

## Rule Change Proposal #4

**Purpose of the Proposal:** Revise information in the Rules (Vols. 1 and 4) of species belonging to families known to have hard seeds, and revise Table 6A instructions and requirements for testing and reporting hard seed test results.

### Present and Proposed Rules:

#### Present Rule: Vol. 1, Sec. 6.2. d.

**Hard seeds.** — Seeds that remain hard at the end of the prescribed test period because they have not absorbed water due to an impermeable seed coat. Seeds known and recognized to contain hard seed are indicated in either the "Specific Requirements and notes" column or "Dormant Seed" column of Table 6A. The percentage hard seed is to be reported in addition to the percentage germination.

#### Proposed Rule: Vol. 1, Sec. 6.2. d.

**Hard seeds.** — Seeds that remain hard at the end of the prescribed test period because they have not absorbed water due to an impermeable seed coat. ~~Seeds~~ **Species of Bixaceae, Cannaceae, Cistaceae, Fabaceae, Geraniaceae, and Malvaceae, are** known and recognized to contain hard seed. **Other families reported with few hard-seeded species include Anacardiaceae, Cochlospermaceae, Convolvulaceae, Dipterocarpaceae, Nelumbonaceae, Rhamnaceae, Sapindaceae, and Sarcolaenaceae. For species of all families listed above, indicated in either the "Specific Requirements and notes" column or "Dormant Seed" column of Table 6A, the percentage hard seed is to be reported in addition to the percentage germination. Families for which there is no evidence of hard seeds include Amaryllidaceae, Brassicaceae, Chenopodiaceae, Cucurbitaceae<sup>(footnote X)</sup>, Poaceae, Rosaceae, and Solanaceae. In addition, seeds of Gymnosperms do not exhibit hard seed dormancy. For species of the preceding seven families and gymnosperms, report hard seed as N/A.**

**Footnote X:** Very few wild species of this family have been reported to have hard seeds. However, none of the cultivated species of this family listed in Table 6A produce hard seeds. Seeds of those species that appear 'hard' are rigid due to physical and physiological constraints, but the seed coat is permeable to water.

**Present Rule: Vol. 4, Sec. 3.5.4: 3.5.4 Hard, swollen, dormant and dead seeds.** Hard seeds are seeds that remain hard at the end of the prescribed test period because they have not absorbed water due to an impermeable seed coat. Species known to produce hard seeds are indicated by footnotes in Table 6A of the AOSA Rules for Testing Seeds Vol. 1. The percentage of hard seeds occurring in the germination test will vary with the age, kind, variety and

moisture content of the seed. The hard seed content of some recently harvested legumes such as red clover, lespedeza and field peas may decrease rapidly within the first few weeks or months of dry laboratory storage. Conversely, seeds of okra, vetch and certain other legumes may increase in hard seed content during dry laboratory storage. The hard seededness in beans is increased as the beans become desiccated. The relative humidity of the air in the storage area may cause moisture changes within the seeds and hence changes in the number of hard seeds. These changes are reversible. In reporting the test results, the percentage of hard seeds is reported in addition to the percentage germination.

**Proposed Rule: Vol. 4, Sec. 3.5.4: 3.5.4 Hard, swollen, dormant and dead seeds.** Hard seeds are seeds that remain hard at the end of the prescribed test period because they have not absorbed water due to an impermeable seed coat. Species known to produce hard seeds are indicated **by footnotes** in Table 6A of the AOSA Rules for Testing Seeds Vol. 1, under "Specific requirements and notes" and "Dormant seed." Families known and recognized to contain hard seed include Bixaceae, Cannaceae, Cistaceae, Fabaceae, Geraniaceae, and Malvaceae. Families reported to include only a few species with hard seeds include Anacardiaceae, Cochlospermaceae, Convolvulaceae, Dipterocarpaceae, Nelumbonaceae, Rhamnaceae, Sapindaceae, and Sarcolaenaceae. Families for which there is no evidence of hard seeds include Amaryllidaceae, Brassicaceae, Chenopodiaceae, Cucurbitaceae<sup>(footnote X)</sup>, Poaceae, Rosaceae, and Solanaceae. In addition, seeds of Gymnosperms do not exhibit hard seed dormancy. The percentage of hard seeds occurring in the germination test will vary with the age, kind, variety and moisture content of the seed. The hard seed content of some recently harvested legumes such as red clover, lespedeza and field peas may decrease rapidly within the first few weeks or months of dry laboratory storage. Conversely, seeds of okra, vetch and certain other legumes may increase in hard seed content during dry laboratory storage. The hard seededness in beans is increased as the beans become desiccated. The relative humidity of the air in the storage area may cause moisture changes within the seeds and hence changes in the number of hard seeds. These changes are reversible. In reporting the test results, the percentage of hard seeds is reported in addition to the percentage germination.

