CROP-SPECIFIC GENEBANK STANDARDS FOR ORTHODOX SEEDS

Endorsed by the Forages Working Group

August 2023

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 – Forages** *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.	Sampling should be done in such a way that no harm comes to the original population.	
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	**Cross-pollinated species:** *Preferred number* of sampled plants: 100 genetic individuals or more *Minimum number*: 30 individuals **Self-pollinated species**: At least from 10 individuals (whenever possible 30) per sub-population and, if applicable, separate collections from other subpopulations within the metapopulation in the region. Preferably seeds should be collected from many sub-populations but at least from 3 (if available).	Scientific studies show that self-pollinated species have higher inter-population differentiation and lower intra-population diversity than cross-pollinated species. A sampling strategy where fewer individuals per subpopulations but more subpopulations are sampled will therefore better capture the diversity. In some cases, it can be difficult to identify genetically distinct individuals from propagules of the same clone. In these cases, knowledge about the species growth habit and dispersal biology should be used to avoid sampling one individual clone multiple times.
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.		

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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 air-tight containers/bags, no humidity control will be required.	
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.	The active collection can preferably also be stored under long-term conditions	To store the active collection under long-term conditions facilitates the monitoring since samples from the active collection can be used for monitoring both the base and active collections. Furthermore, it would avoid unnecessary regeneration since seed viability of the accessions in the active collection will be prolonged.
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.		

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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.	**Germination percentage** The initial germination value should exceed 70 percent for most cultivated forage species, for forage crop wild relatives a lower value (≥50 percent) can be accepted. **Germination seed number** Preferred: ≥ 200 Acceptable: ≥ 50	**Germination percentage** 85 percent can be difficult to reach in many forage species. **Germination seed number** The number of seeds used greatly affects the reliability of the germination estimate. It is therefore important to give a minimum number for this in the gene bank standard. Whenever possible and feasible, at least 100 seeds per accessions should be targeted.
4.3.3 Viability monitoring test intervals should be set at one-third of the time predicted for viability to fall to 85 percent[1] 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.		

[1] 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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4.3.4	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.	The threshold for regeneration or other management decisions should be 85 percent of the initial viability or lower depending on the species or specific accessions. The thresholds should be predefined for each species/type of material/specific accession in the gene bank.	In accordance with the acceptable lower initial germination value agreed in 4.3.2
4.4	**Standards for regeneration**		
4.4.1	Regeneration should be carried out 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.	A threshold of 70 percent seed viability is appropriate for most cultivated forage crop species.	In accordance with the acceptable lower initial germination value agreed in 4.3.2.

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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.	**<u>Isolation</u>** **Insect-pollinated crops:** Preferred: isolation cabins with pollinators Acceptable: ≥ 100 m isolation distance between accessions (or other individuals of the same species, like weedy or wild plants) **Wind pollinated crops**: Preferred: ≥ 30 m isolation distance with an efficient barrier crop Acceptable: ≥ 60 m isolation distance without an efficient barrier crop **<u>No. plants per accession</u>** Preferred: ≥ 100 Acceptable: ≥ 30 **<u>Weeding</u>** Other crop plants and weeds should be removed from the regeneration plot. Weeds and crops of the regenerated species should be removed within the isolation distance. **<u>Harvesting</u>** Preferred: ≥ 100 plants: unbalanced bulk (or <100 plants: harvest and store seeds of individual plants) Acceptable: unbalanced bulk harvest (seeds from all plants are harvested and pooled, but no attempt is made to harvest the same number of seeds from each plant).	Standards are set to maintain the genetic integrity of the accessions.
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		

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4.5.1	Around 60 percent of accessions should be characterized within five to seven years of acquisition or during the first regeneration cycle.	Characterisation should be conducted on as many of the accessions as possible. Focus should be on traits that are of relevance to the users of the material.	Characterisation of forage crops for relevant traits is resource demanding and it is unlikely that a goal of 60% can be reached within seven years.
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.	Standard reference varieties should be included in evaluation experiments. Focus should be on traits that are of relevance to the users of the material, with emphasis on breeding and pre-breeding.	A recommendation: use crop/species specific evaluation standards with recommended and obligatory traits and at least three reference varieties.
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.	Minimum standard: Data should be collected over at least two years in each evaluation trial in each environment.	The crop-specific standard indicates a target which may be more often feasible than the FAO standard and would nonetheless offer valuable information.
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.	In addition to the FAO descriptors, gene bank and/or crop specific descriptors can be used.	

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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.	The gene bank database should be constructed in such a way that relevant data can be easily uploaded to EURISCO.	
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.		
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.		