



# TRAINING IN ORGANIC BREEDING!





# Training in organic breeding organized in 5 Modules

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1. **Module 1 - Plant Genetic Resources (PGRs):** collection, conservation and exchange to support the increase of agrobiodiversity in farming systems
2. **Module 2 - Phenomics:** approaches and tools for genetic resources and breeding material characterisation - FEBRUARY 3rd 2025, 9:00 to 17:30 CET
3. **Module 3 - Breeding methods fundamentals** - FEBRUARY 13th 2025, 9:00 to 18:00 CET
4. **Module 4 - Development and application of molecular methods in organic breeding** - MARCH 4th 2025, 9:00 to 18:00 CET
5. **Module 5 - Organic heterogeneous material (OHM) design and development** - MARCH 7th 2025, 9:00 to 18:00 CET



**January 27th 2025 - 9:30 to 16:00 CET**



■ **Unit 1.1: Public/Institutional seedbanks: PGRs collection, conservation and exchange**

- 9:30-11:00 - UPV (Adrian Rodriguez-Burruezo, Eva Solbes, Ana Fita)
- 11:00-11:30 Break

■ **Unit 1.2: Prebreeding: from genetic resources characterisation to their use in breeding programmes**

- 11:30-13:00 - KIS (Vladimir Meglic)
- 13:00-14:30 Lunch Break

■ **Unit 1.3: Community seed banks: collection, dynamic management and exchange**

- 14:30-16:00 - Aegilops (Kostas Koutis) + LLD (Gabriele Maneo) + RSR (Riccardo Bocci)

# T1.4 Training in Organic Breeding

**Module 1: Plant Genetic Resources (PGRs): collection, conservation and exchange to support the increase of agrobiodiversity in farming systems**

**Unit 1 – Public/Institutional seedbanks: PGRs collection, conservation and exchange**

**Adrian Rodríguez-Burruezo**

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COMAV Institute, UPV seedbank

Universitat Politècnica de València

# Module 1 – Unit 1 Public/Institutional Seedbanks

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Planned for today

DYNAMIC MIXTURE OF:

1. *Presentation about main topics on Seedbanks: seed management, exchanges, parameters, knowledge, additional material (50 min)*
2. Guided virtual activity (about 10 min)
3. Fast quiz (about 10 min) \*\*\*
4. Debate (about 10 min)
5. Wrap up & Proposed homework (about 5 min) \*\*\*
6. QUESTIONS: THROUGH THE CHAT (Petra Jelincic will manage)

\*\*\* = IMPORTANT for CERTIFICATES (ALL THE THREE UNITS!!!!)



# Module 1 – Unit 1 Public/Institutional Seedbanks

## What's a seedbank?

*In situ* vs. *ex situ* conservation of diversity

In-situ mainly focuses on protecting organisms in their original habitat, while ex-situ works on protecting into external protective habitats



**IN SITU**



National parks,  
protected areas,  
wilderness,

**ON-FARM**

**EX SITU**



Botanical gardens,  
Zoos,

**SEEDBANKS**



# Module 1 – Unit 1    Public/Institutional Seedbanks

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## What's a seedbank?

- ☐ *Essential to preserve agrodiversity, technically called PLANT GENETIC RESOURCES (PGR). Both cultivated forms of crops and wild relatives\**
- ☐ *Available (depending on the category of seedbank) to provide materials to farmers, sources of variation to breeders, to perform genomic studies, etc.*
- ☐ *Essential i) to guarantee that agrobiodiversity does not loose, i.e. as a tool to mitigate genetic erosion\* ii) to face future breeding challenges\**
- ☐ *LIMITATION: as materials are preserved and multiplied under ex situ conditions, they do not evolve dynamically in their original habitat. As a result, cases of genetic drift may occur\**

# Module 1 – Unit 1 Public/Institutional Seedbanks

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## Collecting plant genetic resources (PGR)

### IMPORTANT TERMS

- ❑ *Any PGR, regardless their origin, botanical status (cultivated, wild relatives, ancient landraces, breeding lines, etc.) is named in Seedbank terminology **ACCESSION**.*
- ❑ *Accessions can come from:*
  - ❑ *Exchanges with farmers or other seedbanks<sup>1</sup>*
  - ❑ *Collecting expeditions to areas of natural occurrence or cultivation*
  - ❑ *Expeditions can be at a local, regional, national or **International<sup>2</sup>** level*

