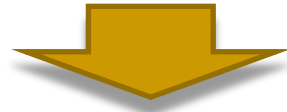


BEST PRACTICES FOR COLLECTING AND ACQUIRING PLANT GENETIC RESOURCES

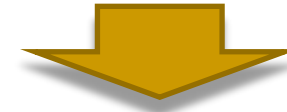
A.L. Tsivelikas and GRS team



Enriching Genebank's Holdings



...collecting expeditions
(farmer's field, farmer's
storehouse, local markets,
wild habitats, etc.)



...donations (correspondence
and acquiring germplasm by
donors, e.g. other genebanks,
plant breeders, etc.)

Ex situ Germplasm Collections (Genebanks)

- Increased enormously in number and size over the last decades
 - ✓ Global efforts to conserve plant genetic resources for food and agriculture (PGRFA) ... sometimes with support from international community
- Worldwide...
 - ✓ 1 750 genebanks are registered and conserve over 7.5 million accessions, including major crops, minor or neglected crop species, together with trees and wild plants (Hay, 2019).



ICARDA Genebank seed collection at Rabat, Morocco



Reasons for Collecting/Acquiring Germplasm

- ✓ Address the gaps that exist in collection (non represented areas, non represented taxa).
- ✓ Danger of genetic erosion or extinction of target species (rescue collecting).
- ✓ Need for immediate use for breeding purposes.
- ✓ More needs to be known about the target species (research purposes).

Trifolium uniflorum

- Deep root system, drought resistant, cross compatible with *T. repens*



A. Collecting Expeditions

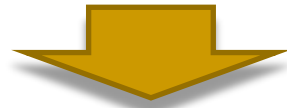
Type of Collecting Expedition

- ✓ Single- crop expeditions (collecting all available genetic resources of only one crop, i.e. wild species, primitive forms, landraces, cultivars, etc.).
- ✓ Specific- crop expeditions (collecting only a few crops, e.g. cereals, pulses, forages, medicinal plants, etc.).
- ✓ Multi- crop expeditions (collecting genetic resources of a range of crops in a particular region).

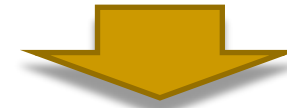
The aim of germplasm acquisition is to collect materials with maximum amount of useful genetic diversity within a strictly limited number of individuals in the least amount of time.



Prior to the Mission (Preparatory Phase)



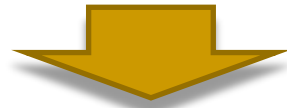
...technical planning (addresses the scientific issues involved, i.e. selection of target species, sampling strategies, etc.)



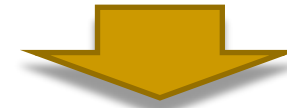
...logistic planning (concerns how the mission is organized, i.e. partners, collecting team, itinerary, equipment, etc.)

Collecting or Funding proposal detailing the justification, aims and objectives of the mission.

Prior to the Mission (Preparatory Phase)



...technical planning (addresses the scientific issues involved, i.e. selection of target species, sampling strategies, etc.)



...logistic planning (concerns how the mission is organized, i.e. partners, collecting team, itinerary, equipment, etc.)

Collecting or Funding proposal detailing the justification, aims and objectives of the mission.

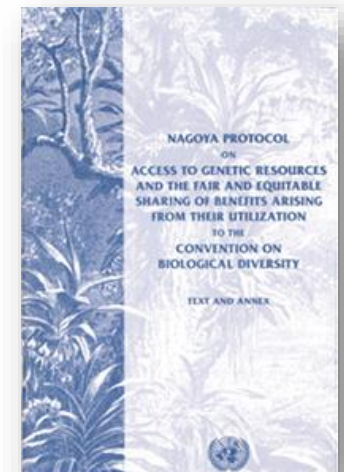
International Legal Framework

➤ International Treaty (IT) on PGRFA

- ✓ Adopted in 2001 and came to replace the former IU
- ✓ Legally binding character aiming at exploration, conservation and sustainable use of plant genetic resources.
- ✓ Deals with the establishment of Multilateral System (MLS) of Access and Benefit Sharing.
- ✓ MLS includes major but not all crops that are under the management of the contracting parties and in the public domain.

