Seed Testing and Seed Dormancy

Aleta Meyr
Ransom Seed Laboratory, P.O. Box 300, Carpinteria, California 93014

THE SEED TESTING LABORATORY

The job of the seed testing laboratory is to provide information about the quality of a given seed lot. The data reported by the lab is useful for initial cleaning, processing, and labeling as the seed moves into commercial channels.

The primary seed tests done by a certified seed laboratory are the germination or viability test, the physical purity test, seed counts, and the moisture content of the seed.

In the United States there are three main types of certified seed labs: Federal and State Labs, staffed by a member of A.O.S.A. (Association of Official Seed Analysts); company labs, staffed by a Registered Seed Technologist, member of S.C.S.T. (Society Commercial Seed Technologists); and an independent, private, commercial seed testing lab, staffed by an R.S.T. from S.C.S.T.

Seed testing in all three of the above labs is usually performed according to the Rules for Testing Seed put forth by the A.O.S.A. By testing the viability of seeds in paper media and in controlled environmental chambers, information about the seed lot can be obtained in a quick, efficient, and economical manner.

The germination test is performed at a prescribed ideal temperature for a given length of time for the kind of seed being tested. Results are reported on a standard reporting form.

As a laboratory practice, seeds remaining ungerminated at the end of a germination test are cut to determine whether they are dead, empty, or dormant. If dormancy exists, it is a general practice to report this on the reporting form. It might appear in the following way:

Days in test	Germination %	Hard%	Dormant%	Total viable (%)
14	68	---	28	96

Because a seed lab tests seeds that are of all stages of after-harvest maturity, it is relevant to record and report dormant live seed. It is just as important for the group receiving the lab data to understand and interpret the test results and use it in an appropriate manner. In the above data, the total potential viability was 96%, but at the date of testing only 68% of the seed germinated readily under ideal conditions.

WHAT IS SEED DORMANCY AND WHERE DID IT COME FROM?

Definitions.

Dormant: Lying inactive as in sleep, resting.

Dormant seeds: Viable seeds that fail to germinate when provided the correct physical and environmental conditions for the kind of seed in question.

Dormancy. Dormancy is generally a problem and a nuisance to economical crop production, particularly in a place like California where we have a favorable yearround climate, irrigation systems, and economic pressure to produce crops. Where did dormancy come from? The seed structure as we know it today has had a long evolutionary development. Seeds have emerged from this development with certain properties. Among these is a control mechanism that can exist in all seed species. If over long periods of time all seed populations just dropped off the plant and germinated immediately, most plant species would have become extinct. It is not always advantageous to germinate freely. Survival of a plant species includes distribution of germination through time with new seedlings emerging at irregular intervals (U.S. Dept. of Agric., 1974). The dormancy mechanisms in seeds lead to survival of a species by controlling the time and place for germination. Seeds are dispersed from the mother plant with different degrees of dormancy. As long as the seed remains viable, the possibility exists that it may eventually find itself more favorably placed to produce a plant.

Dormancy is a wild trait. Since the function of a seed is to establish a new plant and dormancy is an intrinsic block to germination, it seems logical for us to take control of this natural phenomenon and change it to our advantage. When we domesticate seeds to produce crops, we try to reduce or eliminate the dormancy control mechanism. Dormancy has developed for survival of plant species and can exist in seeds in different stages. These stages can be defined as follows:

1) Short-term or primary dormancy, or predictable dormancy. Seed has a natural resting period subsequent to harvest, also referred to as an after-ripening period. This form of dormancy is common to our crop seeds. It can last a few weeks or 2 to 4 months.

2) Long-term or deep dormancy. Long-term dormancy can go on for 2 to more than 20 years. Deep dormancy is more common in wild and weedy species.

