE: Centrantus(B), Fedia(1,2), Patrinia(1), Valeriana(1)

VERBENACEAE: Callicarpa(B), Caryopteris(B), Lippia(1), Pleuroginella(B), Verbena(B,1,2), Vitex(1,2)

VIOLACEAE: Hymenanthera(2), Viola(B,1,2)

VITACEAE: Cissus(2), Parthenocissus(B), Vitis(B)

ZINGIBERACEAE: Cautleya(1), Costus(1,2)

ZYGOPHYLLACEAE: Larrea(B,1,2), Nitraria(1), Zygophyllum(1)

The family has not been found as yet for the following: Haleria(1), Hyemantha(2), Mesperula(2), Prasophyllum(2), and Selenomeles(2)

COMMON NAMES FOR PLANTS

One general complaint about my two books was that there was no alphabetical listing of common names. Thus a reader wishing to look up germination of Ash Trees might not recall that the genus is Fraxinus. I found myself in this circumstance many times and realized that I knew of no alphabetical listing of common names. It was evident that this Second Supplement should include such a list. A list was compiled by laboriously going through Bailey's Hortus III, Rickett's Wild Flowers of the United States, Gray's Manual of Botany, Rehder's Manual of Trees and Shrubs, Wyman's Trees for American Gardens and Shrubs and Vines for American Gardens, and several seed catalogs, notably Chilterns.

It must immediately be emphasized that this list of common names is not a list of species whose germination has been studied. In fact only about half have been studied. One reason for this is that common names are particulary prevalent for tropical species whereas most of my work has been with temperate zone species. In fact I have omitted many common names that are derived from tribal tongues and languages other than English.

A problem arose where the common name consisted of two or more words such as Trout Lily. Should the entry be under Trout or under Lily? In this example it is listed under Lily, Trout, and usually this pattern has been used, but readers should look under both.

In this list only the name of the botanical genus is given and no attempt has been made to assign species names. Often the common name is applied to several members of the genus such as Trout Lily for Erythronium. It seemed best for the reader to go to a book such as Hortus III and determine in more detail the particular species to which the common name is applied.

Hortus III contains a large number of cross-indexed botanical names. I have used the botanical name chosen in Hortus III without any attempt to decide which name should take precedence. This problem would never has arisen if botanists had organized a conference comparable to the Geneva Congress in 1892 when chemical names were standardized and frozen.

Common names have been omitted where the common name is similar to the botanical name. Examples are Pine (Pinus) and Juniper (Juniperus). Considerable liberties have been taken with eliminating hyphens and coalescing words. Every effort has been made to simplify the common names.

Adam's Needle (Yucca), Adder's Mouth (Malaxis), Adder's Tongue (Erythronium), Air Plant (Bryophylum), Alder (Alnus), Alexanders (Smyrnium), Alfalfa (Medicago), Alkali Grass (Zigadenus elegans), Alkanet (Anchusa), Allegheny Spurge (Pachysandra), Allegheny Vine (Adlumia fungosa), Allspice (Calycantha, Pimenta), Almond (Prunus), Alpine Azalea (Loiseleuria), Althaea Shrub (Hibiscus syriacus), Amur Cork Tree (Phellodendron), Anchor Plant (Colletia), Andromeda (Pieris), Angelica Tree (Aralia elata), Angel's Trumpet (Datura arborea), Angle Pod (Gonolobus), Anise (Pimpinella anisum), Anise Tree (Illicium), Annatto Tree (Bixa orellana), Antelope Brush (Purshia), Apache Plume (Fallugia), Apple (Malus), Apple, Balsam (Momordica balsamina), Apple, Custard (Annona reticulata), Apple, Malay (Eugenia malaccensis), Apple, May (Podophyllum), Apple Mint (Mentha rotundifolia), Apple of Peru (Nicandra), Apple, Otaheite (Spondia cytherea), Apple, Pond (Annona glabra), Apple, Rose (Eugenia jambos), Apple, Star (Chrysophyllum cainito), Apple, Sugar (Annona squamoso), Apple, Wood (Feronia limonia), Apricot (Prunus armenaica), Arborvitae (Thuja), Arbutus (Epigea repens), Arrow Arum (Peltandra), Arrowhead (Sagittaria), Arrowroot (Marania), Arrow Wood (Viburnum dentatum), Artichoke (Cynara), Artillery Plant (Pilea), Arum Lily (Zantedeschia), Ash (Fraxinus), Ash, Mountain (Sorbus), Aspen (Populus), Atamosco (Zephyranthes), Australian Tea Tree (Leptospermum), Australia Silk Oak (Grevillea), Avalanche Lily (Erythronium montanum), Avens (Geum), Avignon Berry (Rhamnus infectoria), Azalea (Rhododendron)

Baby Blue Eyes (Nemophila menziesii), Baby's Breath (Gypsophila), Bachelor's Buttons (Centaurea cyanus), Bael Fruit (Aegle marmelos), Bald Cypress (Taxodium), Balloon Berry (Rubus illecebrosus), Balloon Flower (Platycodon), Balloon Vine (Cardiospermum), Balm (Melissa officinalis), Balm of Gilead (Cedronella triphylla, Populus candicans), Balsam (Impatiens), Balsam Apple (Momordica), Balsamroot (Balsamorhiza), Bamboo (several genera in Poaceae), Banana (Musa), Baneberry (Actaea), Banyan Tree (Ficus benghalensis), Baobab (Adansonia digitata), Barbara's Buttons (Marshallia), Barberry (Berberis), Barley (Hordeum), Barrens Clawflower (Calothamnus), Barren Strawberry (Waldsteinia), Basil (Ocimum), Basket of Gold (Alyssum saxatile), Basswood (Tilia), Bast (Hibiscus elatus), Bastard Toadflax (Comandra), Bayberry (Myrica), Bay Tree (Magnolia), Bay, Loblolly (Gordonia), Bay, Red (Persea), Bay, Sweet (Laurus, Magnolia virginiana), Bead Plant (Nertera depressa), Bead Tree (Adenanthera, Melia), Beam Tree (Sorbus), Bearberry (Arctostaphylos), Beard-Tongue (Penstemon), Beargrass (Xerophyllum, Yucca), Bear's Breeches (Acanthus mollis), Beard Tongue (Penstemon), Beauty Berry (Callicarpa), Beauty Bush (Kolkwitzia), Bee Balm (Monarda), Beech Drops (Epifagus), Beech Tree (Fagus), Beefwood (Casuarina), Beet (Beta), Beggarweed (Desmodium purpureum), Bells of Ireland (Molucella laevis), Bean (Phaseolus vulgaris), Beauty Berry (Callicarpa), Beauty Bush (Kolkowitzia amabilis), Bedstraw (Galium), Bee Balm (Monarda didyma), Beefsteak Plant (Perilla), Beefwood (Casuarina), Beggar Ticks (Bidens frondosa), Belladonna (Atropa belladonna), Belladonna Lily (Amaryllis belladonna), Bell Flambeau Tree (Spathodea), Bellflower (Campanula), Bell-fruit Tree (Codonocarpus continifolius), Bell Vine (Rhodochiton volubile), Bellwort (Uvularia), Bells, Fairy (Disporum), Bergamot (Monarda), Betel Palm (Areca), Betony (Stachys), Bindweed (Convolvus), Birch (Betula), Bird of Paradise (Caesalpina), Bird of Paradise Flower (Strelitzia), Bird's Beak (Cordylanthus), Bird's Eye (Gilia tricolor, Veronica persica), Bird's Foot-trefoil (Lotus), Bird's Nest Fern (Asplenium nidus), Birthwort (Aristolochia), Bishop's Cap (Mitella), Bishop's Flower (Ammi majus), Bishop's Hood (Astrophytum myriostigma), Bistort (Polygonum), Bitterbrush (Purshia), Bitter Cress (Cardamine), Bitternut (Carya), Bitterroot (Lewisia rediviva), Bittersweet (Celastrus), Blackberry (Rubus argutus), Blackberry Lily (Belamcanda chinensis), Black-eyed Susan (Rudbeckia, Thunbergia), Black Gum (Nyssa), Blackhaw (Viburnum prunifolium), Black Locust (Robinia), Black Salsify (Scorzonera), Black Snakeroot (Cimicifuga racemosa, Sanicula), Blackthorn (Prunus spinosa), Black Tupelo (Nyssa), Bladdernut (Staphylea), Bladder Pod (Lesquerella, Vesicaria), Bladder Senna (Colutea), Bladderwort (Utricularia), Blazing Star (Chamaelirium, Liatris, Mentzelia), Bleeding Heart (Dicentra spectabilis), Blessed Thistle (Cnicus), Blitum (Chenopodium capitatum), Blood Flower (Asclepias curassavica), Bloodroot (Sanguinaria), Blood Trumpet Vine (Phaedranthus), Bloodwood (Eucalyptus), Blow Wives (Achyrachaena), Bluebead (Clintonia), Blue Bean Shrub (Decaisnea fargesii), Bluebeard (Caryopteris), Blue Beech (Carpinus), Bluebell (Campanula), Bluebells, Virginia (Mertensia), Blueberry (Vaccinium), Blueblossom (Ceanothus), Bluebonnet (Lupinus), Bluebottle (Centaurea cyanus), Blue buttons (Knautia), Blue Cohosh (Caulophyllum), Blue Curls (Trichostema), Blue Dicks (Brodiaea pullchella), Blue-eyed Grass (Sisyrinchium), Blue-eyed Mary (Collinsia verna), Blue Lips (Collinsia grandiflora), Bluets (Houstonia), Blue Flag (Iris), Blue Hearts (Buchnera), Blue Lace Flower (Didiscus caeruleus), Blue Star (Amsonia), Blueweed (Echium vulgare, Helianthus ciliaria), Bog Asphodel (Narthecium), Bogbean (Menyanthes), Bog Rosemary (Andromeda), Boneset (Eupatorium), Borage (Borago), Boston Ivy (Parthenocissus), Bo Tree (Ficus religiosa), Bottle Brush (Callistemon), Bottle Tree (Brachychiton, Sterculia rupestris), Bouncing Bet (Saponaria officinalis), Bower Plant (Pandorea jasminoides), Bowman's Root (Gillenia trifoliata), Boxwood (Buxus), Box Elder (Acer negundo), Box Huckleberry (Gaylussacia), Boxthorn (Lycium), Boxwood (Buxus), Bracken (Pteridium), Brass Buttons (Cotula), Brazil Nut (Bertholettia), Brazil Wood (Caesalpina echinata), Breadfruit (Artocarpus communis), Breadnut (Brosimum alicastrum), Breadroot (Psoralea esculenta), Bridal Wreath (Spirea), Bride's Bonnet (Clintonia), Bramble (Rubus), Broccoli (Brassica), Brooklime (Veronica americana), Broom (Cytisus, Genista, Spartium), Broomrape (Orobanche), Broomweed (Gutierrezia); Brown-eyed Susan (Rudbeckia triloba), Brussel Sprouts (Brassica), Buckbean (Menyanthes trifoliata), Buckberry (Gaylussacia ursina), Buckeye (Aesculus), Buckthorn (Rhamnus), Buckwheat (Fagopyrum), Buffalo Berry (Shepherdia), Bugbane (Cimicifuga), Bugleweed (Ajuga, Lycopus), Bugloss (Anchusa, Lycopsis), Bull Bay (Magnolia grandiflora, Persea borbonia), Bulrush (Scirpus), Bunch Berry (Cornus canadensis), Bunchflower (Melanthium), Bur Chervil (Anthriscus), Bur Cucumber (Sicyos), Burdock (Arctium lappa), Burhead (Echinodorus), Bur Marigold (Bidens cernua), Burnet (Poterium sanguisorba, Sanguisorba), Burning Bush (Dictamnus alba, Euonymus alatus), Bur Reed (Sparganium), Burstwort (Herniaria), Bush Clover (Lespedeza), Bushman's Pipe (Ceropegia ampliata), Bushmans Poison (Acokanthera venenata), Busy Lizzie (Impatiens walleriana), Butcher's Broom (Ruscus), Butter and Eggs (Linaria vulgaris, Orthocarpus erianthus), Butterbur (Petasites), Buttercup (Ranunculus), Butter Daisy (Verbesina), Butterfly Bush (Buddleia davidi), Butterfly Flower (Bauhinia monarda, Schizanthus), Butterfly Palm (Areca lutescens), Butterflyweed (Asclepias tuberosa), Butternut (Juglans), Butterwort (Pinguicula), Buttonbush (Cephalanthus occidentalis), Buttonwood (Platanus occidentalis).

