

Seed trait data

The National Seed Bank aims to learn as much as possible about the seed collections we store for conservation and research purposes. Data associated with particular seed accessions may include herbarium voucher specimens, collection details such as date and GPS coordinates, a 'thousand seed weight', purity of the collection, germination trial details, and digital images of the seeds with associated morphological trait data. Information relating to a seed accession can be found via the linked herbarium specimen stored at the [Australian National Herbarium](#).

Collections stored at the National Seed Bank are usually population samples, preferably collected from 20-25 plants. These are then processed as much as is practical in an effort to store only pure live seed. However, sometimes fruits bearing seeds and occasionally flower parts or other plant parts are stored along with the seed. Occasionally attachments such as wings or awns may be removed from dispersal units during processing, but this is only done if they detach easily without damaging the seed. In general, what is stored is the '**dispersal unit**' or the part of the plant that easily detaches from the mother plant and naturally remains intact. This can be an actual seed (a mature plant ovule) or a fruit (a structure formed from the ovary, bearing seeds, and sometimes incorporating other plant parts e.g. the calyx from the flower). Therefore, many collections consist of units that are not technically seeds, but they are commonly (and hereafter) referred to as seeds for simplicity.

Seed collections are routinely **dried** to 15% eRH (equilibrium relative humidity), before any of the trait data below are collected. Therefore any records of mass or notes on appearance of seeds relate to the dried, stored state of the seed or dispersal unit and not the fresh state.

Purity of a seed collection takes into account other plant material (such as flower parts or detached sections of fruit wall) that may have been collected along with the seed or dispersal unit but could not be separated during processing. Seed collections may undergo various processing (also referred to as cleaning) methods to remove extraneous material. In some cases it is not practical to remove all non-seed components out of a collection (e.g. very small leaves or bracts of a comparable size to the seeds) and in these cases a measure of purity (by weight) can be useful. A subsample of the collection can be thoroughly cleaned by hand and the weight of this subsample before and after cleaning can give a measure of percentage purity by weight.

Thousand seed weight is a measure of the average mass of one thousand seeds. Two methods have been historically employed to obtain this data. Basic method: Exactly 1000 seeds are separated from the collection as a whole and then weighed to give an amount in grams, to 4 decimal places. Replicate method: up to 5 replicates of an exact number of seeds (e.g. 25, 50, 100) are weighed; the average seed weight is calculated and used to estimate the weight of 1000 seeds (in grams to 4 decimal places).

Digital images of the seed collections serve to illustrate morphological characters of the seed or dispersal unit while the collections remain safely stored in the freezers for long-term conservation. Three types of images may be captured:

Images of **one representative seed** are available. These magnified images are obtained with photomicroscopy, using focal plane stacking to overcome shallow depth of field to obtain a composite image capturing the whole seed. Images for larger fruits are captured using macro photography. Calibrated **group images** of 20-30 seeds enable measurements of **size** with calculations of average size and variation among seeds (standard deviation). Measurements of seed

dimensions **width** (at widest point) and **length** (longest point) are made concurrently with seed imaging. Measurements are made along straight lines and at the maximum extent of each dimension; as opposed to following curvature of the seeds or making measurements between precise parts of plant anatomy. These gross measurements provide a measure of mean seed size per accession which can demonstrate variation within an accession, variation within a species, or can be used for comparison across taxonomically diverse groups. Images of **special features** may also be captured if a certain feature is not clearly visible from the representative seed or the group image.

As a general rule, the current gross measurements cover those parts of the dispersal unit derived from the seed itself (e.g. wing, aril) but not any parts derived from the flower (e.g. pappus, peduncle). Sometimes this distinction is not easy to make, particularly in the case of grass 'seed'. Grass seed collections can vary from a seed/caryopsis that has been cleaned of any awns/glumes/parts of the spikelet to a dispersal unit that still bears firmly attached glumes/palea/lemma and any associated awns. The gross measurements may or may not include any of these anatomical parts depending on the species, ease of detachment of parts and the level of processing that the collection has undergone.

The digital images are also annotated with other morphological trait data such as overall shape, appendages present, and texture of the seed or fruit surface. It should be noted that these descriptive terms relate to the seed collection as stored (after drying), and therefore may differ from those of the dispersal unit as it is first released from the plant (especially in the case of fleshy fruits).

Appendage terms used: hairs, spine(s), wing, aril, pappus, plug, bristle(s), awn(s), elaiosome, hook(s), aerenchyma (spongy tissue with air channels), glume(s)

Shape terms used: rectangular; ovoid; reniform (kidney-shaped); globose; fusiform; irregular; lanceolate; cylindrical/terete; sectoroid (like an orange segment); pyramidal; cordate (heart-shaped); cuneate (wedge-shaped); falcate (sickle-shaped)

Texture terms used: rugose (wrinkled); finely textured; pitted; smooth (at high magnification); reticulate (net-like); tuberculate (covered in nodules); spinose; striate; plumose (feathery); ciliate; scabrous (covered in small rough projections); tomentose (covered in cottony hairs); papillose (covered in papillae); costate (ribbed); chartaceous (papery)

Australian native seeds: a digital image library was initiated with funding from the Australian Government's Australian Biological Resources Study (ABRS) Bush Blitz Program which provided support for imaging of 1000 species of Australian native seed. Future aims include further imaging of seed accessions at the National Seed Bank along with collecting associated trait data to better understand our native seeds. All seed images are available under a creative commons licence (CC-BY) with attribution to the National Seed Bank and acknowledging support from ABRS Bush Blitz.

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