CROP-SPECIFIC GENEBANK STANDARDS FOR ORTHODOX SEEDS

Agreed by the *Beta* Working Group

March 2016

Note: the "FAO Genebank standards for orthodox seeds" listed in the first column correspond to Chapter 4, pp. 17-63 in: FAO. 2014. Genebank Standards for Plant Genetic Resources for Food and Agriculture. Rev. ed. Rome. (www.fao.org/docrep/019/i3704e/i3704e.pdf)

FAO Genebank standards for orthodox seeds		**Crop-specific genebank standards for orthodox seeds – *Beta* and *Patellifolia* species** *No comment in this column means agreement with FAO standard*	**Remarks** **(reasons for deviating from FAO standards)**
4.1	**Standards for acquisition of germplasm**		
4.1.1	All seed samples added to the genebank collection have been acquired legally with relevant technical documentation.		
4.1.2	Seed collecting should be made as close as possible to the time of maturation and prior to natural seed dispersal, avoiding potential genetic contamination, to ensure maximum seed quality.		
4.1.3	To maximize seed quality, the period between seed collecting and transfer to a controlled drying environment should be within 3 to 5 days or as short as possible, bearing in mind that seeds should not be exposed to high temperatures and intense light and that some species may have immature seeds that require time after harvest to achieve embryo maturation.		
4.1.4	All seed samples should be accompanied by at least a minimum of associated data as detailed in the FAO/Bioversity multi-crop passport descriptors.		

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4.1.5	The minimum number of plants from which seeds should be collected is between 30-60 plants, depending on the breeding system of the target species	The minimum number of plants from which seeds should be collected is between **40-100** plants, depending on the breeding system of the target species **and on the size of the population mainly for wild or rare species. In the cases the seed quantity is small multiplication must take place before storage.**	For *Beta* and *Patellifolia* species, seeds from 40-100 plants should be collected in the case of allogamous species. In the case of autogamous and apomictic species, especially if the target species is a threatened one, few seeds from at least 10 individuals but from as many sub-populations as possible should be collected.
4.2	**Standards for drying and storage**		
4.2.1	All seed samples should be dried to equilibrium in a controlled environment of 5-20°C and 10-25 percent of relative humidity, depending upon species.		According to genebank curators and different countries' seed increase manuals for *Beta*[1], seed samples should be dried in a controlled environment, till the moisture content drops to 5-8%.
4.2.2	After drying, all seed samples need to be sealed in a suitable airtight container for long term storage; in some instances where collections that need frequent access to seeds or likely to be depleted well before the predicted time for loss in viability, it is then possible to store seeds in non–airtight containers.		
4.2.3	Most-original-samples and safety duplicate samples should be stored under long-term conditions (base collections) at a temperature of -18 ± 3°C and relative humidity of 15 ± 3 percent.		When samples are stored in airtight bags or containers at -18°C, there is actually no need to control the relative humidity of the storage room.
4.2.4	For medium-term conditions (active collection) samples should be stored under refrigeration at 5-10°C and relative humidity of 15 ± 3 percent.		According to genebank curators the active collection can also be stored under long-term conditions (see also comment for standard 4.2.3).

[1] Manuals provided by countries are available online here.

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4.3 Standards for seed viability monitoring		
4.3.1 The initial seed viability test should be conducted after cleaning and drying the accession or at the latest within 12 months after receipt of the sample at the genebank.		
	NEW Viability tests should be conducted at the appropriate substrate and special treatments and temperatures. Sample sizes for viability monitoring depend on the available quantity (the size of the accession). Usually two replicates with 100 seeds each or two replicates with 50 or 25 seeds for small accession sizes or for species that have a low seed multiplication rate and those with problems in seed regeneration (such as wild species) could be acceptable.	Cultivated types can be tested according to protocols defined, reproducible and tested over years and described in quality assurance (QA) documents. Also for wild species with seed dormancy or in the case of hard-seeded species special procedures have developed, agreed and applied.[2]

[2] These documents are available online here.