Cabbage (Brassica), Cabbage, Skunk (Symplocarpus), Cabbage Tree (several Palms), Cacalia (Emilia, Senecio succulentus), Cacao (Theobroma cacao), Cactus, Christmas (Zygocactus), Cactus, Crab (Zygocactus), Cactus, Deerhorn (Peniocereus), Cactus, Easter (Schlumbergera), Cactus, Giant (Carnegiea gigantea), Cactus, Hair Brush (Pachycereus), Cactus, Hatchet (Pelecyphora), Cactus, Mistletoe (Rhipsalis), Cactus, Old Man (Cephalocereus), Cactus, Organ Pipe (Pachycereus), Cactus, Prickly Pear (Opuntia), Cactus, Redbird (Pedilanthus), Cactus, Sea Urchin (Echinopsis), Cactus, Snowball (Pediocactus), Cactus, Star (Astrophytum), Cactus, Turks Cap or Head (Melocactus), Cactus, Vine (Fouquieria), Cactus, Rainbow (Echinocereus), Cactus, Rat Tail (Aporocactus), Cajeput Tree (Melaleuca leucadendra), Calabash Gourd (Lagenaria), Calabash Tree (Crescentia cujete), Calamintha (Satureja), Calamondin (Citrus mitis), Calico Bush (Kalmia latifolia), Calla, Black (Arum palaestinum), Calla, Red (Sauromatum guttatum), Calla Lily (Zantedeschia), Calico Flower (Aristolochia elegans), California Poppy (Eschscholzia californica), Callichroa (Layia), Calliglossa (Layia calliglossa), Calliopsis (Coreopsis), Calliprora (Brodiaea ixioides), Callistachys (Oxylobium), Calocarpum (Achras), Camel Hay (Cymbopogon), Camel Thorn (Acacia giraffae), Caltrop (Tribulus), Camass (Camassia, Zigadenus), Camphor (Cinnamomum camphora), Camphor Tree (Cinnamomum), Camphor Weed (Heterotheca), Campion (Lychnis, Silene), Camwood (Baphia racemosa), Canada Mayflower (Maianthemum), Canada Thistle (Cirsium arvense), Canaigre (Rumex hymenosepalus), Canary Bird Flower (Tropaeolium), Candle Berry Tree and Candlenut (Aleurites), Candle Plant (Senecio articulatus), Candle Tree (Parmentiera cereifera), Candy Stick (Allotropa), Candytuft (Iberis umbellata), Canterbury Bells (Campanula medium), Caoutchouc Tree (Hevea brasiliensis), Caper (Capparis), Carambola (Averrhoa carambola), Caraway (Carum), Cardamon (Elettaria), Cardinal Climber (Quamoclit sloteri), Cardinal flower (Lobelia cardinalis), Cardoon (Cynara cardunculus), Carnation (Dianthus caryophyllus), Caro (Enterolobium cyclocarpum), Carob (Ceratonia siliqua), Carrion Flower (Smilax, Stapelia), Carrot (Daucus carota), Cascara (Rhamnus purshiana), Cashew (Anacardium occidentale), Cassandra (Chamaedaphne calyculata), Cassava (Manihot esculenta), Cassena (Ilex vomitoria), Cassia Bark Tree (Cinnamomum cassia), Cassia Flower Tree (Cinnamomum lureirii), Cassie (Acacia farnesiana), Castor Oil Plant (Ricinus communis), Cat Brier (Smilax glauca), Catchfly (Lychnis, Silene), Cat Claw Vine (Doxantha), Catmint (Nepeta cataria), Catnip (Nepeta cataria), Cat's Claw (Doxantha, Pithecellobium, Schrankia), Cat's Ear (Calochortus, Hypochoeris), Cat Tail (Typha), Cat's Ear (Hypochoeris), Caucasian Elm (Zelkova), Cauliflower (Brassica), Cedar (Cedrus, Thuja), Cedar, Incense (Libocedrus), Cedar, Port Orford (Libocedrus), Celandine (Chelidonium majus), Celandine Poppy (Stylophorum), Celandine Tree (Macleaya cordata), Celery (Apium graveolens, Apiastrum), Centipede Plant (Homalocladium), Century Plant (Agave americana), Chaffseed (Schwalbea), Chaffweed (Centunculus), Chalice Vine (Solandra), Chamomiile (Anthemis nobilis, Matricaria recutita), Chard (Beta), Charity (Polemonium caeruleum), Charlock (Brassica arvensis), Chaste Tree (Vitex agnus-castus), Chaulmoogra (Taraktogenos), Chayote (Sechium edule), Checkerberry (Gaultheria procumbens), Checkerbloom (Sidalcea malvaeflora), Checker Lily (Fritillaria lanceolata), Checkers (Sidalcea), Chenille Plant (Acalypha hispida), Cherimoya (Annona cherimola), Cherry (Prunus), Cherry, Barbados (Malpighia glabra), Cherry Cornelian (Cornus mas), Cherry, Ground (Physalis), Cherry, Indian (Rhamnus caroliniana), Cherry, Jerusalem (Solanum), Cherry, Madden (Maddenia hypoleuca), Cherry, Spanish (Mimusops elengi), Cherry, Surinam (Eugenia uniflora), Cherry, Winter (Physalis alkekengi), Chervil, Salad (Anthriscus cerefolium), Chervil, Tuberous (Chaerophyllum bulbosum), Chestnut (Castanea, Castanopsis), Chestnut, Cape (Calodendrum capensis), Chestnut, Guiana (Pachira aquatica), Chestnut, Horse (Aesculus), Chestnut, Moreton Bay (Castianospermum australe), Chestnut, Water (Trapa), Chickweed (Cerastium), Chicory (Cichorum), Chilean Bellflower (Lapageria), Chilean Flame Bush (Embothrium), Chilean Glory Flower (Eccremocarpus), Chilean Jasmine (Mandevilla), Chilean Nut (Gevuina avellana), China Aster (Callistephus), Chinaberry (Melia azederach), China Flower (Adenandra uniflora), China Tree (Melia azederach), Chinese Box Orange (Severinia), Chinese Evergreen (Aglaonema simplex), Chinese Fir (Cunninghamia), Chinese Hat Plant (Holmskioldia sanguinea), Chinese Lantern (Physalis), Chinese Parasol Tree (Firmiana), Chinese Scholar Tree (Sophora), Chinese Snowball (Viburnum macrocephalum), Chinese Toon (Cedrala), Chinese Woodbine (Lonicera tragophylla), Chinkapin, Water (Nelumbium luteum), Chinquapin (Castanea, Castianopsis), Chives (Allium schoenoprasum), Chocolate (see Cacao), Chokeberry (Aronia), Chokecherry (Prunus), Cholla (Opuntia), Chondrosea (Saxifraga aizoon), Christmas Bell (Blanfordia grandiflora), Christmas Berry (Heteromeles), Christmas Cactus (Schlumbergera), Christmas Rose (Helleborus niger), Christ Thorn (Paliurius), Chufa (Cyperus esculentus), Cicely, Sweet (Myrrhis odorata), Cigar Flower (Cuphea platycentra), Cineraria (Senecio cruentus), Cinnamon Tree (Cinnamomum zeylanicum), Cinnamon Vine (Dioscorea batatas), Cinnamon, Wild (Canella winterana), Cinquifoil (Potentilla), Circassian Seeds (Adenanthera pavonina), Citron (Citrus medica), Citronella (Collinsonia canadensis), Clammy Weed (Polanisia), Clary (Salvia sclarea), Cleavers (Galium aparine), Cliff Brake (Pellea), Climbing Dogbane (Trachelospermum), Climbing Fumitory (Adlumia fungosa), Climbing Lily (Littonia), Clock Vine (Thunbergia), Cloudberry (Rubus chamaemorus), Clover (Medicago, Trifolium), Clover, Bokhara (Melilotus alba), Clover, Bur (Medicago), Clover, Bush (Lespedeza), Clover, Holy (Onobrychis vicaefolia), Clover, Hubam (Melilotus alba), Clover, Japan (Lespedeza striata), Clover, Mexican (Richardia scabra), Clover, Musk (Erodium moschatum), Clover, Owls (Orthocarpus), Clover, Prairie (Petalostemon), Clover, Sweet (Melilotus), Clover, Tick (Desmodium), Coachwhip (Fouquieria splendens), Coat Flower (Tunica saxifraga), Cobnut (Corylus avellana), Coca (Erythroxylon coca), Cocaine Plant (Erythoxylon coca), Cobra Plant (Arisaema nepenthoides, Darlingtonia), Cochineal Plant (Nopalea cochenillifera), Cockscomb (Celosia argentea), Cocks Eggs (Salpichroa rhomboidea), Cocks Foot (Dactylis glomerata), Cockspur Thorn (Crataegus), Coconut (Cocos), Coffee (Coffea), Coffeeberry (Rhamnus californica), Coffee, Kentucky Tree (Gymoncladus dioica), Coffee, Wild (Psychotria), Cohosh (Actaea), Cohosh, Black (Cimicifuga racemosa), Cohosh, Blue (Caulophyllum thalictroides), Colic Root (Aletris, Dioscorea villosa), Collards (Brassica), Coltsfoot (Tussilago), Columbine (Aquilegia), Columbo (Frasera), Comfrey (Cynoglossum, Symphytum officinale), Compass Plant (Silphium), Coneflower (Echinacea, Lepachys, Ratibida, Rudbeckia), Cone Plant (Conophytum), Confederate Rose (Hibiscus mutabilis), Confederate Vine (Antigonon leptopus), Coontie (Zamia), Copperlead (Acalypha wilkesiana), Coppertip (Crocosmia aurea), Copra (Cocos), Coral Bells (Heuchera), Coral Berry (Ardisia crispa, Symphoricarpos orbiculatus), Coral Blow (Ruselia), Coral Bush (Templetonia retusa), Coral Plant (Jatropha multifida, Russelia edquisetiformis), Coral Root (Corallorhiza), Coral Tree (Erythrina crista-galli), Coral Vine (Antigonon leptopus), Coriander (Coriandrum sativum), Corkscrew Flower (Phaseolus caracalla), Cork tree (Phellodendron), Corkwood (Leitneria), Corn (Zea), Corn Cockle (Agrostemma githago), Cornel (Cornus), Cornelian Cherry (Cornus mas), Cornflower (Centaurea), Corn Lily (Ixia), Corn Salad (Valerianella), Coronaria (Lychnis), Costmary (Chrysanthemum balsamita), Cotton (Gossypium), Cotton, Lavender (Santolina chamaecyparissus), Cottonweed (Diotis candidissima), Cottonwood (Populus), Cowberry (Vaccinium), Cow Herb (Saponaria vaccaria), Cowitch (Stizolobium pruritum), Cow Parsley (Anthriscus sylvestris), Cow Parsnip (Heracleum), Cowpea (Vigna sinensis), Cow Poison (Delphinium trollifolium), Cowslip (Primula veris), Cowslip, Cape (Lachenalia), Cow Wheat (Melampyrum), Crabapple (Malus, Pyrus), Crab Claws (Stylidium macranthum), Cranberry (Vaccinium), Cranberry Bush (Viburnum), Cranesbill (Geranium), Crapemyrtle (Lagerstroemia), Crazy Weed (Oxytropis), Cream Cups (Platystemon californicus), Creeping Charlie (Lysimachia nummularia), Creeping Jenny (Lysimachia nummularia), Creosote Bush (Larrea), Cress, Bitter (Cardamine), Cress, Blister (Erysimum), Cress, Garden (Lepidium sativum), Cress, Indian (Tropaeolum), Cress, Penny (Thlaspi), Cress, Rock (Arabis), Cress, Stone (Aethionema), Cress, Wart (Coronopus), Cress, Water (Nasturtium officinale), Crinkle Bush (Lomatia silaifolia), Crocus, Autumn (Colchicum), Cross Vine (Bignonia), Crosswort (Crucianella), Croton (Codiaeum), Crowberry (Empetrum), Crowfoot (Ranunculus), Crownbeard (Verbesina), Crown Imperial (Fritillaria imperialis), Crown of Thorns (Euphorbia splendens), Crown Vetch (Cornonilla varia), Crow Poison (Zigadenus), Cruel Plant (Araujia sericofera), Cubeb (Piper cubeba), Cuckoo Flower (Cardamine pratensis, Lychnis flos-cuculi), Cuckoo Pint (Arum maculatum), Cuckoo Plant (Arum maculatum), Cucumber (Cucurbita sativus), Cucumber, Bur (Sicyos angulatus), Cucumber, Mock (Echinocystis lobata), Cucumber Root (Medeloa virginiana), Cucumber, Squirting (Ecballium elaterium), Cucumber, Star (Sicyos angulatus), Cucumber Tree (Magnolia acuminata and Magnolia macrophylla), Cucumber, Wild (Echinocystis lobata), Cudweed (Gnaphalium, Filago), Culver's Root (Veronicastrum virginicum), Cup-and-Saucer Vine (Cobaea scandens), Cupid's Dart (Catanache caerulea), Cup Flower (Nierembergia), Cupids Dart (Catanache), Cup Plant (Silphium perfoliatum), Currant (Ribes), Currant, Indian (Symphoricarpos orbiculatus), Custard Apple (Annona squamosa), Cypress (Chamaecyparis, Cupressus, Taxodium), Cypress, False (Chamaecyparis), Cypress Pine (Callitris), Cypress, Standing (Gilia rubra), Cypress, Summer (Kochia scoparia), Cypress Vine (Quamoclit)