<sup>1</sup> Sanitary issues considered with care, particularly quarantine and sanitary certificates in international or interstatal exchanges

<sup>2</sup> Many decades ago, collecting in biodiversity hotspots of foreign countries was possible. Also exchanging materials collected by local authorities. However, nowadays, since the signature of intern PGR protocols it has become difficult



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## Collecting plant genetic resources (PGR)

*Examples of collecting expeditions*

- ❑ **Local materials.** *On-farm collection of “Valenciano” and other tomato landraces along the Region of Valencia and surrounding areas.*

*Organised with contact farmers*

*Radial trips (1 d) or round trip (1 wk)*



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## Collecting plant genetic resources (PGR)

### *Examples of prospection expeditions*

❑ **International.** *Tomato wild relatives or Capsicum peppers in S. America (before International protocols): Ecuador, Peru, Chile, Galapagos Islands, etc*

*USDA, CGN, AVRDC, UPV, etc. PGR programs and seedbanks have hundrends of accessions from tomato, peppers, Cucurbitaceae (and wild relatives) from America, prospected in the 70s-80s.*<sup>1</sup>

*Prospection S. cheesmaniae.  
Sea cliffs Galapagos Islands*



*Peppers  
(cultivated and wild)*



*Tomato wild relatives in Peru*



# Module 1 – Unit 1 Public/Institutional Seedbanks

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## Collecting plant genetic resources (PGR)

*What happens once collected?*

- ☐ *The material receives an accession code and passport data <sup>1</sup>*
- ☐ *If coming from other Seedbank (seedbanks exchange): the receiver seedbank records both i) the new code & ii) the code from the ancient bank. This allows a control of the flow among banks, avoid redundancies/duplicates*
- ☐ *The materials are stabilised and preserved in the facilities*

*1 Passport data: the most simple and primary data of an accession. Usually include origin (soil and agroecological conditions, location, country, GPS if available), species, varietal type, local name, pictures (if available) among others.*

*See also the section CONSERVATION for more details about the kind of data of seedbanks accessions*



# Module 1 – Unit 1 Public/Institutional Seedbanks

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## Conservation and multiplication

*Type of data of accessions in Seedbanks*

1. *Passport (link CGN, USDA, COMAV-UPV)*
2. *Characterization (less available). Based on phenomic traits*
3. *Evaluation (less available)*

# Module 1 – Unit 1 Public/Institutional Seedbanks

## Conservation and multiplication

### 1. Passport data

- ☐ The most common when visiting the webpage of Seedbanks
- ☐ Usually include origin (soil and agroecological conditions, location, country, GPS if available), species, varietal type, local name, pictures (if available), ...

Ex.1 Access UPV-COMAV Seedbank repository with passport data  
(<https://comav-seeds.ssmervice.ch/seeds-list.php?lang=es>)

The screenshot displays the UPV-COMAV Seedbank repository interface. A modal window titled 'Detalles de la semilla' (Seed details) is open, showing passport data for a tomato sample. The data includes:

- id\_orden: 9
- Disponibilidad de la muestra: si
- Número de la accesión: BGV00101
- Código Inventario Nacional RRF: NC100226
- Número de recolección: A-L-11\_1
- Código del instituto recolector: ESP058
- Nombre del instituto recolector: [empty]
- Genero: Solanum
- Especie: lycopersicum
- Autoridad de la especie: L
- Subtaxón: lycopersicum
- Autoridad del subtaxón: [empty]
- Nombre común del cultivo: tomate
- Tipo varietal: beefrijito
- Nombre de la accesión: Tomate de corazón
- Fecha de adquisición: 1984----
- País de origen: España
- Ubicación del sitio de recolección (nivel 1): Aragon
- Ubicación del sitio de recolección (nivel 2): Huesca
- Ubicación del sitio de recolección (nivel 3): Quicena
- Ubicación del sitio de recolección (nivel 4): [empty]
- Ubicación del sitio de recolección (nivel 5): [empty]
- Nota: [empty]

The background shows a table with columns for 'COLL SITE\_1', 'COLL SITE\_2', and 'SAMP/STAT'. The table lists multiple entries for 'Aragon' and 'Huesca' with a value of '300' in the 'SAMP/STAT' column.

