SEEDLING PRODUCTION OF PEONIES

Don Hollingsworth-Maryville, Missouri

Seedling production in peonies is usually associated with the search for new varieties and, to a much lesser extent, with the propagation of the species. The garden varieties of peony do not come true from seed. Instead, each peony cultivar (cultivated variety) is a clone which must be reproduced by asexual means - division or grafting, for example, to keep it consistent. Seed propagation is the natural, sexual reproduction process.

The seedlings are variable - more so in the domestic selections and less so in the wild populations - depending on the variations in the genes preserved in domestic selection among the members of the parent group, but including that retained from their more distant species ancestry. Through sexual reproduction the available genes are by natural processes enabled to recombine in different ways among the members of the progeny. The resulting forms may then be selected for our desired characteristics.

In the purposeful production of seedlings, it is necessary to work with the inborn habit of the subject plants with regard to their germination cycle. With peonies, the cycle is more complex than is commonly encountered in plants normally grown from seeds in gardens, the latter having been bred up to be uniform from seed. Like many other garden plants that are usually propagated asexually, peonies are seen to retain the natural controls of germination timing which are characteristic of their wild ancestors.

Plants in nature survive from generation to generation partly because their germination is genetically timed such that the seedlings emerge at the season which is most favorable for their survival. This comes about through various internal growth controls and through other features, such as timing of seed maturation and seed dispersal mechanisms. In peonies, a large proportion of these controls are embodied in the germination processes. It is these processes which dictate the options available to one who wishes to grow peonies from seed.

Peony seeds can be dependably germinated out-of-doors in most latitudes without having special skills or elaborate equipment, provided certain guidelines are followed.

Expect a full year or more from planting to first emergence of leafy shoots. Starting with seeds from storage (store the seeds cool and dry after harvest or when received from other sources), plant anytime from late autumn until late spring. Think of this as the safe period, it emulates the natural delayed drop of seeds from the pods (in the full-season species lineages). At more southerly locations, this period can be extended to later in the growing season, for reasons to be explained further herein. Plant out-of-doors where the seeds will be exposed to the seasonal cycle of temperatures, where they will remain undisturbed and the soil will be not be allowed to completely dry, as dehydration can be expected to cause embryo death.

Preparatory development of the embryo takes place in the moist seeds during the summer and, in the seeds which have become ready, a root emerges upon decline of soil temperature in autumn. The leafy shoots appear above ground in the spring. This is the same annual cycle of growth with which we are

familiar in established peony plants. However, there appears to be a difference in that the seeds go through a preparatory development before root initiation is enabled in autumn. (Maybe this is not different. Perhaps the stem buds of established plants also go through a preparatory phase, but something not easily learned.)

The seeds are attuned to the seasonal phase of temperatures by their internal growth controls. Enough is understood about these processes and their requirements to make germination results highly predictable. Several control phases have been studied and the associated environmental requirements described.

To begin with, there is a dormancy or block to germination which appears to arise during seed maturation. This dormancy is recognized by the fact that rooting does not happen in every seed when soil temperatures fall. It is overcome over the time while the seeds are in a warm moist environment. It appears this reduction does not go forward during dry storage. The depth of this initial dormancy varies by different individual seeds within a particular cross, among different crosses and between species. (Presumably, then, it might be selected against in breeding.) This first “dormancy” may be quite shallow and reduced by a few days or a few weeks of warm-moist treatment, or it may range to much deeper, delaying the onset of germination development for a year or longer.

Once the initial dormancy is reduced, root germination is induced by the onset of cool temperatures, in nature upon the decline of soil temperatures in autumn. In controlled environment trials, this stimulation of root initiation by cool temperatures has been shown by controlled laboratory test. Seeds can be kept from rooting indefinitely by simply holding them at a higher temperature than that at which root growth can respond. (Hollingsworth, D., 1980, University of Missouri-Kansas City, unpublished).

When the initial dormancy remains in a seed at the time of first onset of the root- stimulating temperature, the dormancy restraint may continue to decline over time. Some seeds may become free to root germinate, and do so, later in autumn. It is now recognized that these late germinators run a higher risk of failing to make plants, for reasons to be discussed below.

The radicle end of the embryo produces the primary root. At the other end of the embryo is the epicotyl which I will call the shoot bud in order to emphasize the parallel with the overwintering shoot buds of peony plants. After root growth is under way, the embryonic shoot bud becomes more active. This bud has a strong dormancy which must be reduced by chilling and the passage of time, but not by freezing. This is a common phenomenon among temperate zone plants of numerous genera. It has been studied extensively in fruit crops, but is only partly understood in peonies. Accordingly, there is a tendency to generalize from the research on other genera to peonies, sometimes useful, but may well be imperfect, especially with respect to what is the most efficient temperature level for this process. I note that when the limited fluctuation of ordinary refrigerator temperatures are used for indoor germination trials, it can seemingly take a very long time before the seedling shoots are completely free of the dormancy block.

The winter dormancy reduction requirement appears to vary. Perhaps there are different ideal temperatures among different geographic ancestral lineages and for different temperature/time

regimes. Research with other genera and limited observations of controlled temperatures with germinating peony seeds suggests that the best temperatures are in a range which centers somewhere around 45° F. The progress of reduction seems to be slowed as temperatures go higher or lower from an ideal level. It has also been noted that when root growth has become longer before refrigeration (the roots sometimes grow as much as six inches in germinating peony seedlings) the apparent time requirement seems shorter. Perhaps this depends on whether the roots were growing in a cooler environment or that to some extent the duration of time may support dormancy reduction without the lower temperature.