Daffodil (Narcissus), Dahoon (Ilex cassine), Daisy (Chrysanthemum), Daisy, African (Arctotis), Daisy, Blue (Felicia amelloides), Daisy Bush (Olearia), Daisy, English (Bellis perennis), Daisy, Michaelmas (Aster species), Daisy, Swan River (Brachycome), Dame's Rocket (Hesperis matronalis), Dandelion (Taraxacum), Dasheen (Colocasia esculenta), Date, Jerusalem (Bauhinia monandra), Date Palm (Phoenix dactylifera), Dawn Redwood (Metasequoia), Dayflower (Commelina), Daylily (Hemerocallis), Deadly Nightshade (Atropa belladonna), Dead Nettle (Lamium), Death Camas (Zigadenus venenosus), Deerberry (Vaccinium stamineum), Deerbrush (Ceanothus integerrimus), Deerfoot (Achlys triphylla), Deptford Pink (Dianthus armeria), Desert Candle (Eremurus), Desert Marigold (Baileya multiradiata), Desert Rose (Adenium obesum), Desert Willow (Chilopsis), Devil's Claw (Physoplexis, Proboscidea), Devil's Club (Echinopanax horridum, Oplopanax), Devils Paintbrush (Hieracium aurantiacum), Devils Tongue (Hydrosme rivieri), Devils Walking Stick (Aralia spinosa), Devil Tree (Alstonia scholaris), Devilwood (Osmanthus americanus), Dewberry (Rubus), Dewdrop (Dalibarda), Diamond Flower (Ionopsidium), Dill (Peucedanum graveolens), Distaff Thistle (Carthamus), Dittany (Cunila, Dictamnus alba), Dock (Rumex), Dockmackie (Viburnum acerifolium), Dodder (Cuscuta), Dogbane (Apocyanum), Dog Fennel (Anthemis), Dog's Tooth Violet (Erythronium), Dogwood (Cornus), Douglas Fir (Pseudotsuga), Dove Flower (Peristeria elata), Dove Tree (Davidia), Dove Weed (Eremocarpus), Dragonhead (Dracocephalum), Dragonroot (Arisaema dracontium), Dragon Tree (Dracaena draco), Duckweed (Lemna), Durian (Durio), Dusty Miller (Artemisia, Centaurea, Lychnis, Senecio), Dutchman's Breeches (Dicentra cucullaria), Dutchman's Pipe (Aristolochia macrophylla), Dwarf Cornel (Cornus canadensis or Cornus suecica), Dwarf Dandelion (Krigia), Dyer's Greenweed (Genista tinctoria), Dyer's Woad (Isatis).

Earth Chestnut (Bunium), Easter Bells (Stellaria), Ebony Wood (Bauhinia), Ebony, Mountain (Bauhinia), Edelweiss (Leontopodium), Eel Grass (Vallisneria), Eggfruit (Lucuma), Eggplant (Solanum), Elecampane (Inula), Elder (Sambucus), Elderberry (Sambucus), Elder, Box (Acer), Elecampane (Inula), Elephants Ear (Colocasia, Enterolobium), Elephants Foot (Testudinaria), Elm (Ulmus), Empress Tree (Paulownia), Emu Bush (Eremophila), Enchanter's Nightshade (Circaea), Endive (Cichorium), English Daisy (Bellis), Epaulette Tree (Pterostyrax), Evening Primrose (Oenothera), Everlasting (Antennaria), Eyebright (Euphrasia).

Fairy Bell (Dierama, Disporum), Fairy Fans (Eucharidium), Fairy Slipper (Calypso), Fairywand (Chamaelirium), False Asphodel (Tofieldia), False Bugbane (Trautvetteria), False Cypress (Chamaecyparis), False Dragonhead (Physostegia), False Flax (Camelina), False Foxglove (Aureolaria), False Garlic (Nothoscordum), False Goat's Beard (Astilbe), False Gromwell (Onosmodium), False Hellebore (Veratrum), False Indigo (Amorpha, Baptisia), False Panax (Nothopanax), False Pennyroyal (Isanthus), False Pimpernel (Lindernia), False Rue Anemone (Isopyrum), Fameflower (Talinum), Fan Palm (Livistonia), Fanwort (Cabomba), Farkleberry (Vaccinium), Fan Palm (Livistona), Featherbells (Stenanthium), Feather Climber (Acridocarpus), Feather Fleece (Stenanthium), Fennel (Ferula, Foeniculum), Fennel Flower (Nigella), Fetterbush (Lyonia), Feverfew (Chrysanthemum, Tanacetum), Feverwort (Triosteum), Fiddle Necks (Amsinckia), Fiddlewood (Citharexylum), Field Scabious (Knautia), Fiesta Flower (Nemophila aurita), Fig (Ficus), Fig, Hottentot (Carpobrotus), Figmarigold (Mesembryanthemum), Figwort (Scrophularia), Filbert (Corylus), Fir (Abies), Fir, China (Cunninghamia), Fir, Douglas (Pseudotsuga), Firecracker, Floral (Brevoortia), Fire Lily (Cyrtanthus), Fire Pink (Silene), Fireplant, Mexican (Euphorbia), Firethorn (Pyracantha), Fireweed (Epilobium, Erectites), Five Spot (Nemophila), Flag (Iris), Flame Pea (Chorizema), Flame Tree (Delonix, Sterculia), Flannel Bush (Fremontia), Flannel Flower (Actinotus), Flax (Linum), Flax, New Zealand (Phormium), Fleabane (Erigeron), Fleece, Mountain (Polygonum), Fleece Vine (Polygonum), Floating Heart (Nymphoides), Floss Silk Tree (Chorisia), Flowering Maple (Abutilon), Fly Poison (Amianthium), Foamflower (Tiarella), Fog Fruit (Lippia), Forest Fever Tree (Anthocleista), Forget-me-not (Myosotis, Omphalodes), Fountain Plant (Russelia), Four O'Clocks (Mirabilis), Foxglove (Digitalis), Foxtail (Alopecurus), Foxtail Lilies (Eremurus), Frangipani (Hymenosporum, Plumeria), Fringe Bell (Schizocodon), Fringe Cup (Tellima), Fringe Tree (Chionanthus), Frogsbit (Hydrocharis), Frostweed (Helianthemum), Fumitory (Fumaria), Fumitory, Climbing (Adlumia), Funkia (Hosta), Furze (Ulex), Fuschia, California (Zauschneria).