➤ Nagoya Protocol (CBD)

- ✓ Adopted in 2010 and came to complement the CBD.
- ✓ *"Access to Genetic Resources" and the "Fair and Equitable Sharing of Benefits Arising from their Utilization"* between donors and users.
- ✓ Emphasis on bilateral negotiations and agreements as mutually agreed terms (MAT)
- ✓ Benefits may be monetary (such as royalties) or non-monetary (such as sharing research results or technology transfer)

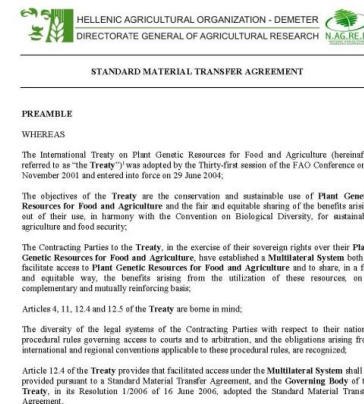


Preparatory Phase (continue...)

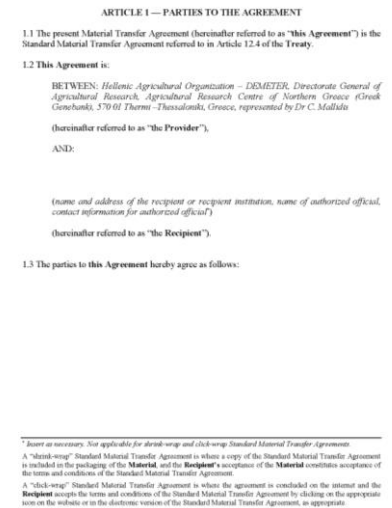
National Legal Framework

- ✓ Knowledge if target-country has ratified international agreements on plant genetic resources (CBD, ITPGRFA, NP)
- ✓ Knowledge of national legislation of the country where the mission is targeting (protected germplasm, areas under specific protection regimes, benefit sharing, etc.).
- ✓ Elaboration of appropriate material transfer agreement (SMTA) according to the national regulations or Material Acquisition Agreement (MAA) for crops/species that are not under MLS.

Ultimate Goal
Obtaining the permission
for collecting



¹ Note by the Secretariat as suggested by the Legal Working Group during the Contact Group for the Drafting of the Standard Material Transfer Agreement, defined terms have, for clarity, been put in bold throughout.

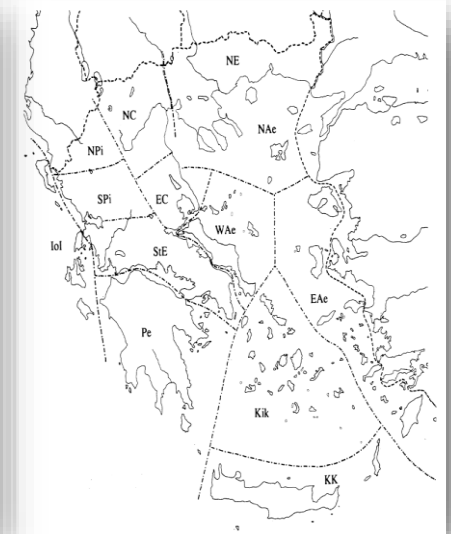
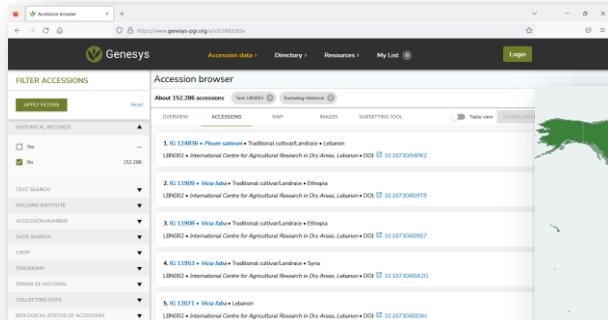


² Insert as necessary. Not applicable for click-wrap and click-wrap Standard Material Transfer Agreements.
³ A "click-wrap" Standard Material Transfer Agreement is where a copy of the Standard Material Transfer Agreement is included in the packaging of the Material, and the Recipient's acceptance of the Material constitutes acceptance of the terms and conditions of the Standard Material Transfer Agreement.
⁴ A "click-wrap" Standard Material Transfer Agreement is where the agreement is concluded on the internet and the Recipient accepts the terms and conditions of the Standard Material Transfer Agreement by clicking on the appropriate box on the website or in the electronic version of the Standard Material Transfer Agreement, as appropriate.