Once growing temperatures have arrived in spring, higher soil temperatures, above which chilling can no longer take place, are in the near offing. Seedlings with shoot buds which have not reached their release from dormancy can then be expected to fail, insofar as our present observations are a guide. This is the source of the proposed increased risk of failure when root germination has been delayed well into autumn and is the basis of the "safe period" guideline for seed planting which is stated above. On the other hand, seeds which reach moist soil in late autumn will have little risk of making it through the reduction of initial dormancy, root-germinating before the onset of winter temperatures put physiological activity on "hold".

There is another procedure which has been long advocated by peony growers as a method for getting seedling leafy shoot production the first spring after seed harvest, instead of the second spring, as is inherent in the above. The basic idea is to get the seeds planted without letting them become dry from the maturing seed pod. This is, of course, available only when one has control of the seed harvest, or close cooperation of one’s seed source. The seeds are collected as soon as the ripe color of the seed coats has developed, or slightly before. The seeds are immediately placed in moist environment and planted or held where they will remain moist and warm through late summer and autumn. Otherwise they are handled as above. This probably works best when ancestry of the seeds includes species which naturally shut down in midsummer.

Results can range from excellent to very poor. We have already observed that there are differences in parent material. There are also important differences in the temperature/time sequences of the seasons, between years and between latitudes. Results are probably more reliable in the more southerly latitudes, where the seeds are likely to ripen earlier and the long, open autumn gives more time for the developmental processes to run their course. Attention to prevention of drying might be effective by limiting development of the initial, warmth-reduced dormancy, or may simply avoid interruption of the physiological process.

The above discussion of the phases of temperature controlled development in peony seed germination has arisen out of shared experiences by numerous peony seed growers seeking to simulate natural environmental requirements under indoor conditions. Once sufficient skill has been obtained with indoor procedures, it is possible to obtain good results which are predictable and reproducible. Details are available in other publications of the American Peony Society. One should recognize at the outset that there is a certain amount of tedium inherent in “indoor” peony seed germination, as the personal

satisfaction inherent in the study and experimentation that may be involved in bringing the process under a degree of control.

Less tedious, in some ways, than indoor germination, but more demanding of equipment and facilities, is embryo culture. For published information on both these laboratory-centered methods, see articles in past and current issues of the Bulletin, some of which have been reprinted in the book The Best of 75 Years, also published by this Society.

Care of the Seedlings

Seeds may be planted in cold frames or in the open ground. In either situation, it is desirable to prevent excessive freezing and thawing, especially after the seeds have root germinated. Any common mulch, or an insulated cover may be used. Peony shoots emerge at very low soil temperatures, once they are ready to grow. Therefore, it is necessary to remove obstruction to the light, once they commence growing. This will be before freezing and thawing is over for the season, but should be done regardless.

In covered frames, it is especially desirable to do something to control mice. They are apparently attracted to the seeds by their odor, and will carry them around. But, there is little in my observations to indicate they choose them as food. In order to reduce problems of their mixing the seed placement, I have usually placed a quantity of poisoned feed in the frames before putting on the covers for the winter.

Moles are always a problem in the field. They go directly to the newly planted peony row and make a tunnel the length of it. Presumably, the moles are attracted by the odor of the peony roots and expect to find soil insects feeding there. Voles use the runs, but usually do not feed on peony roots.

Peony seeds should be planted an inch or so apart, if to be transplanted the first year, or a little further apart if to be left a second year. Three inches apart is said to be suitable for leaving them until flowering size. I use frames and double row the seeds an inch apart and rows four inches apart. If there is good germination the first year, I mean to transplant. However, they are more often left another year for one reason or another. When plants are left for too many seasons where seeds were closely planted it predicts extensive loss of the weaker plants.

All first year seedlings are shaded during the summer in my latitude (Northwest Missouri). Otherwise, there is likely to be foliage burn when the sun's rays strike the leaflet most directly. Typically there is only one leaflet, so when lost the seedling is normally lost. I use aluminum fly screen for shading, sometimes supported on half-inch mesh hardware cloth, or in frames (repurposed screen sashes) while the sun is highest, late spring into early summer.

Seeds can be planted around an inch deep. Such depth may be necessary until they have germinated in order to keep them in place, especially if a hose will be used for watering. Watering should be done as

necessary to maintain the moist environment during the first summer. It is easy to overlook this while there are no leafy shoots to remind one.

Fungicide can be used to reduce the loss of first year foliage to disease. Most seedlings produce only one leaf. This leaf is the food factory for building the storage root. The longer it stays active and functioning during that first season, the better start the seedling will make.

The seed bed should be fertile and a supplemental nutrient program should be if applied needed to assure a good growing environment. I tend to use either a slow-release fertilizer product and/or a soluble fertilizer which includes trace elements. However, these should be used sparingly; the seed content largely provides for initial growth of the leafy shoot.

At transplanting to the field, my seedlings are spaced six inches or so, the rows close set, sufficiently that the planting forms a canopy early on against weed germination, and left until they flower in anticipation some will be worthy of growing on for further selection.