3) Secondary dormancy, induced dormancy or deep dormancy on and off. A seed which has overcome primary dormancy, but is then subjected to conditions of stress unfavorable for germination can go into a deep, secondary dormancy. This could happen when the seed is planted in the field, during conditioning, or during storage. Secondary dormancy is the most complex to explain and can occur in crop seed or wild and weedy species. This secondary or induced dormancy can be the most surprising and problematical to our industry.

Germination. Germination involves: (1) imbibition of water, (2) activation of metabolic process, and (3) growth of the embryo. If any of these stages are blocked, a state of dormancy exists. The mechanisms restricting germination vary widely by species.

There are two major places where dormancy can occur in seeds. Dormancy can be in the seed coverings, such as seed coats, fruit walls or other structures surrounding the seed. Dormancy can also be based in the embryo itself. (Bewley and Black, 1985). The deeper dormancies usually involve both seed coverings and embryo dormancy. The dormancies based on seed coverings involve permeability of these membranes to water, salts, gases, or physical restraint of the embryo. These dormancies can be overcome in the laboratory by any method which increases membrane permeability. These would include: cold stratification (cold temperature in the presence of moisture), sharp alternation of temperature, light, addition of potassium nitrate (KNO_3), and physical scarification or clipping the seed covering. Gibberellic acid can be effective in breaking embryo-based dormancy, but it does not increase membrane

