SOAKING SEEDS FOR IMPROVED GERMINATION

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High seed germination, if irregular, is no longer acceptable in commercial mechanized production. Seedsmen and propagators are challenged by the advent of "plug" and mechanized production systems to produce uniform seed germination at all times of the year. The single most important step a grower can take for uniform germination, after breaking dormancy, is to imbibe the seeds with water prior to sowing in soil.

The seedsperson must do his part by,

A) harvesting mature seeds from plants which will produce uniform seedlings,

B) processing the seed for long storage and easy sowing, without damaging the seed, and

C) delivering the seed with good vitality at the time needed by the propagator (2, 7, 10). Many germination problems are the result of improper seed handling.

The importance of harvesting mature seed cannot be overstated. After a seed pod or fruit has reached its maximum fresh weight there are still many changes taking place: (3, 5, 6, 7).

A) carbohydrate reserves are produced from sugars,

B) proteins and fats are stored (especially late in seed maturation),

C) nutrients are translocated from the plant to developing seeds. and,

D) three major hormonal changes occur: gibberellic acid is . . . "sequestered in an inactive form" (3), auxins accumulate in the nutritive tissue, and cytokinins are drastically reduced. Fruit and pods may appear mature to the layman but, in fact, the seed is still undergoing extensive maturation which is critical for optimum vitality.

The most important step is to initiate imbibition of the seed before the seed is sown in the soil medium. Planting seeds in the soil before imbibition results in sporadic germination . . . "by the impedance of the soil matrix due chiefly to surface and collodial forces and the degree of contact of the seed with the soil moisture" (3) which prevents seeds from imbibing water and subsequently germinating. This is documented by Pollock's work (9) where better germination occurred with higher initial seed moisture at the time of planting. It is stated by Bewley and Black (3) that . . . "the distance over which water flows to a seed through the soil often does not exceed 10mm irrespective of the soil water content". It should also be noted that this does not take into account the degree of contact between the soil holding the moisture, and the dry seed. Furthermore, late germinating seeds often die due to the changing water and environmental requirements of the seedling which have already emerged.

"Water is essential for the rehydration of seed as the initial step toward germination" (3). The uptake of water as described by Bewley and Black has a triphasic pattern: beginning with rapid imbibition of a resting seed, then a period of time where very little water uptake occurs but with increasing cellular activity and thirdly, rapid imbibition as visible germination begins. For some seeds then it is easy to soak them (preferably with distilled water) prior to sowing until the initial phase of imbibition is completed; many kinds of ornamental seed, however, have numerous barriers which prevent imbibition of water. These barriers cause different types of dormancy which are summarized by Nikolaeva (7). Dormancy has usually been overcome by use of trial and error techniques. Atwater (1) groups herbaceous ornamental plant into eight divisions according to the morphological structure of their seed. This can be used as starting guide for recommended seed treatment on herbaceous ornamentals. Atwater also lists many individual treatments for some species in each group. Some of these groupings may be applied to the woody ornamentals as well.

It is also important to maintain a perspective of the possible effects the native environment has on individual species, which includes understanding where the seed comes from and what occurs naturally for good germination (4). For example, soaking most mucilaginous seeds like Heteromeles arbutifolia or Iberis amara is counterproductive as mucilage . . . will spread around the seed and act as a pathway for the water (3); however, this group usually has more problems with gas uptake due to the mucilage (1, 4).

It is important not to oversoak seed either as some problems, such as rapid alcohol fermentation and gradual depletion of seed reserves and possible oxygen deficiency occur (8), all of which cause damage to the seed. Seed which has been "primed" by the seedsman has already received the initial imbibition necessary to start germination so it is not necessary to soak them; however, it is important to sow "primed" seed immediately.

Other considerations while imbibing include seed treated with fungicides or insecticides in the resting stage. These should be rinsed off prior to promoting imbibition as the chemicals may damage the seed during the first phase of imbibition (4). It is important not to add fungicides to the water during the initial imbibition but at the end of imbibition, or after the seed has been planted. For easy handling, surface air dry the seed lightly and sow seed immediately. Many types of mechanical machines are not able to accommodate this without overdrying the imbibed seed or damaging it. A general guide for time of seed soaking, using Atwater's classification scheme (and palms which are not included in her analysis) are as follows:

I. Endospermic seeds

A. Basal rudimentary embryo

ARALIACEAE. Soak 4–12 hours depending on size, age, and dryness of seed. Exception *Cussonia spicata,* maximum of 4 hours as it is from an arid climate and will be damaged.

B. Axillary linear embryo

PRIMULACEAE. Soak 6–24 hours again depending on age and dryness of seed. Small seeds such as *Hypericum calycinum* soaking is difficult as well as unnecessary as they are so small.

C. Axillary miniature embryo

SOLANACEAE. Soak 2–6 hours, no soak for CRASSULACEAE and BEGONIACEAE because the seeds are small.

D. Peripheral linear embryo

AMARANTHACEAE. No soaking required of *Celosia argentea*—small seeds.

II. Non-endospermic seeds

A. Hard seed coat limiting water entry

LEGUMINOSAE and ANACARDIACEAE. Soak 4–12 hours.

B. Thin seed coat with mucilaginous layer

No soaking required.

C. Woody seed coats with inner semipermeable layer.

POLIMONIACEAE. Soak 4 hours *Phlox drummondii;* smaller seed in this group should not be soaked. BALSAMINACEAE, *Impatiens* spp.

D. Fibrous seed coats with separate semi-permeable membrous layer.

COMPOSITAE. Soak 4 hours, seed will float so use a screen to press into water. (1, 4)

For the family PALMAE. Soak seeds for 24 hours; those with thick seed coats can soak longer (100 hours while changing the water often), or the seed coat must be sacrificed to allow imbibition. It is very important that palm seed be fully mature when harvested and, on most palm seed, the surrounding fruit should be removed so that the decaying fruit does not damage the seed. (4)

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PHIL BARKER: *Question for Eric Anderson. In soaking your* seeds to improve germination, just how long do you soak them?

ERIC ANDERSON: Most seeds we handle are soaked from two to 48 hours, although some kinds with very hard seed coats require from 3 to 5 days, with the water changed each day. Size of seeds and where they come from can make a difference. Very small seeds, as eucalyptus, primulas, and begonias require no soaking due to their small surface and easy absorption of moisture.

RON KADISH: In germinating seeds, I weigh the seeds before I soak them, then I start to weigh them as they are being soaked. If they gain 50% or more in weight, I find they will germinate; if they gain only 10 or 20%, I find they will not germinate.

Another interesting aspect of working with seeds; once I was collecting some *Euphorbia* seeds and had inadvertently rubbed my eyes. The next morning my eyes were swollen shut. I was sensitive to this plant, so one must be careful in working with certain toxic plant material.