Preparatory Phase (continue...)

Desk survey - Collection of data and related information

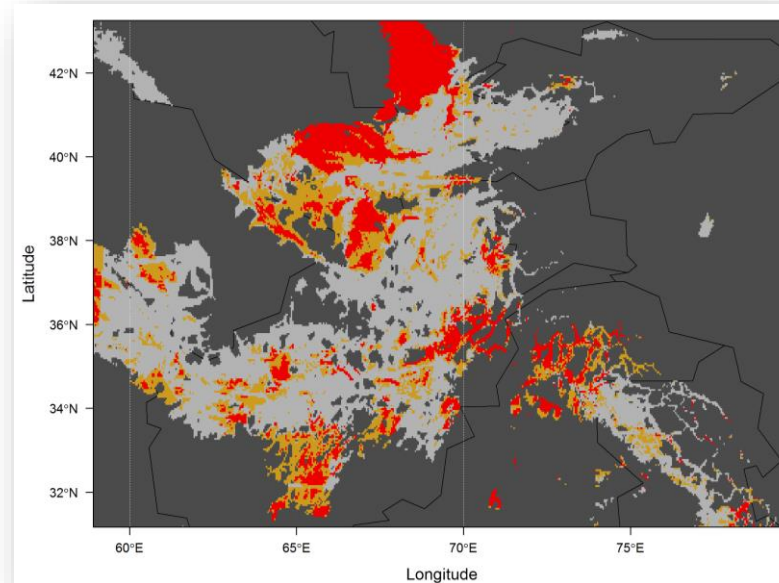
- Survey of taxonomic, ecological and ecogeographic, ethnobotanic data sources
 - ✓ Native plant taxa, endemic, threatened species of interest
 - ✓ Floristic regions
 - ✓ Related bibliography on socioeconomic aspects for the target country (e.g., traditional farming practices, customs-traditions, populations migrations, etc.)
- Collection of ecogeographic data
 - ✓ Herbaria
 - ✓ 'Floras' and other publications
 - ✓ On line databases



Preparatory Phase (continue...)

Gap Analysis

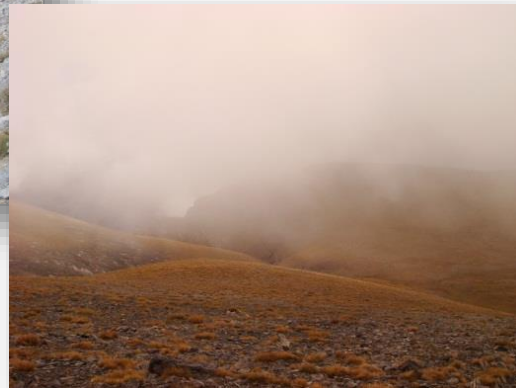
- Assessment of related information for...
 - ✓ Targeting specific areas in the country to cover the gaps in Collections
 - i. Areas not previously covered through collecting missions
 - ii. Taxa not collected
 - iii. Populations (wild or cultivated) within specific taxa
 - ✓ Targeting accessions for specific adaptive traits (e.g. drought, heat, salinity tolerance)



Preparatory Phase (continue...)

Designing mission itinerary

- ✓ Accessibility within the target area
- ✓ Geographic diversity
- ✓ Site ecology
- ✓ Information from local partners
- ✓ Time available
- ✓ Resources available



Application on planning and visualizing collecting routes

https://ciat.shinyapps.io/LGA_dashboard/

	Latitude	Longitude	Address
1.	38.517	69.713	
2.	38.029	70.308	
3.	37.618	68.855	

Preparatory Phase (continue...)