#### **Proposed changes to Vol. 1, Table 6A:**

-For each current and future species listed in Table 6A of the Rules (Vol. 1), belonging to Anacardiaceae, Bixaceae, Cannaceae, Cistaceae, Cochlospermaceae, Convolvulaceae, Dipterocarpaceae, Fabaceae, Geraniaceae, Malvaceae, Nelumbonaceae, Rhamnaceae, Sapindaceae and Sarcolaenaceae, include the hard seed statement [**Hard seeds: see sec. 6.2d and 6.9m (6)**] to the "Specific requirements and notes" column of Table 6A. For the very few occurrences where that statement appears in the "Dormant seed" column of the current Table 6A, it should be moved to the "Specific requirements and notes" column.

#### **Harmonization and Impact Statement:**

The proposed changes reduce the differences and improve harmonization with ISTA Rules, although some differences in hard seed reporting requirements will still exist.

### **Supporting Evidence:**

Studies in the past 25 years have produced a wealth of new information on the taxonomy, anatomy and physiology of hard seed dormancy. Hard seed dormancy, or physical dormancy, is common in some plant families, absent in others, and exhibited in only one or few species in some families. Physical dormancy was defined by Baskin and Baskin (1) and Baskin et al. (3) as “Seed dormancy caused by a water-impermeable seed (or fruit) coat,” essentially the same definition as the one cited in the AOSA Rules. While many classification systems of dormancy have been proposed, that of Baskin and Baskin (2) is the most widely used by seed scientists and technologists, and has been since refined by other researchers (4, 5). It is proposed that their classification and identification of families with hard seeds be used to update the Rules and clarify testing and reporting requirements for hard seeds.

- Based on Baskin and Baskin’s (2) classification, as well as subsequent research, each of the following families include many species with hard seeds: Bixaceae, Cannaceae (the only monocot), Cistaceae, Fabaceae, Geraniaceae, and Malvaceae.
- Families within which only few species were reported to have hard seeds include Anacardiaceae, Cochlospermaceae, Convolvulaceae, Dipterocarpaceae, Nelumbonaceae, Rhamnaceae, Sapindaceae, and Sarcolaenaceae.
- Families for which there is no evidence of physical dormancy (hard seeds) include Amaryllidaceae, Brassicaceae, Chenopodiaceae, Cucurbitaceae (cultivated species), Poaceae, Rosaceae, and Solanaceae.
- In addition, Gymnosperms do not have hard seeds.

## References

1. Baskin, C.C. and J.M. Baskin. 1998. Seeds: ecology, biogeography, and evolution of dormancy and germination. Academic press, San Diego.
2. Baskin, J.M. and C.C. Baskin. 2004. A classification system for seed dormancy. Seed Science Research. 14: 1-16.
3. Baskin, J.M., C.C. Baskin and X. Li. 2000. Taxonomy, anatomy, and evolution of physical dormancy in seeds. Plant Species Biology. 15: 139-152.
4. Finch-Savage, W.E. and G. Leubner-Metzger. 2006. Seed dormancy and the control of germination. New Phytologist. 171: 501–523.
5. Leubner, G. 2021. Phylogenetic table: Seed dormancy classification with examples. The seed biology place. Retrieved from <http://www.seedbiology.de/dormancy2.asp> (verified 10 March 2021).

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