Galax, Fringed (Schizocodon), Gale, Sweet (Myrica), Garland Flower (Hedychium), Garlic (Allium), Garlic, False (Nothoscordum), Garlic Mustard (Alliaria), Garlic, Wild (Allium), Gas Plant (Dictamnus), Gayfeather (Liatris), Germander (Teucrium), Gloriosa Daisy (Rudbeckia), Garlic Mustard (Alliaria), Gas Plant (Dictamnus), Geiger Tree (Cordia), Gentian, Horse (Triosteum), Gentian, Prairie (Lisianthus), Geranium (Pelargonium), Gerardia (Agalinis), Germander (Teucrium), Gilliflower (Mathiola), Gill-over-the-Ground (Glechoma), Ginger (Zingiber), Ginger, Wild (Asarum), Ginseng (Panax), Glade Mallow (Napasa), Glasswort (Salicornia), Globe Amaranth (Gomphrena), Globe Flower (Trollius), Globe Mallow (Sphaeralcea), Gloriosa Daisies (Rudbeckia), Glory Bower (Clerodendron), Glorybush (Tibouchina), Gloryflower (Eccremocarpus), Glory of the snow (Chionodoxa), Gloxinia (Sinningia), Goatnut (Simmondsia), Goats Beard (Aruncus, Tragopogon), Goat's Rue (Galega), Gold Dust (Alyssum), Golden Aster (Chrysopsis), Golden Bell (Emmenanthe, Forsythia), Golden Chain Tree (Laburnum), Golden Club (Orontium), Goldencup (Hunnemania), Golden-eyed Grass (Sisyrinchium), Goldenglow (Rudbeckia), Golden Larch (Pseudolarix), Golden Rain Tree (Koelreuteria), Golden Rod (Solidago), Golden Seal (Hydrastis), Golden Shower (Cassia), Golden Star (Chrysogonum), Golden Stars (Bloomeria), Goldentop(Lamarckia), Goldentuft (Alyssum), Goldenwave (Corepopsis), Goldfields (Baeria), Goldflower (Hypericum), Goldilocks (Linosyris), Goldthread (Coptis), Gold Tree (Aucuba), Gooseberry (Ribes), Gooseberry, Barbados (Pereskia), Gooseberry, Cape (Physalis), Gooseberry, Ceylon (Dovyalis), Gooseberry, Hill (Rhodomyrtus), Gooseberry, Otaheite (Phyllanthus), Gooseberry Tree (Phyllanthus), Goosefoot (Suaeda), Goose Grass (Galium aparine), Gorse (Genista, Ulex), Gourd (Cucurbita), Goutweed (Aegopodium), Governors Plum (Flacourtia), Granadilla (Passiflora), Grape (Vitis), Grapefruit (Citrus), Grape Hyacinth (Muscari), Grape, Oregon Holly (Mahonia), Grape, Sea (Coccolobis), Grape,Tail (Artabotrys), Grass (any in the family Poaceae), Grass, Blue-eyed (Sisyrinchium), Grass, Golden-eyed (Sisyrinchium), Grassnut (Brodiaea), Grass of Parnassus (Parnassia), Grass Pink (Calopogon), Grass Widows (Sisyrinchium), Grasswort (Cerastium), Greasewood (Audibertia), Greek Valerian (Polemonium), Greenbrier (Smilax), Green Violet (Hybanthus), Gromwell (Lithospermum), Gromwell, False (Onosmodium), Ground Cherry (Physalis), Ground Ivy (Glecoma), Ground Nut (Apios), Groundsel (Senecio), Groundsel Bush (Baccharis), Guava (Psidium), Guava, Chilean (Myrtus), Guelder Rose (Viburnum opulus), Guinea Hen Weed (Petiveria), Gum Myrtle (Angophora), Gum, Sour (Nyssa), Gum, Sweet (Liquidambar), Gum Tree (Eucalyptus), Gumweed (Grindelia), Gutta-Percha Tree (Eucommia, Pelaquium).

Hackberry (Celtis), Harbinger of Spring (Erigenia), Hardhack (Spiraea), Hardheads (Centaurea), Hardy Orange (Poncirus), Harebell (Campanula, Wahlenbergia), Hawkbit (Leontodon), Haw, Black (Viburnum), Hawksbeard (Crepis), Hawkbit (Leontodon), Hawkweed (Hieracium), Haw, Medlar (Crataegomespilus), Haw, Possum (Ilex), Hawthorn (Crataegus), Hawthorn, India (Raphiolepis), Hawthorn, Water (Aponogeton), Hawthorn, Yeddo (Raphiolepis), Hazel, Chile (Gevuina), Hazel Nut (Corylus cavellana), Hazel, Winter (Corylopsis), Healall (Prunella), Heartnut (Juglans), Hearts-a-bustin (Euonymus), Heartsease (Viola), Heartseed (Cardiospermum), Heath (Erica), Heath, Irish (Daboecia), Heather (Calluna), Heavenly Bamboo (Nandina), Hedge Mustard (Sisymbrium), Hedge Nettle (Stachys), Hedge Parsley (Torilis), Hedgethorn (Carissa), Hellebore, False (Veratrum), Helleborine (Epipactis, Veratrum), Hemlock (Tsuga), Hemlock Parsley (Concoselinum), Hemlock, Poison (Conium), Hemlock, Water (Cicuta), Hemp (Cannabis), Hemp, Bowstring (Sanseviera), Hemp, Manila (Musa), Hemp Nettle (Galeopsis), Hemp, Sisal (Agave), Hemp Tree (Vitex), Hempweed, Climbing (Mikania), Hen and Chickens (Sempervivum), Henbane (Hyoscyamus), Henbit (Lamium), Henna (Lawsonia), Heralds Trumpet (Beaumontia), Herb Christopher (Actaea), Herb Robert (Geranium), Hercules Club (Aralia), Heronsbill (Erodium), Hickory (Carya), Hills of Snow (Hydrangea), Himalayan Magnolia Vine (Schisandra), Hoarhound (Marrubium), Hoarhound, Black (Ballota), Hoarhound, Water (Lycopus), Hoary Alyssum (Berteroa), Hoary Pea (Tephrosia), Hobble Bush (Viburnum), Hog Fennel (Oxypolis), Hog Peanut (Amphicarpaea), Holly (Ilex), Holly, African (Solanum), Holly Grape (Mahonia), Hollyhock (Althaea), Holly, Mountain (Nemopanthus), Holly, Sea (Eryngium), Holy Ghost Flower (Peristeria), Honesty (Lunaria), Honewort (Cryptotaenia), Honeybell (Mahernia), Honeybush (Melianthus), Honey Locust (Gleditsia), Honey Myrtles (Melaleuca), Honeysuckle (Lonicera), Honeysuckle, Bush (Diervilla), Honeysuckle, Cape (Tecomaria), Honeysuckle, French (Hedysarum), Honeysuckle, Himalaya (Leycesteria), Honeysuckle, Jamaica (Passiflora), Honeysuckle, White Swamp (Rhododendron), Honeywort (Cerinthe), Hop Hornbeam (Ostrya), Hops (Humulus), Hop Tree (Ptelea), Horehound (Marrubium), Hornbeam (Carpinus), Horned Poppy (Glaucium), Hornwort (Ceratophyllum), Horse Brier (Smilax), Horse Balm (Collinsonia), Horse Chestnut (Aesculus), Horse Mint (Monarda punctata, Pycnanthemum), Horse Radish (Armoracia), Horse Radish Tree (Moringa), Horsetail (Equisetum), Horsetail Tree (Casuarina), Horseweed (Collinsonia), Hottentot Fig (Carpobrotus edulis), Hottentots Bread (Testudinaria), Hounds Tongue (Cynoglossum), House Leek (Sempervivum), Huckleberry (Vaccinium), Humble Plant (Mimosa), Hyacinth (Hyacinthus), Hyacinth Bean (Dolichos), Hyacinth, Summer (Galtonia), Hyacinth, Grape (Muscari), Hyacinth, Star (Scilla), Hyacinth, Water (Eichornia), Hyacinth, Wild (Brodiaea), Hydrangea Vine (Schizophragma), Hyssop (Agastache, Gratiola).

Ice Plant (Cryophytum, Mesymbryanthemum), Illawarra Palm (Archontophoenix), Incense Cedar (Libocedrus), Indian Bean Tree (Catalpa), Indian Cucumber Root (Medeola), Indian Cup (Silphium), Indian Currant (Symphoricarpos), Indian Hemp (Apocyanum cannabinum), Indian Physic (Gillenia trifoliata), Indian Pipe (Monotropa), Indian Pink (Spigelia), Indian Plantain (Cacalia), Indian Shot (Canna), Indian Strawberry (Duchesnea), Indian Tobacco (Lobelia), Indian Turnip (Arisaema), Indigo (Indigofera), Indigo, False (Amorpha, Baptisia), Indigo, Wild (Baptisia), Inkberry (Ilex), Ipecac, American (Gillenia), Irish Heath (Daboecia), Ironweed (Vernonia), Ismene Lily (Hymenocallis), Italian thistle (Carduus), Ivy (Hedera).