Ex. 2 CGN-WUR Passport data link (faba bean):  
<https://cgn.websites.wur.nl/Website/downloads/DownloadCnr12.htm>

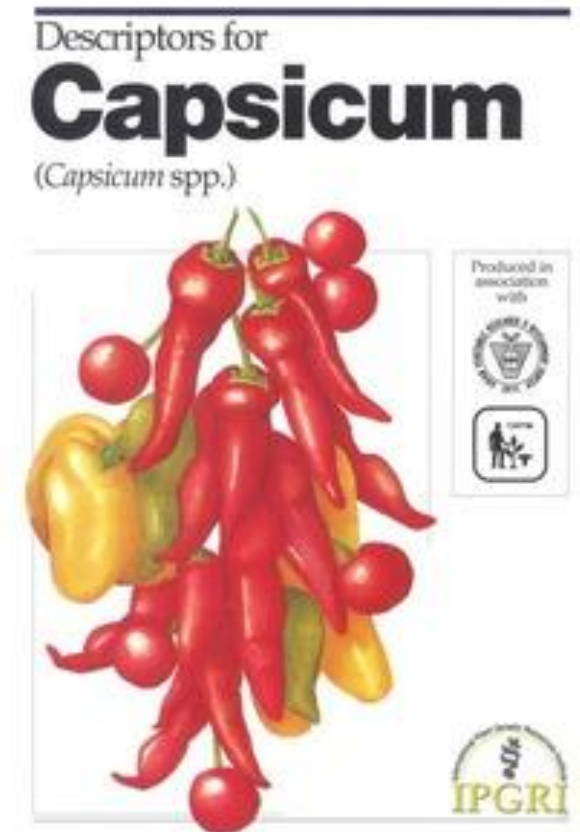
# Module 1 – Unit 1 Public/Institutional Seedbanks

## Conservation and multiplication

### 2. Characterization data

- ☐ *Based on descriptive phenotypic traits. The most commonly used are listed by Bioversity International (<https://alliancebioversityciat.org/>)*
- ☐ *Plant growth&development, reproductive organs, seeds, etc.*
- ☐ *Specific descriptors of each species and wild relatives (available online free, several languages)*
- ☐ *Usually recorded when accessions are multiplied for first time to increase seed stock (usually seeds after expeditions or from exchanges are very few)*

[https://alliancebioversityciat.org/publications-data?search\\_api\\_fulltext=descriptors+capsicum](https://alliancebioversityciat.org/publications-data?search_api_fulltext=descriptors+capsicum)





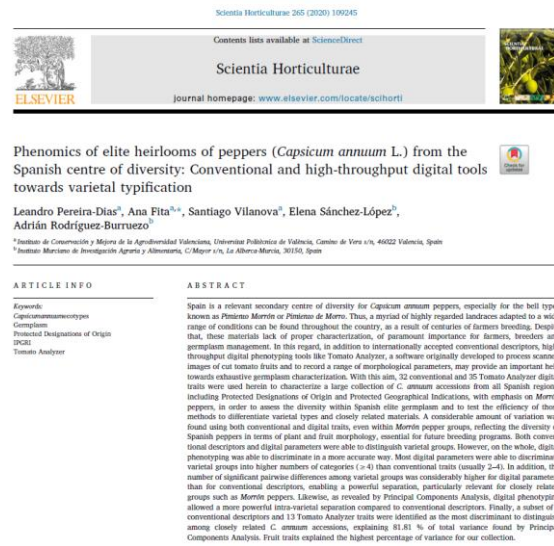
# Module 1 – Unit 1 Public/Institutional Seedbanks

