PLT 132
Plant Propagation
Seeds – part 3: Seed Technology
D. W. Still
dwstill@csupomona.edu
Seeds – Part 3  
Chapters 6 & 7

1. Harvesting and Processing Seeds
   
a.) All seeds must be collected, dried, cleaned, and stored.
b.) Fleshy fruits (watermelon) or dry (lettuce, maize, etc.)

2. All (commercial) seeds will be tested
   
a.) Standard germination test (% normal seedlings)
b.) Excised embryo test (woody plants, dormant seeds)
c.) tetrazolium test (measures respiration – i.e., viability)
d.) vigor test
   - “seed vigor comprises those seed properties which determine the potential for rapid, uniform emergence and development of normal seedlings under a wide variety of field conditions”.
   - includes accelerated aging, controlled deterioration, cold test, cool test, electrolyte leakage, seedling growth rate, high temperature tests, light tests, etc.
Seeds – Part 3

3. Seed treatments serve several purposes:
   a.) Seed protectants: chemical trts, heat trts, inoculation.
   b.) Aid in planting: pellets, film coating. (Figs. 6-18, -19)
   c.) Aid in germination under stress: Priming

4. Seeds must be stored:
   a.) Orthodox vs. recalcitrant
   b.) Moisture content and temperature are key components.
       - vigor > normal germination > viability
   c.) Seeds are genetic resources.
Cryopreservation in liquid N$_2$

ca. 1958
1. Seed transition from seed development to germination
   a.) Germination with respect to water uptake (see figure 7.3)
1. All seed germination is based on water relations

   a.) Water potential = $\psi_{cell}$

      i.) Matric potential = $\psi_m$

      ii.) Osmotic potential = $\psi_\pi$

      iii.) Pressure potential = $\psi_p$

   iv.) $\psi_{cell} = \psi_m + \psi_\pi + \psi_p$
1. Environment affects seed germination
   a.) Temperature
      i) Max, min, optimum
   b.) Light
      i) red light promotes, far-red or dark inhibits
   c.) Water potential
      i) Embryo must generate force
   b.) Priming
      i) alleviate thermo- and photo-dormancy
Seed Technology

• Pelleted or coated seeds
  – Coating (diatomaceous earth)
  – Binding (inert materials)

• Change size and shape of seeds
  – Uniform size

• Precision planting (tractors)
Pelleted lettuce seed
1. Dormancy
   a.) definition: the inability of a seed to germinate when environmental conditions are favorable for germination to occur.
   
   b.) Primary: dormancy that is initiated during seed development
      i. Exogenous – external to embryo
      ii. Endogenous – embryo specific
1. Dormancy
   
   b.) Primary: dormancy that is initiated during seed development
   
   i. Exogenous
      1) Physical – e.g., seed coat, fruit parts
         Scarification may be needed
      2) Chemical – chemicals produced by seed or fruit
         Leaching may be needed

   ii. Endogenous
      1) Morphological – embryo is not fully developed
      2) Physiological – including:
         A) non-deep, intermediate, deep
         B) e.g., photodormancy, after-ripening, stratification
Seeds – Part 3

1. Dormancy

   b. Secondary dormancy – seeds may lose primary dormancy and subsequently re-enter dormancy again. This is secondary dormancy.

      i. Thermodormancy – seeds exposed to high temperatures fail to germinate when returned to a permissible temperature.

2. Release from dormancy

   a. Hormonal balance is key to germination

   b. GA promotes germination, ABA prevents germination
Seeds – Part 3

Red light (660 nm)

http://www.psy.ritsumei.ac.jp/~akitaoka/sun.jpg
Filtered light (far-red) 730 nm

$P_{fr}$

$P_r$
Improvement of germination in lettuce through genetics and breeding

Recombinant inbred line (RIL) ‘Diplomat’ (Iceberg) X ‘Margarita’ (Butter)

F₁
Recombinant Inbred Line (RIL)

F1

F2

F3

F4

F5

F6

F7

F8

RIL population with 131 families (Dip x Mar)
Far-red light can induce dormancy of lettuce seeds. Ability to germinate in FR$_{24}$-D environment is a complex (quantitative trait).

Distribution of germination response after exposure to FR-D among RIL (D X M)
Determining the location of the genes that confer ability to germinate
- what is the role of genes known to be involved in germination?
Introgression of alleles from wild species improves high temperature germination in lettuce

Figure 1. (A) Prickly lettuce (*Lactuca serriola*) germinates at higher temperatures than domesticated lettuce (*L. sativa*). Prickly lettuce (B) is the wild ancestor of lettuce (C) and served as the *NCED4* allele donor.
Using traditional plant breeding techniques aided by marker assisted selection, beneficial genes can be transferred to elite cultivars to improve traits.

Gene tagged with a fluorescent protein identifies the location of the introgressed gene that will improve performance.