Jackfruit (Artocarpus), Jack-in-the-Pulpit (Arisaema), Jacobs Ladder (Polemonium), Jacobs Rod (Asphodeline), Jacobs Staff (Fouquieria), Jajoba (Simmondsia), Japanese Cedar (Cryptomeria), Japanese Pagoda Tree (Sophora), Japanese Quince (Chaenomeles), Japanese Raisin Tree (Hovenia), Jasmine (Jasminium), Jasmine, Cape (Gardenia), Jasmine, Chilean (Mandevilla), Jasmine, Confederate (Trachelospermum), Jasmine, Crape (Ervatamia), Jasmine, Madagascar (Stephanotis), Jasmine, Night (Nyctanthes), Jasmine, Rock (Androsace), Jasmine, Star (Trachelospermum), Jerusalem Artichoke (Helianthus tuberosus), Jerusalem Cross (Lychnis), Jerusalem Sage (Phlomis), Jerusalem Thorn (Parkinsonia), Jetbead (Rhodotypos), Jewel Vine (Derris), Jewel Weed (Impatiens), Jicama (Pachyrhizus tuberosus), Jimson Weed (Datura), Jobs Tears (Coix, Tradescantia), Joe-Pye-Weed (Eupatorium), Johny Jump-up (Viola), Joint Fir (Ephedra), Jointweed (Polygonella), Jointwood (Cassia), Jojoba (Simmondsia), Jonquil (Narcissus), Josephs Coat (Amaranthus), Joshua Tree (Yucca), Judas Tree (Cercis), Jujube (Zizyphus), Juneberry (Amelanchier), Jupiters Beard (Anthyllis, Centranthus), Jute (Corchorus).

Kaffir Lily (Clivia, Schizostylis), Kaki (Diospyros), Kale (Brassica), Kangaroo Paw (Anigozanthos), Kangaroo Thorn (Acacia), Kangaroo Vine (Cissus), Kapok (Ceiba), Karanda (Carissa), Karo (Pittosporum), Karum Oil Tree (Pongamia), Kassod Tree (Cassia), Katsura Tree (Cercidiphyllum), Kei Apple (Dovyalis), Kenilworth Ivy (Cymbalaria), Kentucky Coffee Tree (Gymnocladus), Kingfisher Daisy (Felicia), King of the Alps (Eritrichium), Kiwi Fruit (Actinidia), Knapweed (Centaurea), Knotroot (Stachys), Knotweed (Polygonum), Kohlrabi (Brassica), Kudzu Vine (Pueraria), Kumquat (Citrus).

Labrador Tea (Ledum), Lacebark (Gaya), Lace Flower, Blue (Trachymene), Laceleaf (Aponogeton), Lace Vine (Polygonum), Lacquer Tree (Rhus), Ladies Tresses (Spiranthes), Ladybell (Adenophora), Ladys Bedstraw (Galium), Ladys Fingers (Anthyllis), Ladys Mantle (Alchemilla), Ladys Slipper (Cypripedium), Ladys Smock (Cardamine), Lake Cress (Amoracia), Lambkill (Kalmia), Lambs Ears (Stachys), Lambs Lettuce (Valerianella), Lambs Quarters (Chenopodium), Lampwick Plant (Phlomis), Lancepod (Lonchocarpus), Lantern Plant, Chinese (Physalis), Larch (Larix), Larkspur (Delphinium), Latticeleaf (Aponogeton), Laurel (Kalmia, Laurus), Laurestinus (Viburnum), Laurocerasus (Prunus), Lavender (Lavendula), Lavender Cotton (Santolina), Leadplant (Amorpha), Leadwort (Ceratostigma), Leafcups (Polymnia), Leather Flower (Clematis), Leather Jacket (Eucalyptus), Leather Leaf (Chamaedaphne), Leather Root (Psoralea), Leatherwood (Cyrilla, Dirca), Leek (Allium), Lemon (Citrus), Lemon Lily (Hemerocallis flava), Lemon Mint (Monarda citriodora), Lenten Rose (Helleborus orientalis), Lentil (Lens), Leopard's Bane (Doronicum), Lettuce (Lactuca), Lettuce, Water (Pistia), Licorice (Glycyrrhiza), Lignum Vitae (Guiacum), Lilac (Syringa), Lilac, Indian (Melia), Lilac, Summer (Buddleia), Lily (Lilium), Lily, Adobe (Fritillaria), Lily, African (Agapanthus), Lily, Amazon (Eucharis), Lily, Atamasco (Zephyranthes), Lily, Belladonna (Amaryllis), Lily, Blackberry (Belamcanda), Lily, Blood (Haemanthus), Lily, Checkered (Fritillaria), Lily, Chinese Sacred (Narcissus), Lily, Cow (Nymphozanthus), Lily, Day (Hemerocallis), Lily, Fawn (Erythronium), Lily, Ginger (Hedychium), Lily, Glory (Gloriosa), Lily, Guernsey (Nerine), Lily, Jacobean (Sprekelia), Lily, Josephines (Brunsvigia), Lily, Kaffir (Clivia), Lily, Mariposa (Calochortus), Lily, Mountain (Ranunculus), Lily of the Nile (Agapanthus), Lily of the Valley (Convallaria), Lily, Plantain (Hosta), Lily, Pond (Nymphozanthos), Lily, Prairie (Cooperia), Lily, Rain (Cooperia), Lily, St. Bernards (Anthericum), Lily, St. Brunos (Paradisea), Lily, St. James (Sprekelia), Lily, Sand (Leucocrinum), Lily, Scarborough (Vallota), Lily, Sego (Calachortus), Lily, Snake (Brodiaea), Lily, Spear (Doryanthes), Lily, Spider (Hymenocallis), Lily, Star (Leucocrinum), Lily, Tiger (Lilium tigrinum), Lily, Toad (Tricyrtis), Lily, Torch (Kniphofia), Lily, Triplet (Brodiaea), Lily, Trout (Erythronium), Lily, Turf (Liriope), Lily, Water (Nymphaea), Lily, Zephyr (Zephyranthes), Lime (Citrus), Lime Tree (Tilia), Linden Tree (Tilia), Lion's Ear (Leonotis), Liquorice (Glycyrrhiza), Live for ever (Sedum), Liverleaf (Hepatica), Living Rock (Roseocactus), Livingstone Daisy (Mesembryanthemum), Living Stones (Lithops), Lizard's Tail (Saururus), Loblolly Bay (Gordonia), Lobster's Claw (Clianthus punicea), Locoweed (Oxytropis), Locust (Gleditsia, Robinia), Logwood (Haematoxylum), London Pride (Saxifraga), Loosestrife (Lysimachia, Lythrum), Lopseed (Phyrma), Loquat (Eriobotrya), Lords and Ladies (Arum maculatum), Lotus (Nelumbo, Nymphaea), Lousewort (Pedicularis), Lovage (Levisticium), Love-in-a-mist (Nigella), Love Lies Bleeding (Amaranthus), Lucerne (Medicago), Lungwort (Mertensia, Pulmonaria), Lupine (Lupinus, Thermopsis), Lychee (Litchi), Lyon Shrub (Lyonothamnus).

Madder (Rubia), Madeira Vine (Boussingaultia), Madrona (Arbutus), Madwort (Alyssum), Magellan Box Lily (Philesia), Mahala Mat (Ceanothus), Mahogany (Swietenia), Mahogany, Bastard (Eucalyptus), Mahogany, Mountain (Cercocarpus), Mahogany, Red (Eucalyptus), Mahogany, Swamp (Eucalyptus), Maidenhair Tree (Ginko), Maiden Pink (Dianthus), Maize (Zea), Maleberry (Lyonia), Mallow (Althaea, Lavatera, Malva, Sidalcea, Sphaeralcea), Mallow, False (Malvastrum), Mallow, Globe (Sphaeralcea), Mallow, Marsh (Althaea), Mallow, Musk (Hibiscus), Mallow, Poppy (Callirhoe), Mallow, Prairie (Malvastrum), Mallow, Rose (Hibiscus), Mallow, Tree (Lavatera), Maltese Cross (Lychnis), Malu Creeper (Bauhinia), Mandrake (Mandragora, Podophyllum), Mangel (Beta), Mango (Mangifera), Mangosteen (Garcinia), Mangrove (Rhizophora), Manioc (Manihot), Manzanita (Arctostaphylos), Maple (Acer), Maple, Flowering (Abutilon), Maplewort (Aceranthus), Marigold (Tagetes), Marigold, Bur (Bidens), Marigold, Cape (Dimorphotheca), Marigold, Corn (Chrysanthemum), Marigold, Fig (Mesymbryanthemum), Marigold, Marsh (Caltha), Marigold, Pot (Calendula), Mariposa Lily (Calochortus), Marjoram (Origanum), Marlberry (Ardisia), Marram (Ammophila), Marsh Felwort (Lomatogonium), Marsh Fleabane (Pluchea), Marshmallow (Althaea), Marsh Marigold (Caltha palustris), Marsh Pink (Sabatia), Marsh St. John's Wort (Triadenum), Martynia (Proboscidea), Marvel of Peru (Mirabilis), Mask Flower (Alonsoa), Masterwort (Astrantia), Mastic Tree (Schinus), Matilija Poppy (Romneya), Matrimony Vine (Lycium), Mayapple (Podophyllum), Mayberry (Rubus), Mayflower (Epigea), May Lily (Maianthemum), Maypop (Passiflora), Mayweed (Anthemis), Meadow Beauty (Rhexia), Meadow Foam (Limnanthes), Meadow Parsnip (Thaspium), Meadow Rue (Thalictrum), Meadow Saffron (Colchicum), Meadowsweet (Filipendula, Spiraea), Medlar (Mespilus), Melon (Citrullus, Cucumis, Cucurbita), Mercury (Chenopodium), Mesquite (Prosopis), Mexican Buckeye (Ungnadia), Mexican Cigar Plant (Cuphea ignea), Mexican Orange (Choisya), Michaelmas Daisy (Aster novae-anglae), Mignonette (Reseda), Mignonette Tree (Lawsonia), Mignonette Vine (Boussingaultia), Milk Pea (Galactia), Milkwort (Polygala), Mistletoe (Phoradendron, Viscum), Melon (Cucumis melo), Milfoil (Achillea), Milfoil, Water (Myriophyllum), Milk Bush (Euphorbia, Synadenium), Milk Vetch (Astragalus), Milkweed (Asclepias), Milkwort (Polygala), Mimosa Tree (Albizzia julibrissin), Mina (Quamoclit), Miner's Lettuce (Montia), Mint (Mentha), Mint, Horse (Monarda), Mint, Mountain (Pycnanthemum), Mint, Stone (Cunila), Mistflower (Eupatorium), Mistletoe (Loranthaceae), Mitrewort (Tiarella), Mocassin Flower (Cypripedium), Mockernut (Carya), Mock Orange (Philadelphus), Mole Plant (Euphorbia), Money Plant (Lunaria Annua), Moneywort (Lysimachia nummularia), Monkey Bread Treee (Adansonia), Monkey Flower (Mimulus), Monkey Pod (Samanea), Monkey Puzzle Tree (Araucaria araucana), Monkshood (Aconitum), Monkshood Vine (Ampelopsis), Moonflower (Colonyction), Moonseed (Cocculus, Menispermum), Moonwort (Botrychium, Lunaria), Mooseberry (Viburnum), Moosewood (Acer), Mormon Tea (Ephedra nevadensis), Morning Glory (Argyreia, Convolvus, Ipomaea), Moses-in-the-Cradle (Rhoeo), Mosquito Trap (Cynanchum), Mother-of-thousands (Tolmiea), Mother of Thyme (Thyumus), Motherwort (Leonurus), Mountain Ash (Sorbus), Mountain Avens (Dryas), Mountain Dandelion (Agoseris), Mountain Flax (Phormium), Mountain Fringe (Adlumia), Mountain Hollyhock (Iliamna), Mountain Laurel (Kalmia), Mountain Mint (Pycnanthemum), Mountain Mahogany (Cercocarpus), Mourning Bride (Scabiosa), Mouse Ear Cress (arabidopsis), Mouse Tail (Myosurus), Mud Plantain (Heteranthera), Mudwort (Limosella), Mugwort (Artemisia), Mulberry (Morus), Mulberry, French (Callicarpa), Mulberry, Indian (Morinda), Mulberry, Paper (Broussonetia), Mullein (Verbascum), Mullein Pink (Lychnis), Multiflora Rose (Rosa multiflora), Musk Plant (Mimulus), Muskroot (Adoxa), Mustard (Brassica), Myrobalan (Phyllanthus, Prunus, Terminalia), Myrtle (Myrtus), Myrtle, Crape (Lagerstroemia), Myrtle, Downy (Rhodmyrtus), Myrtle, Gum (Angophora), Myrtle, Running (Vinca), Myrtle, Sand (Leiophyllum), Myrtle, Wax (Myrica).