## Conservation and multiplication

### 2. Characterization data

Example phenomic characterization of *Capsicum* collections

<https://doi.org/10.1016/j.scienta.2020.109245>

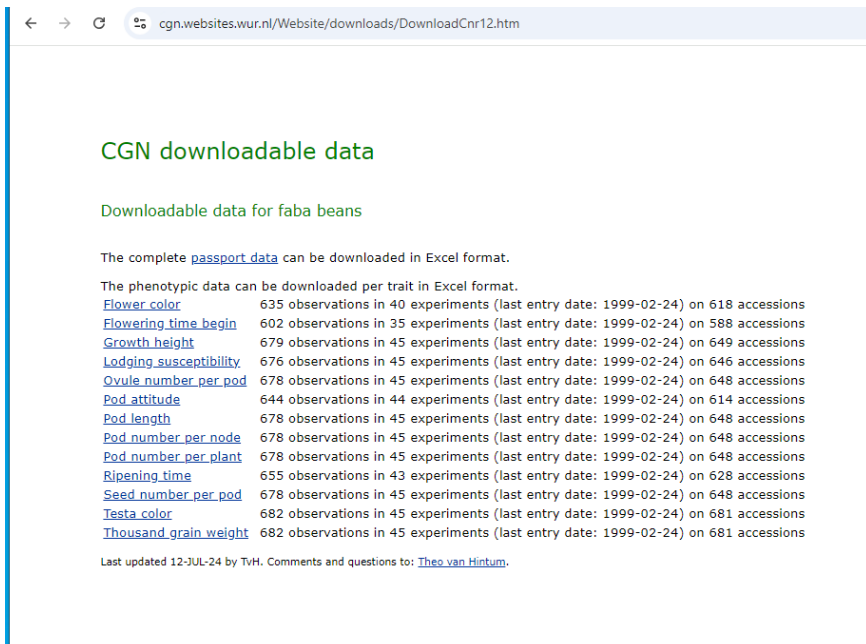


1. Introduction

et al., 2019; Carrizo García et al., 2016; Moscone et al., 2007). Among the cultivated species, *Capsicum annuum* L. (var. *annuum*) is the most

CGN-WUR Seedbank menu for phenotypic data of Faba bean collection

<https://cgn.websites.wur.nl/Website/downloads/DownloadCnr12.htm>



# Module 1 – Unit 1 Public/Institutional Seedbanks

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## Conservation and multiplication

### 3. Evaluation data *(also less available)*

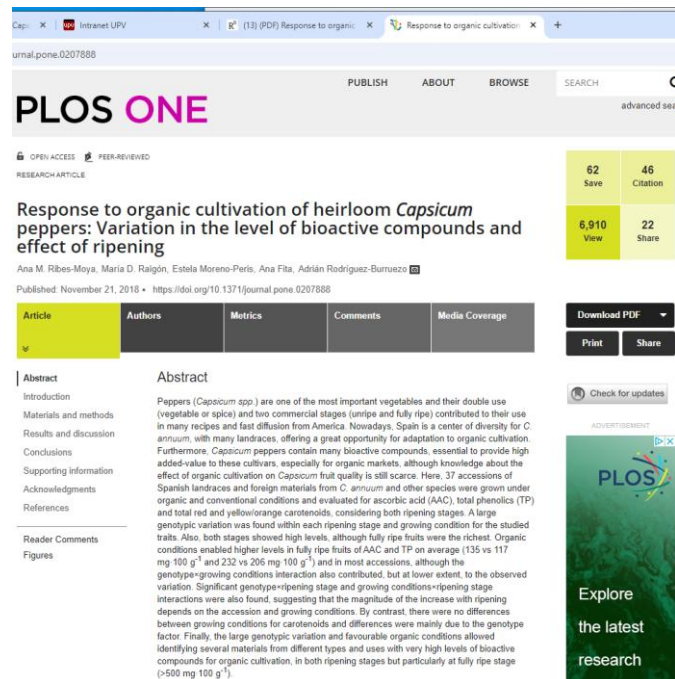
- ☐ *Usually performed by breeders and pathologists*
- ☐ *Result of screenings for specific traits (resistances, physiology, quality traits, agronomic, etc.)*
- ☐ *Within breeding programs, national or international projects aimed at screenings in Seedbanks*
- ☐ *Usually published in Journals or congresses. Sometimes some specific trait may also appear in the list of accessions in the webpage, together characterization/phenotyping data*