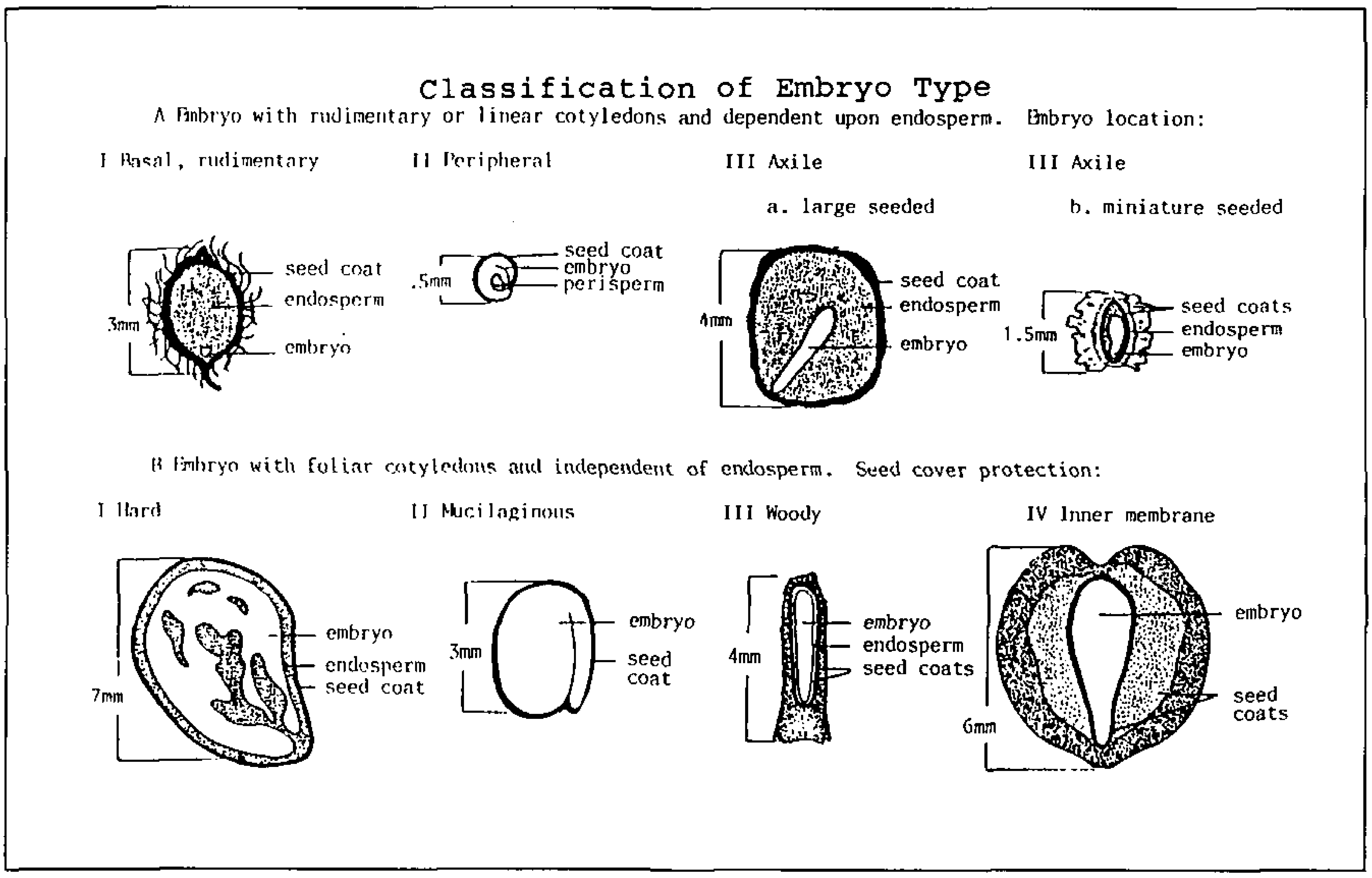

Figure 1. Embryo development, location, and protection (Atwater and Vivrette, 1987).

permeability. It is only effective if the membrane covering the seed is permeable. Cold stratification and sharp alternation of temperature are also effective in breaking embryo based dormancies. In some species high temperature activates the dormant seed. Knowing where the dormancy is likely to reside in a seed is a first step in treating the seed for dormancy (Vivrette, 1991).

There is a close association between seed morphology and the physiology of seed dormancy. Generally, the structure closest to the embryo functions as the barrier to germination (Nikolaeva, 1969). Internal seed structure is very similar for species in the same family or group of families (Atwater, 1980; Corner, 1976; Martin, 1946).

Seeds can be divided into two major groups: seed with a small embryo with food stored in the endosperm (dependent embryos) and seed with a fully developed embryo with food stored in the cotyledons (independent embryos) (Fig. 1). These two groups can be further classified by embryo position, embryo structure, and seed coverings (Atwater and Vivrette, 1986).

CONCLUSION

To begin to understand the whys and whats of dormancy is a complex learning experience. Knowing where the dormancy is likely to reside in a seed is a first step in treating the seed for dormancy. The A.O.S.A. "Rules for Testing Seed", although not requiring that remaining seed be tested for viability, suggests that this be done, and any dormant seed present be reported as additional information. If we want to control the dormancy trait in seeds, we must continue to educate ourselves about the very complex subject of seed dormancy.

LITERATURE CITED

Atwater, B.R. 1980. Germination, dormancy, and morphology of seeds of herbaceous ornamental plants. Seed Sci. and Technol. 8:523-573.

Atwater, B.R. and **N.J. Vivrette.** 1987. Natural protective blocks in the germination of seeds. In: Germination of ornamental plant seeds. K.J. Bradford (ed.). Acta Hort. 202:57-68.

Bewley, J.D., and **M. Black.** 1985. Physiology and biochemistry of seeds in relation to germination. Vol. 2. Viability, dormancy and environmental control. Springer-Verlag, Berlin.

Corner, E.J.H. 1976. The seeds of dicotyledons. Vols. I and II. Cambridge University Press, New York.

Martin, A.C. 1946. The comparative internal morphology of seeds. Amer. Midland Naturalist 36:513-660.

Nikolaeva, M.G. 1969. Physiology of deep dormancy in seeds. Israel Program for Scientific Translations, Jerusalem.

U.S. Department of Agriculture, Forest Service. 1974. Seeds of woody plants in the United States. Handbook 450. U.S. Government Printing office, Washington, D.C.

Vivrette, N.J. 1991. Society commercial seed technologists, seed technologist news. Vol. 65(2):46.