Timing of the mission

- ✓ Growing season in cultivated plants
- ✓ Plant ecology in wild species
- ✓ Site characteristics
- ✓ Season characteristics (e.g., dry/wet season that has an impact on flowering and fruit/seed maturity)
- ✓ A preliminary survey mission may be needed in the optimum time for identification of wild plant populations



Preparatory Phase (continue...)

Logistics and administrative arrangements

- ✓ Selection of the collecting team
- ✓ Definition of participating institutions responsibilities
- ✓ Mission funding and/or contribution 'in kind'
- ✓ Coordination with national and local authorities
- ✓ Agreement on post-collection activities



Collecting team

- 
- 
- Flexible and not too large (3 to 5 people)
 - ✓ Team leader (in charge of administrative and logistical arrangements)
 - ✓ Specialists (experts for the target taxa and the target region)
 - ✓ Driver (experienced and familiar with the target region)
 - Surveys the area and collect samples of genetic material from every spot that indicates ecogeographic differentiation or changes of the native flora and/or the crops.

Rule of thumb: Collect samples when the altitude changes by 200 m or 5,000 m at distances, or when changing the hydrogeological, the soil conditions and vegetation.

Material and Data to be Collected

Seeds (targeted germplasm)

- Landraces are spotted and collected through...
 - ✓ Personal interviews/discussions with the local farmers (visit houses, farms, gathering places, etc.).
 - ✓ Careful exploration of cultivated fields.

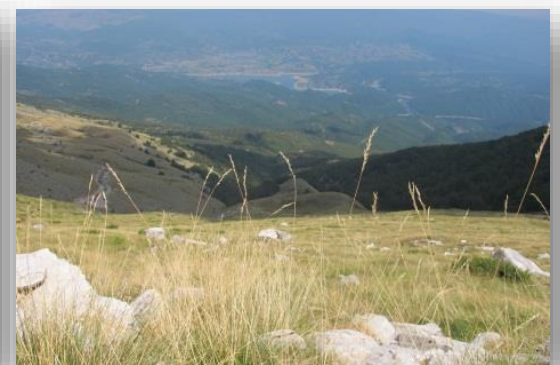
Try to get as much as possible information available by the farmers regarding historical background of accessions and the traditional farming practices of the specific area.



Material and Data to be Collected

Seeds (targeted germplasm)

- ✓ Crop seeds can be collected either directly from the field (view and assessment of diversity) or from areas of temporary maintenance (e.g. threshing floors) or from farmers storehouse and local markets.
- ✓ Wild species are collected from their natural habitats (grasslands, forests, woodland, roadsides, disturbed habitats, etc.).



Material and Data to be Collected

Seeds (targeted germplasm)

- ✓ Containers used for collecting seeds and fruits should be chosen carefully (usually paper bags and cloth bags allow also air circulation).
- ✓ Each accession is given a unique collection number.
- ✓ Seed for each accession is collected as bulk sample from different plants (except if need to be collected as individuals plants, e.g. genetic studies).



Material and Data to be Collected

Seeds (targeted germplasm)

- ✓ A tag with the site number and collection number placed inside and outside of the collecting bag
- ✓ All accessions collected at a particular site are placed inside one larger bag/container with the site number prominently marked on the outside of the bag.
- ✓ Seeds collected in humid environments may require threshing and drying to avoid the growth of moulds (keep with silica gel or using artificial heat).



Material and Data to be Collected

Passport data

- Accessions potential usefulness depends to a large extent upon the passport data
 - ✓ Taxonomy (genus, species, subspecies)
 - ✓ Geographical data (country, province, location, longitude, latitude, altitude)
 - ✓ Data related to the collecting mission (date of collection, collection number, collectors, participating institutes)
 - ✓ Site specific data (site number, rainfall, site habitat, size of area, slope, soil pH, soil texture, parental rock, aspect, salinity, water relation, soil depth, dominant species, characteristic species)
 - ✓ Accessions specific data (accession's form, vegetative part collected, number of plants collected, sowing time, harvesting time, uses, other remarks)



Material and Data to be Collected

Voucher specimens (Herbarium)

- ✓ Good quality voucher specimens should be collected, especially when collecting wild species, because it facilitates identification and records features of the particular accession.
- ✓ Representative flowering and fruiting specimens should be pressed.
- ✓ Good specimens representative of the population, containing all parts of the plant and accompanied by detail passport data.
- ✓ Collect more than one set of material (extra sets can be sent to specialists or sent for exchange).



