Sex and the Single Plant: Seed Propagation: The Basics

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While there are many ways to propagate plants, some of which are very sophisticated, the increase of plants by seed is still a very common practice in the nursery industry. Seedage may be the only way to propagate the plant, is usually less expensive than other methods of propagation, produces plants for evaluation (pest resistance, aesthetics, etc.) and known characteristics, can be used for the production of understock, can be used as clonal propagation, and usually requires less space then other methods (Hartmann and Kester, 1975). However, seed-produced plants may show extreme variability, have a poorer root system, the sex of the plant will not be known, seed may have very low viability, or be unavailable (Macdonald, 1986).

Seed of most plants that have evolved in temperate zone climates have developed protective mechanisms that allow the plant to germinate under the most favorable conditions. This generally means the seed will germinate in the spring following the year or second year after the seed (fruit) ripens. There are a few of these mechanisms to consider and, unfortunately, in some cases there may be more than one mechanism in operation. By knowing the operational mechanisms that affect germination, the propagator may control these factors to affect germination in the most efficient manner and to the benefit of the propagator. Dormancy in plants and seed is the inability of the plant or plant part togrow and may be due to internal and/or external factors (Lang, 1987; Lang et al., 1987). The propagator may allow nature to take its course and have the seeds germinate in due time, or may elect to control the factors affecting germination to allow quicker, more orderly, and better germination. By controlling the factors of germination a more uniform crop may be achieved. Uniformity and predictability of seed germination is becoming a necessity for good grade count in production (Macdonald, 1986).

FACTORS NECESSARY FOR SEED GERMINATION

Seed must be viable. The elements that make a seed viable may be controlled by assuring these factors are in effect. This may be as simple as making sure the plants are pollinated. Separation of viable and non-viable seeds will assure a more uniform and predictable stand.

External Factors. The environmental factors that may affect germination include:

Light. Intensity and/or day length may be important to both germination and subsequent growth.

Oxygen. Needed for normal respiration.

Water. Needed for imbibition, germination processes, and subsequent growth.

Temperature. Many seeds have an optimum temperature for the germination process and for growth.

Any primary dormancy must be eliminated.

Seed germination is a complex interaction of many physical and chemical factors.

The germination process begins with the imbibition of water, elimination of primary dormancies, and along chain of events including enzyme synthesis, release of stored food, and an increase in respiration followed by the commencement of radicle/ embryo emergence.

FACTORS HINDERING GERMINATION

Internal Factors. These factors are normally physiological/chemical in nature:

Physiologically Dormant Embryo. Interaction of various hormones that are normally overcome by a chill period, the duration of which is dependent on the species. This type of dormancy may sometimes be overridden by the application (soaking) of the seeds in various gibberellins. Germination of light sensitive seeds may be enhanced under long days. Some seeds germinate better in the absence of light or under short days. Gibberellins may overcome the long daylight requirement of some seeds.

Rudimentary/Immature Embryo. The further development of an immature embryo is accomplished by warm-moist stratification generally for a period of 3 to 5 months.

Epicotyl Dormancy. Many plants species which have a rudimentary embryo can develop epicotyl dormancy once the embryo has been developed can be overcome by cold stratification. This usually takes 2 to 3 months. The species that have the underdeveloped embryo/epicotyl dormancy systems can be germinated in 6 to 8 months (usually) under ideal conditions, but take 2 to 3 years in nature.

Internal Inhibitors/Internal Resistance to Gaseous Exchange. These are not that common, but dormancies of this type are generally reduced only by cold stratification.

SEED COAT FACTORS

These factors may be either mechanical or chemical in nature.

Mechanical Resistance to Emergence. The first consideration in the germination of any seed is to get water into the seed. Processes which are used to diminish or remove seed coats impervious to water, gaseous exchange, and/or offer resistance to radicle emergence should be eliminated. The strategies which may be used to overcome mechanical seed coat factors and allow for water imbibition are:

Warm Stratification. This normally takes the place of the natural process where soil microbes will etch or erode the seed coat. It should be emphasized that a sterile stratification medium can not be used for this purpose.

Mechanically Wearing the Seed Coat. This is done to where water may penetrate. For small batches of large seed this can be done with a file, sand paper, or by nicking the seed with a sharp instrument. For larger batches an abrasive lined rotary drum may be used. Hot water may be used on some species to soften hard seed coats. Concentrated sulfuric acid can be used with extreme caution (Macdonald, 1986). Organic solvents may be used for dissolving waxy or water repellant outer layers.

Mechanical Resistance to Water Penetration And/or Gaseous Exchange. These seed coats are treated the same as the above.

Chemical inhibitors in the seed coat prevent the normal germination process—seed coat inhibitors have to be leached by soaking them in water or running water. Early maturing seed species and desert species fall into this category. These usuallywill not germinate until seed coat inhibitors are washed out by a heavy rain.

Other methods of enhancing and achieving good and uniform germination (Hartmann et al., 1990) are:

Soaking. Soaking the seeds in water for a period of time is a "pregermination" procedure that can give more uniform emergence (Anderson, 1987).

Osmotic Priming or Osmoconditioning. This process involves soaking the seeds in a high osmotic potential solution (either inorganic salts or polyethylene glycol) that starts the germination process, but does not allow radicle emergence. Seeds primed in this manner germinate more rapidly and with much greater uniformity (Geneve, et al., 1991).

Matriconditioning is surrounding the seed with a water-holding solid such as calcined clay or vermiculite. The matrix potential difference between the solid and the seed allows the seed to use this water. Germination is faster and more uniform.

Preconditioning the seed leads to more rapid and more uniform germination and would have applications in seedling production of annuals and perennials.

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