Nailwort (Paronychia), Nannyberry (Viburnum lentago), Nasturtium (Tropaeolium majus), Natal Plum (Carissa), Navalseed (Omphalodes), Navelwort (Cotyledon, Omphalodes), Necklace Tree (Ormosia), Nettle (Urtica), Nettle, Dead (Lamium), Nickernut (Caesalpinia), New Jersey Tea (Ceanothus americana), Night Phlox (Zaluzianskya), Nightshade (Solanum), Nightshade, Enchanters (Circaea), Ninebark (Physocarpus), Nipplewort (Lapsana), Nippon Bells (Shortia), Norfolk Island Pine (Araucaria excelsa), Nuphar (Nymphosanthus), Nutmeg (Myristica), Nutmeg, California (Torreya), Nuttalia (Mentzelia, Osmaronia).

Oak (Quercus), Oak, Poison (Rhus), Oak, Silk (Grevillea), Oak, Tanbark (Lithocarpus), Oakesia (Uvularia), Oats (Avena), Obedient Plant (Physostegia), Ocean Spray (Holodiscus), Oconee Bells (Shortia), Ocotillo (Fouquieria), Okra (Hibiscus), Oleander (Nerium), Oleaster (Eleaganus), Olive (Olea), Olive, Russian (Eleaganus), Onion (Allium), Opium Poppy (Papaver), Orange (Citrus), Orange, African Cherry (Citropsis), Orange, Mexican (Choisya), Orange, Mock, (Philadelphus, Prunus), Orange, Natal (Strychnos), Orange, Osage (Maclura), Orangeroot (Hydrastis), Orange, Trifoliate (Poncirus), Orange, Wild (Prunus), Oregon Holly Grape (Mahonia), Oregano (Origanum), Orpine (Telephium), Osier (Cornus), Osoberry (Osmaronia), Oswego Tea (Monarda didyma), Owl Clover (Orthocarpus), Oxeye (Bupthalmum), Oxeye Daisy (Chrysanthemum), Oxlip (Primula), Oxtongue (Picris), Oyster Plant (Tragopogon).

Pacific Madrone (Arbutus), Pagoda Tree (Sophora), Paintbrush (Castilleja, Hieracium), Painted Cup (Castilleja), Palmetto Palm (Sabal), Palmetto, Saw or Scrub (Serenoa), Palo Verde (Cercidium), Pampas Grass (Cortaderia), Pansy (Viola), Papaya (Carica), Paperbush (Edgeworthia), Paper Flower (Buginvillaea), Papyrus (Cyperus), Paranut (Bertholettia), Parasol Tree (Firmiana), Pardanthus (Belamcanda), Parrots Beak (Clianthus), Parrots Feather (Myriophyllum), Parsley (Petroselinum), Parsnip (Pastinaca), Paterson Sugarplum (Lagunaria), Partridge Berry (Mitchella), Partridge Foot (Luetkea), Partridge Pea (Cassia), Pasque Flower (Pulsatilla), Passion Flower (Passiflora), Pawpaw (Asimina), Pea (Lathyrus), Pea, Asparagus (Psophocarpus), Pea, Butterfly (Centrosema, Clitoria), Pea, Chick (Cicer), Pea, Glory (Clianthus), Pea, Pigeon (Cajanus), Pea, Rosary (Abrus), Pea, Scurfy (Psoralea), Pea, Shamrock (Parochetus), Pea, Shrub or Tree (Caragana), Pea, Winged (Lotus), Peach (Prunus), Peacock Flower (Delonix, Moraea), Peanut (Arachis), Pear (Pyrus), Pearl Bush (Exochorda), Pearl Fruit (Margyricarpus), Pearlwort (Sagina), Pearly Everlasting (Anaphalis), Pear (Pyrus), Pear, Alligator (Persea), Pear, Balsam (Momordica), Pear, Prickly (Opuntia), Pearlfruit (Margyricarpus), Pearlwort (Sagina), Pecan (Carya), Pelican Flower (Aristolochia), Pencil Flower (Stylosanthes), Pennant Flower (Chasmanthe), Pennycress (Lepidium, Thlaspi), Pennyroyal (Hedeoma, Mentha), Pennywort (Cotyledon, Obolaria), Pepper (Capsicum, Piper), Pepper Grass (Lepidium), Peppermint (Mentha), Pepper Tree (Schinus), Pepper Vine (Ampelopsis), Pepperwort (Marsilea), Periwinkle (Vinca), Persian Violet (Exacum), Persimmon (Diospyros), Peruvian Bark Tree (Cinchona), Peyote (Lophophora), Pheasant's Eye (Adonis), Phoenix Tree (Firmiana), Pickerel Weed (Pontederia), Pie Plant (Rheum), Pigeonberry (Durania), Pigmy Weed (Tillaea), Pignut (Carya), Pigweed (Chenopodium, Portulaca), Pimpernel (Anagallis), Pincushion flower (Scabiosa), Pine (Pinus), Pine, Australian (Casuarina), Pine, Cypress (Callitris), Pine, Norfolk Island (Araucaria), Pine, Screw (Pandanus), Pine, Umbrella (Sciadopitys), Pineapple (Ananas), Pineapple Flower (Eucomis), Pineapple Guava (Feijoa), Pine Drops (Pterospora), Pine Foot (Pityopus), Pinesap (Pleuricospora), Pink (Dianthus), Pink, Cushion (Silene), Pink, Fire (Silene), Pink, Ground (Phlox), Pink, Indian (Lobelia, Silene), Pink, Moss (Phlox), Pink, Mullein (Lychnis), Pinkroot (Spigelia), Pink, Sea (Limonium), Pink, Swamp (Helonias), Pinxter Flower (Rhododendron), Pipsissewa (Chimaphila), Pitcher Plant (Nepenthes, Sarracenia), Pitcher Plant, California (Darlingtonia), Plane Tree (Platanus), Plantain (Plantago), Pleurisy Root (Asclepias), Plum (Prunus), Plum Yew (Cephalotaxus), Poinsettia (Euphorbia), Poison Bulb (Crinum), Poison Hemlock (Conium), Poison Elder, Ivy, Oak, or Sumac (Rhus), Pokeberry or Pokeweed (Phytolacca), Poker Plant (Kniphofia), Pomegranate (Punica), Pond Lily (Nuphar), Poor Mans Weatherglass (Anagallis), Popcorn Flower (Plagiobothrys), Poplar (Populus), Poppy (Meconopsis, Papaver), Poppy, Bush (Dendromecon), Poppy, California (Eschscholzia), Poppy, Celandine (Stylophorum), Poppy, Horned (Glaucium), Poppy, Matilija (Romneya), Poppy, Mexican Tulip (Hunnemania), Poppy, Plume (Macleaya), Poppy, Prickly (Argemone), Poppy, Sea (Glaucium), Poppy, Snow (Eomecon), Poppy, Tree (Dencromecon), Poppy, Water (Hydrocleys), Poppy, Welsh (Meconopsis cambrica), Poppy Mallow (Callirhoe), Porcupine Plant (Hymenanthera), Possum Haw (Ilex), Potato (Solanum), Pot Marigold (Calendula), Prairie Clover (Petalostemon), Pretty Face (Brodiaea), Prickleweed (Desmanthus), Prickly Mallow (Sida), Prickly Pear (Opuntia), Primrose (Primula), Primrose, Arabian (Arnebia), Primrose, Cape (Streptocarpus), Primrose, Evening (Oenothera), Primrose Willow (Ludwigia), Prince Albert Yew (Saxegothaea), Princess Feather (Amaranthus, Polygonum), Princes Pine (Chimaphila umbellata), Privet (Ligustrum), Prophet Flower (Arnebia), Puccoon (Lithospermum), Pumpkin (Cucurbita pepo), Punk Tree (Melaleuca), Purple Wreath (Petrea), Purple Rocket (Iodanthus), Purslane (Calandrinia, Montia, Portulaca), Pussy Toes (Antennaria), Puttyroot (Amplectrum), Pyxie Moss (Pyxidanthera),

Quail Bush (Atriplex), Quaker Ladies (Houstonia), Quamash (Camassia), Queen Anne's Lace (Daucus carota), Queen Cup (Clintonia), Queen of the Prairie (Filipendula), Queensland Nut (Macadamia), Quince (Chaenomeles, Cydonia), Quinine (Cinchona).

