

Seed Production and Handling

Seed production is a major industry in the world. Many crops are produced only through seed. These include:

Agronomic crops – corn, wheat, forage crops, grasses

Horticultural crops - vegetables, flowers, fruit, ornamental trees, natives

Forestry –conifer and hardwood forest trees

The complete process that one goes through to produce seeds has developed into a science – but some of it still remains art (as do other aspects of horticulture). The processes of seed production and handling:

1. **Genetic selection** to select the varieties with the desirable characteristics
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2. **Seed production** itself which involves growing the crops in specific areas or identifying populations in the wild
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3. **Seed collection** which in its most efficient is mechanized. At the other end of the spectrum seed is collected under difficult situations such as forestry crops in high altitudes
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4. **Seed cleaning** (may be called conditioning in the industry) during which seed is removed from the fruit, cleaned and separated from non-seed material and weed seeds
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5. **Seed treatment** which is necessary for or enhances germination
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6. **Packaging and storage** which are prerequisites to sale

Let's consider each of these in turn.

1. Genetic selection arises from breeding or selection of elite individuals in the wild. Agronomic and many horticultural crops are often subjected to intense breeding efforts. Ornamental horticultural crops are often selections found growing wild or as an off-type in a nursery. Unfortunately many of these selected forms cannot be propagated true-to-type from seed and must be propagated clonally.

2. Seed production – Once the specific plant (s) has been identified and selected, special techniques are required to assure that the seed harvested from the individual plants continues to produce the desired genotypes. Such procedures usually require large acreages especially for grain, flower and vegetable crops. Over 10 tons of cabbage seed are produced per year just in the U.S. alone. Since many seed production areas are not irrigated, low rainfall during plant growth or high amounts of rain during harvest time can be devastating.

What kinds of areas are usually selected?

Low summer rainfall, low relative humidity, limited rainfall during seed harvest

Cold winters for crops that require chilling (vernalization) to flower

Areas that meet these requirements are the Pacific Northwest, Coastal California valleys, and parts of the world that have low labor costs. Note the cost for producing hybrid seed can be quite high depending on labor costs. Most of these seed are now produced in South America and Asia.

Woody plants, especially forestry crops, may be collected from in the wild such as in forests (cones), or specific trees that grow in parks, arboreta, streets may be targeted. **Depend on seed collection zones** - based on climatic and geographical areas. Seed zones are determined by the latitude, longitude, and altitude. For most forestry species the zone in which the seed originates is critical. California has 85 seed-collection zones.

How is genetic variation controlled in seed production?

1. Phenotype selection - phenotype of individual seed tree is a good indicator of the phenotype of the offspring that will be produced. Genotype X environment. (ecotypes). How ecotypes are determined -

2. Use of local seed. Use of seed origin or provenance. Natural populations evolve over long period of time to become adapted to that area (ecotypes). Use of **seed collection zones** where actual local seed is not available. Growing conditions are similar even though the actual location may be quite far from the eventual site of planting.

3. Pure stands. In a natural environment or in a planting such as a wood lot. Fruit tree crops and some ornamentals are often produced from **seed orchards**. Seed orchards are used because seed produced by hybridization of trees from nearby trees of different cultivars or species causes variability and decreased yields. Seed orchards are set up so that there is a **known pollination arrangement**. Often use groups of same kind of plants with desired characteristics growing in a pure stand. Nurseries often have their own trees that are carefully maintained to maximize superior genetics. Examples are pistachio (verticillium resistance), walnut (Paradox)

Maintaining genetic identity

How does one maintain genetic identity of the plants that are used to produce seeds?

- 1. Isolation** - a. Prevents contamination by cross-pollination. Cross contamination is more a problem when pollination is by wind or insects. May need up to 2 miles isolation depending on the plant.
b. Prevents mechanical mixing of the seed
- 2. Roguing** - Physically removing offtypes that are identified visually.
- 3. Testing for trueness-to-type** is necessary. Carried out with **seedling progeny tests**. Planting representative seeds in a test plot. Make sure that there has been no change in genotype over time. Changes can occur from selection pressure - by roguing which could change the frequency of certain genes over time. Can get changes just from producing seed in a given environment different from that in which seed will be grown. # generations of increase are restricted for many crops - eg. alfalfa.
- 4. Controlling generation sequence of new cultivars, lines** - limit # generations for production from original seed.

Breeder's seed -----> Foundation Seed -----> Registered seed -----> Certified seed

3. Seed collection

Seeds must be collected (harvested) at the proper stage, which is usually after the seed has reached physiological maturity. Thus it is critical to know the biological seed development of the different species one is dealing with. Physiological maturity is the stage when there is no further increase in dry weight in the seed. This is not as easy as it seems because one has to beware of collecting seed too early or too late - especially if the seed naturally dehisces at maturity.

The text divides the kinds of seeds into three groups as far as collection is concerned. These are:

Type 1 – seeds with dry fruits. Examples include grains, corn

Type 2- Dry seed that dehisces at maturity. The fruit capsule opens and the seed is released. Examples: cones of gymnosperms, ornamental plants such as crepe myrtle, some legumes, and vegetables, many annual or biennial flowers (petunia, tobacco), and weeds

Type 3 – Seeds inside fleshy fruits such as tree fruit crops, vegetables (curcurbits, tomatoes),

In all these cases the seed has to be cleaned, non-seed material removed, and then the seed is usually dried for storage. Drying is necessary in most seeds in order to maintain viability and avoid fungal and bacterial infection. Note that some seeds cannot be dried or they will lose their viability.

4. Seed testing is required by state and federal laws. The producer is required to determine the purity, germination percentage, and must be certified to be disease-free in some crops.

5. Seed treatment is used to enhance potential for germination or facilitate mechanical sowing. Seed treatments currently in use throughout the industry include chemical and physical treatments against pathogens, seed coating, priming, and pregermination. We will discuss these treatments later in the course.

6. Seed storage depends on the kind of seed.

Recalcitrant – short-lived. Remain viable for as little as a day to about 1 year. Often these seeds must be kept moist. Tropical seeds, spring-ripening temperate trees and shrubs, aquatic plants. Nuts with large, fleshy cotyledons but these have also been classified as sub-orthodox.

Orthodox –

Medium lived - Remain viable for up to 15 years. The proper storage is essential for the seeds. Low humidity and low temperatures.

Long-lived - May still germinate after 100 - 200 years or longer. Include seeds with hard seed coats impermeable to water. Large seeded legumes - wisteria, black locust.