Material and Data to be Collected

Vegetative parts of whole plants

- ✓ Need for collecting vegetative parts due to limited seed availability (e.g. *Crocus* spp.).
- ✓ Need for collecting individual plants for accurate sampling purposes (e.g. forage and range species).



Sampling Strategy

- Fundamental objective... capture the maximum amount of genetic variation in the smallest number of samples
 - ✓ Generally accepted benchmark criterion is to ensure that at least one copy of 95% of the alleles at a frequency greater than 0.05 is included in the sample (sample of ~50 individuals from each population (Marshall and Brown, 1975)).
 - ✓ Additional biased sampling is implemented to capture rare alleles.
 - ✓ Self-pollinated species... small samples from many locations.
 - ✓ Cross-pollinated species... larger samples from fewer locations.
 - ✓ Specific measures necessary for clonal material (e.g. stratified sampling, systemic sampling).



Sampling Strategy

Population Type	Plants	Seeds from each individual	Total seeds per population
Fairly uniform (e.g. self-pollinated species)	50	50	2,500
Highly variable (e.g. open-pollinated species)	100	50	5,000

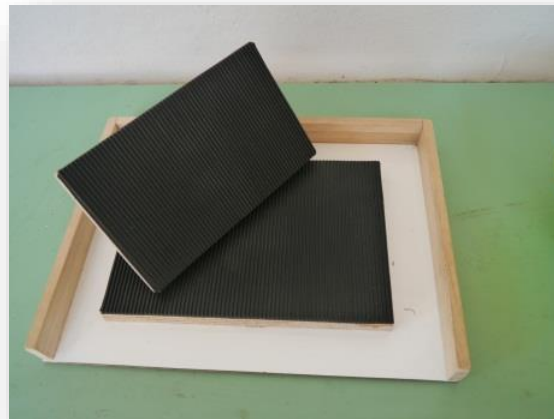
In practice there is a compromise on much smaller seed samples, especially in species with large seeds.

Threshing, Cleaning and Shipping of Collected Material

➤ Before return, material should be threshed (depending on the particularities of the species), cleaned (by destroyed seeds, debris, insects, etc.) and divided according to the arrangements to partners.

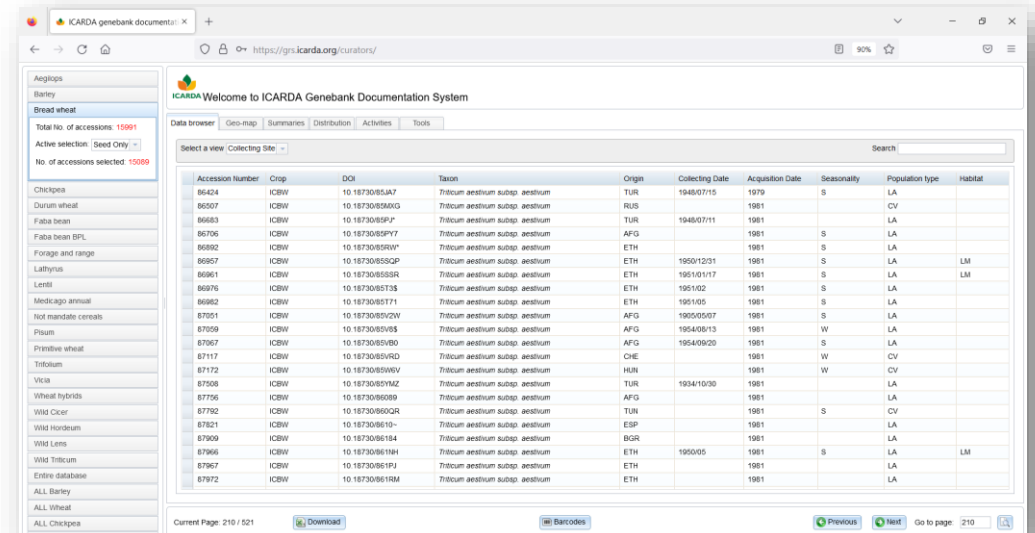
➤ Material is shipped accompanied by:

- ✓ A phytosanitary certificate
- ✓ A non-GMO declaration
- ✓ A non-commercial value declaration
- ✓ A list with the material shipped
- ✓ A signed SMTA of MAA



Follow-up with the Collected Germplasm

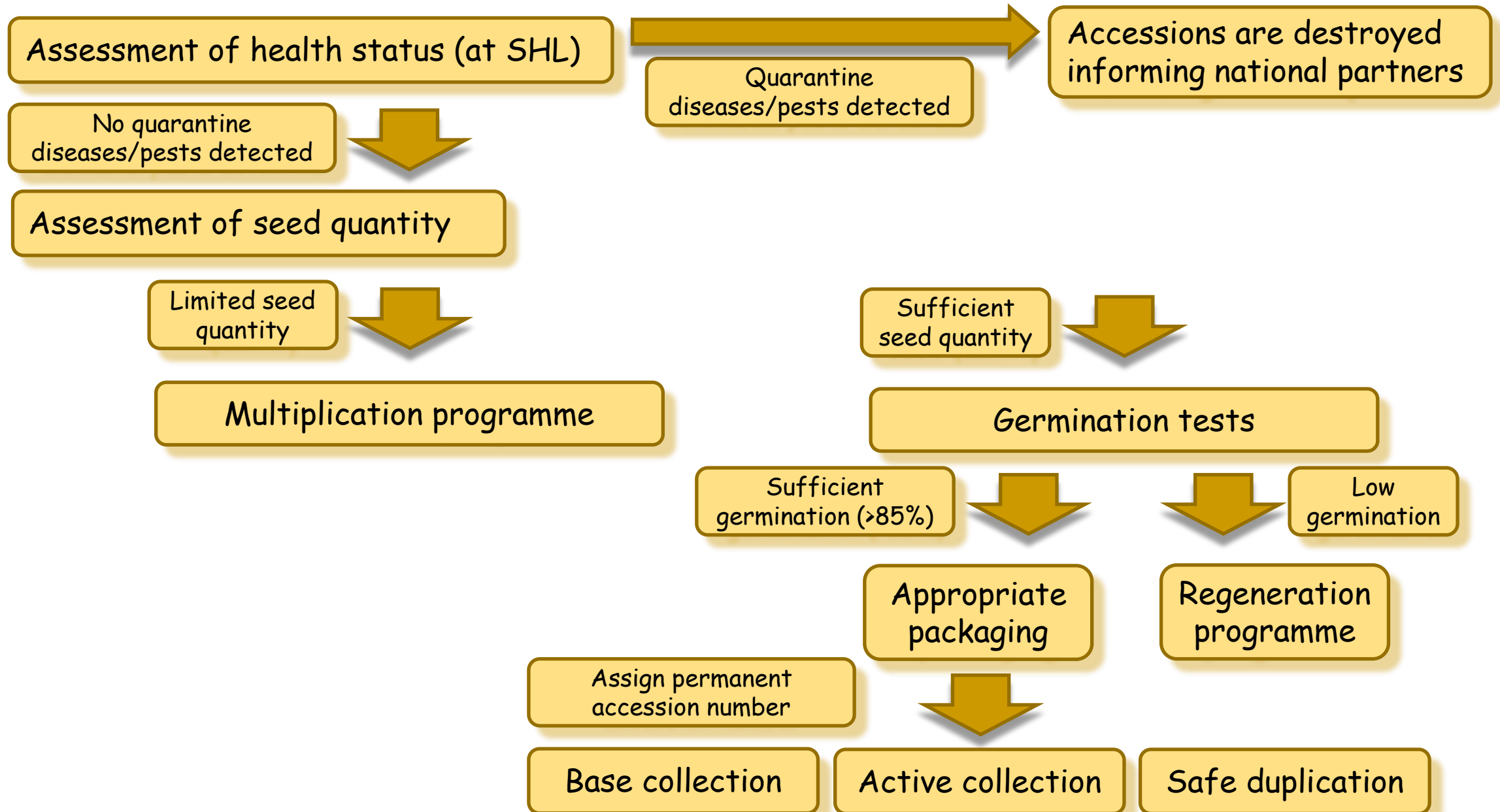
- ✓ Seeds are further cleaned, fumigated (if needed) and dried at Genebank premises.
- ✓ Unidentified accessions are thoroughly studied for accurate identification (use of voucher samples).
- ✓ Information is documented in the database.
 - ❖ Accessions are given a unique number (Accessions number) which links the seeds to the passport data and any other collected information.
 - ❖ All relative information collected (accession specific data, site specific data, legal status, etc.) is documented.
 - ❖ Accessions flagged in the database as 'under introduction', non available.