Rabbit Brush (Chrysothamnus), Radish (Raphanus), Ragged Robin (Lychnis), Ragwort (Senecio), Rainbow Cactus (Echinocereus), Rain Tree (Samanea), Rampion (Campanula, Phyteuma), Rape (Brassica), Raspberry (Rubus), Rattle (Rhinanthus), Rattlebox (Crotolaria), Rattlesnake Master (Eryngium), Rattlesnake Plantain (Goodyera), Rattlesnake Root (Prenanthes), Redbay (Persea), Redbud (Cercis), Red Cedar (Juniperus virginiana), Red Hot Poker (Kniphofia), Redroot (Ceanothus), Red Valerian (Centranthus or Kentranthus), Redwood (Sequoia, Sequoiadendron), Redwood Ivy (Vancouveria), Reed (Cyperis, Juncus, Phragmites), Reed Palm (Chamaedorea seifrizii), Rein Orchid (Habenaria), Restharrow (Ononis), Rhodora (Rhododendron), Rhubarb (Rheum), Rice (Oryza), Rice, Wild (Zizania), Rockbreak (Saxifrage), Rock Cress (Arabis), Rocket (Diplotaxis, Eruca, Hesperis), Rockfoil (Saxifraga), Rock Jasmine (Androsace), Rock Rose (Cistus, Helianthemum), Rock Spiraea (Petrophytum), Rose, Bridal (Matricaria), Rose, Christmas (Helleborus), Rose, Guelder (Viburnum), Rose, Moss (Portulaca), Rose Acacia (Robinia hispida), Rose Campion (Lychnis coronaria), Rosemary (Rosmarinus), Rosemary, Bog (Andromeda), Rosemary, Wild (Ledum), Rose of Sharon (Hibiscus), Roseroot (Sedum roseum), Rosin Weed (Calycadenia, Silphium), Rowan (Sorbus), Royal Palm (Roystonea), Royal Poinciana (Delonix), Rubber (Hevea), Rubber Plant (Ficus), Rue (Ruta), Rue Anemone (Anemonella), Rue, Meadow (Thalictrum), Rupturewort (Herniaria), Rush (Juncus), Russian Olive (Eleaganus), Russian Thistle (Centaurea repens), Rutabaga (Brassica), Rye (Secale), Rye, Wild (Elymus).

Sabina (Juniperus), Safflower (Carthamus), Saffron, False (Carthamus), Sage (Audibertia, Salvia), Sagebrush (Artemisia tridentata), Sage, Jerusalem (Phlomis), Saguaro (Carnegia gigantea), Saint Bernard's Lily (Anthericum liliago), Saint Bruno's Lily (Paradisea), Saint John's Bread (Ceratonia), Saint John's Wort (Hypericum), Saint Peters Wort (Ascyrum), Saint Thomas Tree (Bauhinia), Salal (Gaultheria), Salmon Berry (Rubus), Salsify (Tragopogon), Saltbush (Atriplex), Salt Marsh Mallow (Kosteletzkya), Salt Tree (Halimodendron), Saltwort (Salsola), Sandalwood (Santalum), Sandalwood, Bastard (Myoporum), Sandalwood Tree, Red (Adenanthera), Sandbox Tree (Hura), Sand Lily (Leucocrinum), Sandmyrtle (Leiophyllum), Sand Spurrey (Spergularia), Sand Verbena (Abronia), Sandwort (Arenaria, Minuartia), Sapodilla (Sapota), Sapote (Achras), Sapote, Black (Diospyros), Sapote, White (Casimiroa), Sarsaparilla (Aralia), Satinflower (Lunaria), Satsuma (Citrus), Sausage Tree (Kigelia), Savannah Flower (Echites), Savin (Juniperus), Savory (Satureia), Saw Palmetto (Serenoa), Scarlet Bugler (Penstemon centranthifolius), Scarlet Bush (Hamelia), Scarlet Gilia (Ipomopsis), Scarlet Pimpernel (Anagallis arvensis), Scarlet Plume (Euphorbia), Scarlet Runner (Phaseolus), Scoke (Phytolacca), Scorpion Senna (Coronilla), Screwpine (Pandanus), Screwstem (Bartonia), Scurf Pea (Psoralea), Scurvy Grass (Cochlearia), Sea Buckthorn (Hippophae), Sea Daffodil (Pancratium), Sea Fig (Mesymbryanthemum), Sea Kale (Crambe), Sea Lavender (Limonium), Sea Milkwort (Gaux), Sea Poppy (Glaucium), Sea Rocket (Cakile), Seashore Mallow (Kosteletzkya), Seaside Daisy (Erigeron glaucus), Seaside Grape (Coccoloba uvifera), Sea Urchin (Hakea), Sedge (Carex, Juncus), Self Heal (Prunella), Senna (Cassia, Hebecarpa), Senna, Bladder (Colutea), Sensitive Plant (Mimosa), Service Berry (Amelanchier), Service Tree (Sorbus), Sesame (Sesamum), Seven Stars (Ariocarpus), Shadblow or Shadbush (Amelanchier), Shaddock (Citrus), Shallon (Gaultheria), Shallot (Allium), Shamrock (Trifolium), Shamrock Pea (Parochetus), Sheep Berry (Viburnum), Sheep Laurel (Kalmia), Sheep's Bit (Jasione), Shellflower (Alpinia, Molucella), Shepherd's Cress (Teesdalia), Shepherd's Purse (Capsella), Shepherd's Tree (Boscia), Shieldwort (Peltaria), Shinleaf (Moneses, Pyrola), Shoo-fly Plant (Nicandra), Shooting Star (Dodecatheon), Shrub Violet (Hybanthus), Siberian Pea Shrub (Caragana), Silk Cotton Tree (Ceiba), Silk Oak (Grevillea), Silk Plant (Boehmeria), Silktree (Albizzia), Silk Vine (Periploca), Silkweed (Asclepias), Silkworm Tree (Cudrania), Silverbell Tree (Halesia, Leucadendron), Silverbell Vine (Actinidia), Silverbell Weed (Potentilla), Silver Berry (Eleaganus), Silver Crown (Luina nardosmia), Silver Fleece Vine (Polygonum), Silver Lace Vine (Polygonum), Silver Leaf (Luina), Silver Rod (Solidago), Silver Thatch Palm (Coccothrinax), Silver Vine (Actinidia), Singhara Nut (Trapa), Skullcap (Scutellaria), Skunk Cabbage (Lysochiton, Symplocarpus), Skunkweed (Navarretia, Polemonium), Skyflower (Durania), Slink Pod (Scoliopus), Slipperflower (Pedilanthus), Sloe (Prunus), Smartweed (Polygonum), Smoke Bush or Tree (Cotinus), Snail Flower (Phaeolus), Snailseed (Cocculus), Snakehead (Chelone), Snake Plant (Sansevieria), Snakeroot (Cimicifuga, Eupatorium), Snakeroot, Black (Eryngium, Liatris), Snakeroot, Seneca (Poygala), Snakeroot, Virginia (Aristolochia), Snakeshead (Fritillaria), Snakeweed (Polygonum), Snakewood Tree (Cecropia), Snapdragon (Antirrhinum), Snapweed (Impatiens), Sneezeweed (Helenium), Sneezewort (Achillea), Snowball (Viburnum), Snowbell (Soldanella, Styrax), Snowberry (Chiococca, Symphoricarpos), Snowberry, Creeping (Chiogenes), Snowbush (Breynia), Snowdrop (Galanthus), Snowflake (Leucojum), Snowflake, Water (Nymphioides), Snow in Summer (Cerastium, Euphorbia), Snow Orchid (Eburophyton), Snow Plant (Sarcodes), Snow Wreath (Neviusia), Soapbark Tree (Quillaja), Soapberry (Sapindus), Soap Plant (Chlorogalum), Soapwort (Saponaria), Solomon's Seal (Polygonatum), Sorghum (Holcus), Sorrel (Oxalis, Oxyria, Rumex), Sorrel Tree (Oxydendrum), Sorrel, Wood (Oxalis), Sourberry (Rhus), Sour Gum (Nyssa), Soursop (Annona), Sourwood (Oxydendrum), South African Daisy (Dimorphotheca), Southern Beech (Nothofagus), Southernwood (Artemisia), Sow Thistle (Sonchus), Soybean (Glycine), Spanish Bayonet (Yucca), Spanish Bluebell (Scilla), Spanish Broom (Spartium), Sparkleberry (Vaccinium), Spatterdock (Nymphozanthus), Spearmint (Mentha), Speedwell (Veronica), Spicebush (Lindera), Spider Flower (Cleome), Spiderwort (Commelina, Tradescantia), Spike Heath (Bruckenthalia), Spikenard (Aralia, Smilacina), Spikeweed (Hemizonia), Spinach (Spinacia), Spinach, New Zealand (Tetragonia), Spinach, Rhubarb (Rumex), Spindle Tree (Euonymus), Spirea, Blue (Caryopteris), Spirea, False (Sorbaria), Spirea (Rock (Holodiscus), Spring Snowflake (Leucojum), Spring Beauty (Claytonia), Spruce (Picea), Spurge (Euphorbia, Pachysandra), Spurred Gentian (Halenia), Spurrey (Spergula), Squash (Cucurbita), Squawberry (Mitchella), Squaw Cabbage (Caulanthus), Squaw Lettuce (Hydrophyllum), Squill (Scilla), Squirrel Corn (Dicentra), Staggerbush (Lyonia), Staggerweed (Delphinium), Starflower (Trientalis), Stargrass (Aletris, Hypoxis), Star Lily (Zigadenus fremontii), Star of Bethlehem (Ornithogalum), Star Thistle (Centaurea), Star Violet (Houstonia), Starwort (Aster), Statice (Limonium), Steeplebush (Spirea), Steer's Head (Dicentra), Stickleaf (Mentzelia), Stickseed (Hackelia, Lappala), Sticktights (Bidens), Stinkbells (Fritillaria), Stinking Benjamin (Trillium erectum), Stocks (Malcomia, Matthiola), Stoke's Aster (Stokesia), Stone-Cress (Aethionema), Stonecrop (Sedum), Stoneface (Lithops), Storks Bill (Erodium, Pelargonium), Strawberry (Fragraria), Strawberry, Barren (Waldsteinia), Strawberry Bush (Euonymus), Strawberry Guava (Feijoa), Strawberry, Indian or Mock (Duchesnea), Strawberry Tree (Arbutus), Strawflower (Helichrysum), Stringybark (Eucalyptus), Succory (Cichorium), Sugarberry (Celtis), Suharo (Carnegia), Sumac (Rhus), Summer Cypress (Kochia), Summersweet (Clethra), Sunberry (Solanum), Sundew (Drosera), Sundrops (Oenothera), Sunflower (Helianthus), Sunrose (Helianthemum), Supplejack (Berchemia), Surinam Cherry (Eugenia), Swamp Pink (Arethusa, Helonias), Swan River Daisy (Brachycome beridifolia), Sweet Bay (Laurus, Magnolia virginiana), Sweet Bells (Leucothoe), Sweet Cicely (Myrrhis, Osmorhiza), Sweet Clover (Melilotus), Sweet Fern (Comptonia), Sweet Flag (Acorus), Sweet Gum (Liquidambar), Sweetleaf (Symplocos), Sweet Pea (Lathyrus), Sweet Potato (Ipomaea), Sweet Rocket (Hesperis), Sweetshade (Hymenosporum), Sweet Shrub (Calycanthus), Sweetsop (Annona), Sweetspire (Itea), Sweet Sultan (Centaurea), Sweet William (Dianthus), Sweet Woodruff (Asperula), Swiss Chard (Beta), Sycamore (Platanus).