# Module 1 – Unit 1 Public/Institutional Seedbanks

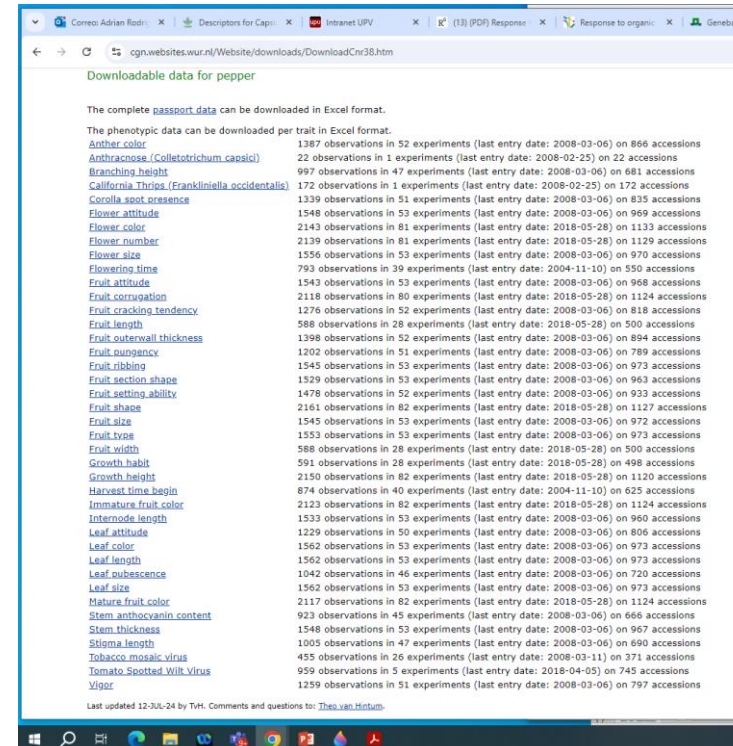
## Conservation and multiplication

### 3. Evaluation data

Ex. agronomic&quality evaluation of *Capsicum* collections  
<https://doi.org/10.1371/journal.pone.0207888>



Example characterization & evaluation traits menu for *Capsicum* peppers in CGN-WUR Seedbank <https://cgn.websites.wur.nl/Website/downloads/DownloadCnr38.htm>



Description of  
results against  
TMV and TSWV



# Module 1 – Unit 1 Public/Institutional Seedbanks

## Conservation and multiplication



**ORTHODOX:** Seeds support de-hydration and subsequent conservation at low temperatures. Most vegetables.

**RECALCITRANT:** Seeds do not support de-hydration and therefore cannot be conserved at low temperatures (they suffer chilling injuries). Many tropical species and vegetatively reproduced species.

**VEGETATIVELY Reproduced species:** they need clonal reproduction to ensure the full genotype and agronomic performance of the variety. Most fruit trees.

**Seeds at low temperatures**

**Clonal methods**  
**Arboretums**  
**In vitro techniques**

# Module 1 – Unit 1 Public/Institutional Seedbanks

## Conservation – Orthodox species

- ❑ Preserved as dried seeds (1 wk at room conditions)
- ❑ The lower  $T$  and  $RH$ , the larger period of viability  
Harrington's rule: "Seed longevity decreases 50% each 1%  $RH$  increase or 6°C  $T$  increase"<sup>1</sup>
- ❑ Seeds can be preserved refrigerated (5-8 °C),  
= shorter periods multiplication (dynamic collect.)
- ❑ But also below 0°C (higher dehydration required)  
= larger periods of multiplication (core collections)
- ❑ After each multiplication, seed viability tests

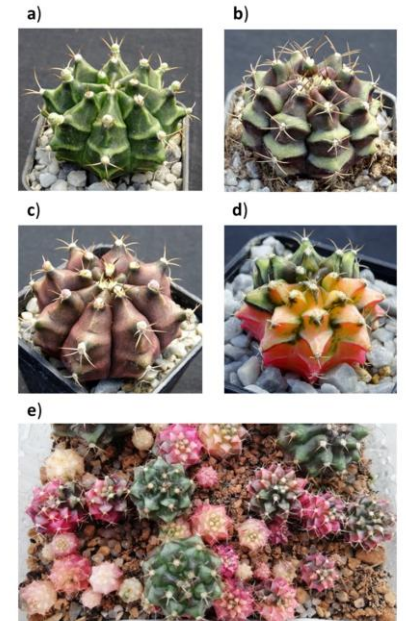


<sup>1</sup> This can be found on many publications. As Example: "Seed Drying Methods and Seed Quality" or "Implementing Drying systems to preserve seed quality" UC Davis, HortCRSP and USAID: [chrome-extension://efaidnbmnnnibpcajpcgclclefindmkaj/https://horticulture.ucdavis.edu/sites/g/files/dgvnsk1816/files/extension\\_material\\_files/104\\_Bradford\\_0.pdf](https://efaidnbmnnnibpcajpcgclclefindmkaj/https://horticulture.ucdavis.edu/sites/g/files/dgvnsk1816/files/extension_material_files/104_Bradford_0.pdf)