The screenshot displays the ICARDA Genebank Documentation System interface. On the left, a sidebar lists various crop categories including Aegilops, Barley, Bread wheat, Chickpea, Durum wheat, Faba bean, Faba bean BPL, Forage and range, Lathyrus, Lentil, Medicago annual, Not mandate cereals, Pisum, Primitive wheat, Triticum, Vicia, Wheat hybrids, Wild Cicer, Wild Hordeum, Wild Lens, Wild Triticum, and Entire database. The main content area shows a table of accessions with columns for Accession Number, Crop, DOI, Taxon, Origin, Collecting Date, Acquisition Date, Seasonality, Population type, and Habitat. The table lists various wheat accessions, including those from Turkey (TUR), Russia (RUS), Ethiopia (ETH), and Hungary (HUN). The interface also includes a search bar, a 'Data browser' tab, and a 'Download' button at the bottom.

Accession Number	Crop	DOI	Taxon	Origin	Collecting Date	Acquisition Date	Seasonality	Population type	Habitat
86424	ICBW	10.18730/85JA7	Triticum aestivum subsp. aestivum	TUR	1948/07/15	1979	S	LA	
86507	ICBW	10.18730/85MKG	Triticum aestivum subsp. aestivum	RUS		1981		CV	
86683	ICBW	10.18730/85PJ2	Triticum aestivum subsp. aestivum	TUR	1948/07/11	1981		LA	
86756	ICBW	10.18730/85PJ7	Triticum aestivum subsp. aestivum	AFG		1981	S	LA	
86882	ICBW	10.18730/85D2W	Triticum aestivum subsp. aestivum	ETH		1981	S	LA	
86957	ICBW	10.18730/85SQP	Triticum aestivum subsp. aestivum	ETH	1950/10/31	1981	S	LA	LM
86961	ICBW	10.18730/85SSR	Triticum aestivum subsp. aestivum	ETH	1951/01/17	1981	S	LA	LM
86976	ICBW	10.18730/85T3S	Triticum aestivum subsp. aestivum	ETH	1951/02	1981	S	LA	
86982	ICBW	10.18730/85T71	Triticum aestivum subsp. aestivum	ETH	1951/05	1981	S	LA	
87051	ICBW	10.18730/85V2W	Triticum aestivum subsp. aestivum	AFG	1950/05/07	1981	S	LA	
87059	ICBW	10.18730/85V5S	Triticum aestivum subsp. aestivum	AFG	1954/06/13	1981	W	LA	
87067	ICBW	10.18730/85V80	Triticum aestivum subsp. aestivum	AFG	1954/09/20	1981	S	LA	
87117	ICBW	10.18730/85V8D	Triticum aestivum subsp. aestivum	CHE		1981	W	CV	
87172	ICBW	10.18730/85V8V	Triticum aestivum subsp. aestivum	HUN		1981	W	CV	
87508	ICBW	10.18730/85Y8Z	Triticum aestivum subsp. aestivum	TUR	1934/10/30	1981		LA	
87756	ICBW	10.18730/86089	Triticum aestivum subsp. aestivum	AFG		1981		LA	
87792	ICBW	10.18730/8602Q	Triticum aestivum subsp. aestivum	TUN		1981	S	CV	
87821	ICBW	10.18730/8610J	Triticum aestivum subsp. aestivum	ESP		1981		LA	
87909	ICBW	10.18730/86184	Triticum aestivum subsp. aestivum	BGR		1981		LA	
87966	ICBW	10.18730/8619H	Triticum aestivum subsp. aestivum	ETH	1950/05	1981	S	LA	LM
87967	ICBW	10.18730/861PJ	Triticum aestivum subsp. aestivum	ETH		1981		LA	
87972	ICBW	10.18730/861RM	Triticum aestivum subsp. aestivum	ETH		1981		LA	