Tallow Tree (Sapium), Tamarack (Larix), Tamarisk (Tamarix), Tanbark Oak (Lithocarpus), Tangerine (Citrus), Tansy (Tanacetum), Tansy Mustard (Descurainia), Tapioca (Manihot), Tara Vine (Actinidia), Tarflower (Befaria), Tarragon (Artemisia), Tarweed (Hemizonia, Holocarpha, Madia), Tassel Flower (Amaranthus; Brickellia, Emilia), Tea (Thea), Teaberry (Gaultheria), Tea, Crystal (Ledum), Tea, Jersey (Ceanothus), Tea, Labrador (Ledum), Tea, Mexican (Chenopodium, Ephedra), Tea, Oswego (Monarda), Tea, Phillippine (Ehretia), Teak (Tectona), Teasel (Dipsacus), Tea Tree, Australian (Leptospermum), Telegraph Plant (Desmodium), Telegraph Weed (Heterotheca), Tempel Bells (Naegelia), Thimbleberry (Rubus), Thistle (Carduus, Carlina, Cirsium, Cnicus, Echinops, Onopordum, Salsola, Scolymus, Silybum), Thorn, Box (Lycium), Thorn, Camel (Acacia), Thorn, Christ (Paliurus), Thorn, Cockspur (Crataegus), Thorn, Hedge (Carissa), Thorn, Jerusalem (Paliurus, Parkinsonia), Thorn, Kangaroo (Acacia), Thorn, Lily (Catesbaea), Thorn, Mysore (Caesalpina), Thorn, Washington (Crataegus), Thorn Apple (Datura), Thorn Mint (Acanthomintha), Thoroughwax (Bupleurum), Thoroughwort (Eupatorium), Three Birds (Triphora), Thrift (Acantholimon, Armeria, Statice), Throatwort (Trachelium), Thyme (Thymus), Tick Trefoil (Desmodium), Tickseed (Bidens, Coreopsis), Tidy Tips (Layia), Tiger Flower (Tigridia), Timothy (Phleum), Tinkerweed (Triosteum), Toadflax (Linaria), Tobacco (Nicotiana), Tobacco, Indian (Lobelia), Tomatillo (Physalis), Tomato (Lycopersicon), Tooth Cup (Rotara), Toothwort (Dentaria), Torch Lily (Kniphofia), Touch-me-not (Impatiens), Trailing Arbutus (Epigea), Trail Plant (Adenocaulon), Traveler's Joy (Clematis), Traveler's Tree (Ravenala), Treebine (Cissus), Tree Fern (Cyathea, Dicksonia), Tree of Heaven (Ailanthus), Tree Poppy (Dendromecon), Tree Tomato (Cyphomandra), Trefoil (Lotus), Trefoil, Tick (Desmodium), Trout Lily (Erythronium), Trumpet Creeper (Campsis), Trumpet flower (Bignonia), Trumpet Vine (Campsis), Tubeflower (Siphonanhtus), Tulip, Globe (Calochortus), Tuberose (Polianthes), Tulip Poppy (Hunnemania), Tulip Tree (Liriodendron), Tupelo (Nyssa), Turkey Beard (Xerophyllum), Turkey Mullein (Eremocarpus), Turpentine Weed (Trichostema), Turtlehead (Chelone), Tuna (Opuntia), Tung Oil Tree (Aleurites), Turnip (Brassica), Turnip, Indian (Arisaema), Turpentine Tree (Syncarpia), Turtlehead (Chelone), Twayblade (Listera), Twinberry (Mitchella), Twinflower (Linnaea), Twinleaf (Jeffersonia), Twinspur (Diascia), Twisted Stalk (Streptopus).

Umbrella Leaf (Diphylleia), Umbrella Pine (Sciadopitys), Umbrella Plant (Peltiphyllum), Umbrella Tree (Magnolia), Unicorn Plant (Proboscidea),

Valerian (Centranthus, Polemonium), Vanilla Leaf (Achlys), Varnish Tree (Aleurites, Rhus), Velvet Leaf (Abutilon), Velvet Plant (Gynura), Venus Comb (Scandix), Venus Fly Trap (Dionaea), Venus Looking Glass (Triodanis), Verbena, Lemon (Lippia), Verbena, Sand (Abronia), Vervain (Verbena), Vetch (Astragalus, Lathyrus, Vicia), Vetch, Crown (Coronilla), Vetch, Kidney (nthyllis), Vetch, Milk (Astragalus), Vetchling (Lathyrus), Vinegar Weed (Trichostema lanceolatum), Violet (Viola), Violet, African (Saintpaulia), Violet, Dames (Hesperis), Violet, Dogstooth (Erythronium), Violet Cress (Ionopsidium), Viper's Bugloss (Echium), Virginia Creeper (Parthenocissus), Virginia Mallow (Sida), Virgin's Bower (Clematis virginiana), Voodoo Lily (Arisaema)

Wafer Ash (Ptelea), Wahoo (Euonymus), Wake Robin (Trillium), Wallflower (Cheiranthus cheiri, Erysimum), Wall Rocket (Diplotoxis), Walnut (Juglans), Wandering Jew (Tradescantia, Zebrina), Wandflower (Sparaxis), Wand Lily (Dierama), Waratah (Telopea), Water Cress (Nasturtium), Water Elm (Planera), Water Feather (Myriophyllum), Water Hawthorn (Aponogeton), Water Hemlock (Cicuta), Water Hyacinth (Eichornia), Water Horehound (Lycopus), Waterleaf (Hydrophyllum), Water Lily (Nymphaea), Water Lettuce (Pistia), Watermelon (Citrullus vulgaris), Water Milfoil (Myriophyllum), Water Parsnip (Berula, Sium), Water Pennywort (Hydrocotyle), Water Pimpernel (Samolus), Water Plantain (Alisma), Water Poppy (Hydrocleys), Water Shield (Brasenia, Cabomba), Water Snowflake (Nymphoides), Water Soldier (Stratioles), Waterweed (Elodea), Water Violet (Hottonia), Water Willow (Decodon, Justica), Wattle (Acacia), Waxberry (Symphoricarpos), Wax Myrtle (Myrica), Wax Plant (Hoya), Wax Tree (Rhus), Waxweed (Cuphea), Waxwork (Celastrus), Wayfaring Tree (Viburnum lantana), Welsh Poppy (Meconopsis cambrica), Wheat (Triticum), Wheat, India (Fagopyrum), Whispering Bells (Emmenanthe), White Alder (Clethra), White Cups (Nierembergia), White Snakeroot (Eupatorium rugosum), Whiteweed (Chrysanthemum), Whitewood (Liriodendron), Whitlow Grass (Draba), Whitlow Wort (Paronychia), Whorled Pogonia (Isotria), Whortleberry (Vaccinium), Wild Anise (Perideridia), Wild Bean (Strophostyles), Wild Cucumber (Echinocystis), Wild Ginger (Asarum), Wild Petunia (Ruellia), Wild Sarsaparilla (Aralia), Willow (Salix), Willow, Desert (Chilopsis), Willow, Primrose (Jussiaea), Willow Herb (Epilobium), Wind Flower (Anemone), Wind Poppy (Stylomecon), Wineberry (Rubus), Wine Plant (Rheum), Wingnut (Pterocarya), Wingstem (Actinomeris, Verbesina), Winter Aconite (Eranthis hyemalis), Winterberry (Ilex montana), Wintercreeper (Euonymus fortunei), Winter Cress (Barbarea), Winterfat (Eurotia), Wintergreen (Gaultheria, Moneses), Winterhazel (Corylopsis), Wintersweet (Celastrus, Chimonanthus), Wire Plant (Calacinum), Wire Vine (Muehlenbeckia), Wisteria (Sesbania), Witch Hazel (Hamamelis), Witherod (Viburnum), Woad (Isatis), Woadwaxen (Genista), Wolfberry (Symphoricarpos), Wolfsbane (Aconitum), Wonderberry (Solanum), Woodbine (Lonicera, Parthenocissus), Woodland Star (Lithofragma), Wood Mint (Blephilia), Wood Poppy (Stylophorum), Woodruff (Asperula), Wood Sorrel (Oxalis), Wormwood (Artemisia), Woundwort (Anthyllis, Stachys, Vulneraria)

Yam (Dioscorea), Yarrow (Achillea), Yaupon (Ilex), Yellow Bells (Emmenanthe), Yellow Cress (Rorippa), Yellow Fumitory (Corydalis), Yellow Pimpernel (Taenidia), Yellow Rattle (Rhinanthus), Yellowroot (Xanthorhiza), Yellow Trumpet (Stenolobium), Yellow Turf (Alyssum), Yellow Wood (Cladrastris), Yew (Taxus).

Zebra Plant (Calathea).

Additional Sources of Seeds

(This supplements earlier lists in the Second Edition and First Supplement)

Chehalis Rare Plant Nursery, 19081 Julie Road, Lebanon MO 65536
Pinetree Garden Seeds, Box 300, New Gloucester ME 04260
Rocky Mountain Rare Plants, 1706 Deerpath Road, Franktown CO 80116
Seedhunt, P. O. Box 96, Freedom CA 95019-0096
Seeds of Change, P. O. Box 15700, Santa Fe NM 87506-5700
Silverhill Seeds, P. O. Box 53108, Kenilworth, 7745 Cape Town, SOUTH AFRICA
SKC, Box 74, 70800 Ostrava-8, CZECH REPUBLIC
Trennol Nursery, 3 West Page Ave., Trenton OH 45067-1614
West Wind Technology, 5 South Hill Street, Athens TN 37303

New Contributors

Ralph Cramer, Columbia PA
Jim Hodge, Midlothian VA
Jeffrey Irons, England
Duncan McDougall, The Seed Guild, UK