# Module 1 – Unit 1 Public/Institutional Seedbanks

## Conservation – Recalcitrant species

- ❑ *Preserved vegetatively in many ways*
- ❑ *Arboretums, germplasm orchards and gardens*
- ❑ *In pots*
- ❑ *Using in vitro techniques*



EXAMPLE: KEW GARDENS: Seeds collection: <https://www.kew.org/science/collections-and-resources/collections/seed-collection>  
Living collection: <https://www.kew.org/kew-gardens/plants>  
In vitro collection <https://www.kew.org/science/collections-and-resources/collections/in-vitro-collection>



# Module 1 – Unit 1    Seedbank methodologies

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## Seed exchange:

- ☐ Public Seedbanks open to ship their seeds to other actors
- ☐ Farmers & farmers' associations
- ☐ Seed companies
- ☐ Other Seedbanks
- ☐ Research units
- ☐ IMPORTANT:
  - ✓ Material Transfer Agreements usually signed
  - ✓ Sanitary certificates needed to ship to foreign countries or other states

# Module 1 – Unit 1      Seedbank methodologies

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## Seed exchange:

IMPORTANT:

Protocol of Genabank-UPV

Standard Material Transfer Agreement (SMTA) is always signed:

The Standard Material Transfer Agreement (SMTA) is a standard contract that sets out the terms and conditions ensuring that the relevant provisions of the International Treaty are followed when transferring plant genetic material that is included in the Multilateral System.

SMTA regulates exchanges of plant genetic material, prevents their misuse, and ensures that any commercial benefits that arise are fairly and equitably shared. You can find the text of the SMTA here:

[https://www.fao.org/plant-treaty/areas-of-work/the-multilateral-system/smta/en/#:~:text=The%20Standard%20Material%20Transfer%20Agreement%20\(SMTA\)%20is%20a%20stand%20ard%20contract,the%20result%20of%20lengthy%20negotiation](https://www.fao.org/plant-treaty/areas-of-work/the-multilateral-system/smta/en/#:~:text=The%20Standard%20Material%20Transfer%20Agreement%20(SMTA)%20is%20a%20stand%20ard%20contract,the%20result%20of%20lengthy%20negotiation)

Terms and conditions of the SMTA may not be varied in any way, but it contains some paragraphs and sections that need to be completed for each use. The SMTA can be compiled online in six languages and, if users wish, can also be concluded online through the Easy-SMTA application.

<https://mls.planttreaty.org/itt/index.php?r=site/index&lang=es>

# Module 1 – Unit 1      Seedbank methodologies

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## Seed exchange:

IMPORTANT:

- ✓ **Sanitary certificates needed to ship to foreign countries or other states**

### **REGULATION (EU) 2019/2072 of 28 November 2019**

**Plant species to be accompanied by a Plant Passport The Uniform Conditions Regulation (EU) 2019/2072 contains:**

- Annex XIII: List of plants, plant products and other objects, which require a Plant Passport for movement within the EU.
- Annex XIV: List of plants, plant products and other objects, which require a Plant Passport for movement within the EU Protected Areas.

**Some of the materials requiring Plant Passport include the following:**

- All plants intended for planting.
- Cereal seeds: *Oryza sativa* L.
- Seeds of oil and fibre plants: *Glycine max* (L.) Merrill, *Brassica napus* L., *Brassica rapa* L., *Helianthus annuus* L., *Linum usitatissimum* L., *Sinapis alba* L.
- Seeds of ornamentals: *Allium* L., *Capsicum* L., *Helianthus annuus* L., *Prunus avium* L., *Prunus armeniaca* L., *Prunus cerasus* L., *Prunus domestica* (L.) Batsch, *Prunus dulcis* (Mill.) D. A. Webb, *Prunus persica* (L.) Batsch, *Prunus salicina* Lindley.
- Fruit plant seeds: *Prunus armeniaca* L., *P. avium* L., *P. cerasus* L., *P. domestica* L., *P. dulcis* (Mill) D. A. Webb., *P. persica* (L.) Batsch, *P. salicina* Lindley.
- Vegetable plant seeds: *Allium cepa* L., *Allium porrum* L., *Capsicum annum* L. *Phaseolus coccineus* L., *Phaseolus vulgaris* L., *Pisum sativum* L., *Solanum lycopersicum* L., *Vicia faba* L.
- Fodder plant seeds: *Medicago sativa* L.
- Seed potato