Management of Collected Germplasm



Reporting

- 
- 
- A report should be submitted to the commissioning/funding agency giving a detailed assessment in regard to the technical and financial progress of the project.
 - ✓ Activities of the planning phase to identify the areas and taxa for collecting, the collaborators/partners, prepare the expedition.
 - ✓ Collecting strategies and any special methods followed in the field.
 - ✓ Ecogeographic areas and taxa actually sampled and any constraints faced.
 - ✓ Collaborators/partners in the collecting.
 - ✓ Data captured during and after the collecting (include a copy of the collecting data with the report).
 - ✓ Highlights of the collecting and of the material collected.
 - ✓ Processing of the collected samples and shipment for safety duplication.

Germplasm Acquisition through Donations

Acquisition Strategy

- ✓ Filling the gaps of the Collection.
- ✓ Historical collections (e.g., VIR).
- ✓ Genetic Stocks (e.g. introgression lines with chromosomal segments from secondary and tertiary genepool, aneuploids, etc.)
- ✓ Areas of diversity for important traits.

First thing to consider:

Determine if the germplasm already exists in the collection by comparing the relative passport data of the donating and recipient genebank

The screenshot displays the Genesys web interface for a specific accession. The browser address bar shows the URL: <https://www.genesys-pgr.org/a/abc852f4-0803-48ed-84cd-9915edb2ebdc>. The page header includes the Genesys logo and navigation links: Accession data >, Directory >, Resources >, My List 0, and a Login button. The main content area shows the current GRIN taxon as *Triticum turgidum* subsp. *durum* (Desf.) van Slageren. Below this, the 'Accession names' section contains a table with the following data:

Accession name	N-85
Other identifier	ICARDA-IG-82503
Other identifier	ICARDA-IG-83680
Other identifier	ICARDA-IG-98538
Other identifier	Citr 10124
Other identifier	CI 10124
Other identifier	AUS 11834
Other identifier	N-85

The 'Collecting information' section shows the provenance of material as China, indicated by a red dot icon.

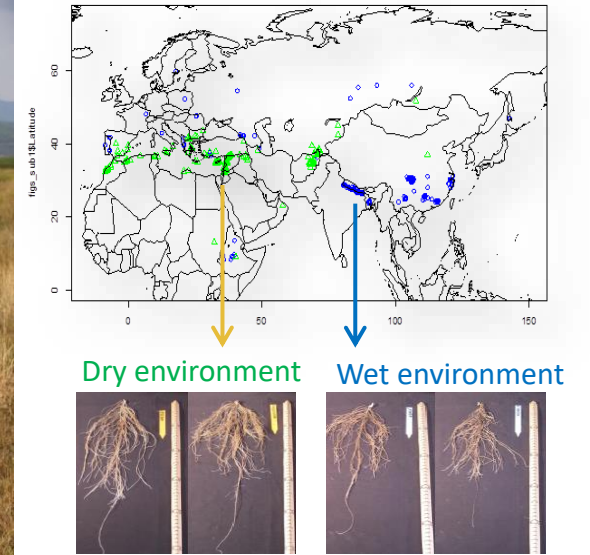
Germplasm Acquisition through Donations

Needed arrangements

- ✓ Prepare the final list of unique accessions to be acquired.
- ✓ Check requirements for seed import with national plant protection office.
- ✓ It may be required an import permit and a certificate of donation to be signed by the consignor prior to the seed import.
- ✓ Always accompanied by signed SMTA.
- ✓ Similar approaches with seeds coming through collecting.

Remember:

Passport data are essential and they should accompany the shipment as hard and as electronic file. Strive to obtain as much information as possible, including also the donor name and the donor identification number.



THANK YOU FOR YOUR KIND
ATTENTION!