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4.3.2	The initial germination value should exceed 85 percent for most seeds of cultivated crop species. For some specific accessions and wild and forest species that do not normally reach high levels of germination, a lower percentage could be accepted.		
4.3.3	Viability monitoring test intervals should be set at one-third of the time predicted for viability to fall to 85 percent[3] of initial viability or lower depending on the species or specific accessions, but no longer than 40 years. If this deterioration period cannot be estimated and accessions are being held in long-term storage at -18°C in hermetically closed containers, the interval should be ten years for species expected to be long-lived and five years or less for species expected to be short-lived.		
4.3.4	The viability threshold for regeneration or other management decision such as recollection should be 85 percent or lower depending on the species or specific accessions of initial viability.		
4.4	**Standards for regeneration**		
4.4.1	Regeneration should be carried when the viability drops below 85 percent of the initial viability or when the remaining seed quantity is less than what is required for three sowings of a representative population of the accession. The most-original-sample should be used to regenerate those accessions.		

[3] The time for seed viability to fall can be predicted for a range of crop species using an online application based on the Ellis/Roberts viability equations (see http://data.kew.org/sid/viability/).

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4.4.2 The regeneration should be carried out in such a manner that the genetic integrity of a given accession is maintained. Species-specific regeneration measures should be taken to prevent admixtures or genetic contamination arising from pollen geneflow that originated from other accessions of the same species or from other species around the regeneration fields.		All *Beta* species of section *Beta and Corollinae* (except the apomictic species *B. trigyna* and *B. intermedia* which can be grown without isolation) and *Patellifolia patellaris* are allogamous species and require isolation, according to the 'Seed increase protocol for *Beta* and *Patellifolia* species' and different countries' seed increase manuals for *Beta*.[4]
4.4.3 If possible at least 50 seeds of the original and the subsequent most-original-samples should be archived in long-term storage for reference purposes.		
4.5 Standards for characterization		
4.5.1 Around 60 percent of accessions should be characterized within five to seven years of acquisition or during the first regeneration cycle.		
4.5.2 Characterization should be based on standardized and calibrated measuring formats and characterization data follow internationally agreed descriptor lists and are made publicly available.		
4.6 Standards for evaluation		
4.6.1 Evaluation data on genebank accessions should be obtained for traits that are included in internationally agreed crop descriptor lists. They should conform to standardized and calibrated measuring formats.		

[4] These documents are available online here.

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4.6.2	Evaluation data should be obtained for as many accessions as practically possible, through laboratory, greenhouse and/or field analysis as may be applicable.		
4.6.3	Evaluation trials should be carried out in at least three environmentally diverse locations and data collected over at least three years.		Similar evaluation trials should be carried out in the framework of research projects, breeding programmes or in collaboration with other research institutes. Otherwise it is not workable in practice due to lack of funding and skilled personnel for a genebank to carry out this evaluation for all the accessions but only for few priority species.
4.7	**Standards for documentation**		
4.7.1	Passport data of 100 percent of the accessions should be documented using FAO/Bioversity multi-crop passport descriptors.		
4.7.2	All data and information generated in the genebank relating to all aspects of conservation and use of the material should be recorded in a suitably designed database.		
4.8	**Standards for distribution and exchange**		
4.8.1	Seeds should be distributed in compliance with national laws and relevant international treaties and conventions.		
4.8.2	Seed samples should be provided with all relevant documents required by recipient country.		
4.8.3	The time span between receipt of a request for seeds and the dispatch of the seeds should be kept to a minimum.		

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4.8.4	For most species, a sample of a minimum of 30-50 viable seeds should be supplied for accessions with sufficient seeds in stock. For accessions with too little seed at the time of request and in the absence of a suitable alternative accession, samples should be supplied after regeneration/multiplication, based on a renewed request. For some species and some research uses, smaller numbers of seeds should be an acceptable distribution sample size.		
4.9	**Standards for safety duplication**		
4.9.1	A safety duplicate sample for every original accession should be stored in a geographically distant area, under the same or better conditions than those in the original genebank.		
4.9.2	Each safety duplicate sample should be accompanied by relevant associated information.		
4.10	**Standards for security and personnel**		
4.10.1	A genebank should have a risk management strategy in place that includes *inter alia* measures against power cut, fire, flooding and earthquakes.		
4.10.2	A genebank should follow the local Occupational Safety and Health requirements and protocols where applicable.		
4.10.3	A genebank should employ the requisite staff to fulfil all the routine responsibilities to ensure that the genebank can acquire, conserve and distribute germplasm according to the standards.		