# Module 1 – Unit 1    Public/Institutional Seedbanks

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## PRACTICAL EXERCISE (guided searching of PGRs)

- ☐ *Use your PCs laptops and follow me!!*
- ☐ *Go to slide “Additional available materials”: 4. Webpages of PGR Seedbanks and Programs*
- ☐ *Let’s explore one webpage/repository of germplasm for 10 min*

# Module 1 – Unit 1 Public/Institutional Seedbanks

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## FAST QUIZ

- ☐ *Question 1: Explain the correlation between temperature, relative humidity and seed longevity*
- ☐ *Question 2: differences between orthodox and recalcitrant species*
- ☐ *Question 3: Which kind/levels of data are managed with PGRs?*
- ☐ *Question 4: Define in situ vs. ex situ conservation*

Send to :

[adrodbur@doctor.upv.es](mailto:adrodbur@doctor.upv.es) and [petra.jelincic@ips-konzalting.hr](mailto:petra.jelincic@ips-konzalting.hr)

**In 10 min**

# Module 1 – Unit 1    Public/Institutional Seedbanks

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## DEBATE

- ☐ *Revise the quiz in common*
- ☐ *What I know about Seedbanks close to me?*
- ☐ *Own previous experiences*
- ☐ *Other questions and doubts*



# WRAP UP

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- ☐ *What we have learned today?*
- ☐ *Proposed homework: search germplasm by yourself in repository (CGN, AVRDC, USDA-ARS) and prepare a list of 20 accessions of 1 species from different origins <sup>1</sup>*

<sup>1</sup> send to [adrodbur@doctor.upv.es](mailto:adrodbur@doctor.upv.es)

# Additional available materials

1. Operational Genebank Manual. Centre for Genetic Resources, The Netherlands (CGN-WUR). And others manuals: <https://www.ecpgr.org/aegis/aquas/genebank-manuals>
2. IPGRI/Bioversity international descriptors: <https://cgspace.cgiar.org/collections/835fa638-0167-4669-9532-ffc488facc94>
3. International PGR treaties and management: *“CURSO DE PROCEDIMIENTOS DE ACCESO A RECURSOS FITOGENÉTICOS PARA LA ALIMENTACIÓN Y LA AGRICULTURA”*. Ministerio de Agricultura, Pesca y Alimentación (Spain chrome-extension://efaidnbmnnnibpcajpcgltclfindmkaj/https://preservicio.mapama.gob.es/es/agricultura/temas/medios-de-produccion/curso\_mapa\_acceso\_rfaa\_easysmta\_tcm30-690179.pdf
4. Webpages of PGR Seedbanks and Programs:  
CGN: <https://www.wur.nl/nl/onderzoek-resultaten/kennisonline-onderzoeksprojecten-lvvn/centre-for-genetic-resources-the-netherlands/plant-genetic-resources.htm>  
Kew Gardens: <https://www.kew.org/science/collections-and-resources/collections>  
USDA-ARS: <https://www.ars.usda.gov/plains-area/fort-collins-co/center-for-agricultural-resources-research/paagrpru/docs/seed/seed-collections/>  
Real Jardín Botánico de Madrid-CSIC: <https://rjb.csic.es/rjb-colecciones/banco-de-germoplasma/>  
COMAV-UPV: <https://www.upv.es/contenidos/BGCOMAV/>

# Additional available materials

## Video casts (In Spanish):

<https://www.youtube.com/watch?v=BpQo1Zg1rFQ>



[https://www.youtube.com/watch?v=71mq\\_fLjpb4](https://www.youtube.com/watch?v=71mq_fLjpb4)



<https://www.youtube.com/watch?v=J8OuhnX34Zw>



<https://www.youtube.com/watch?v=sLODMS45hg0>





# LiveSeeding







*LiveSeeding*

