

# **Module 1.** Strategies for conserving plant genetic resources

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# Module 1. Strategies for conserving plant genetic resources

## *Definitions and techniques*

### *In situ* conservation

- Genetic reserves or protected areas
- On-farm maintenance
- Home garden preservation

### *Ex situ* conservation

- Seed storage
- *In vitro* maintenance
- Field collections
- Additional *ex situ* conservation tools
  - ❖ pollen
  - ❖ DNA storage
- Basic institutions practising *ex situ* conservation
  - ❖ gene banks
  - ❖ botanical gardens

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## *In situ conservation definitions*

“protection of genetic variation of a species at its native sites”  
(Schmidt, L., 1997)

### *Reference definition*

“The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties”

(CBD, 1992)

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## *In situ* conservation techniques

**“Genetic reserve conservation** – the location, management and monitoring of genetic diversity in natural wild populations within defined areas designated for active, long-term preservation”

(Maxted, N. et al., 1997)

This method is suitable for CWRs conservation.

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## *In situ* conservation techniques

**“On –farm maintenance** – the sustainable management of genetic diversity of locally developed traditional crop varieties with associated wild and weedy species or forms by farmers within traditional agricultural, horticultural or agri-silvicultural cultivation systems”

(Maxted, N. et al., 1997)

The method is suitable for conservation of landraces, but also for CWRs and weeds associated with the former ones.

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## *In situ* conservation techniques

**Home garden preservation** – the sustainable management of a great diversity of species and varieties within micro-environments close or slightly further away to household.

The method is suitable for conservation of landraces, but also for CWRs and weeds associated with the former ones.

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## *Ex situ* conservation definitions

“Conservation of genetic resources that entails removal of individuals or reproductive material from its site of natural occurrence, i.e. conservation *off site*”

(Koski, V., 1997)

### *Standard definition*

“The conservation of components of biological diversity outside their natural habitats”

(CBD, 1992)

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## *Ex situ* conservation techniques

**Seed storage** – maintenance of dried seeds (5 – 8%) in controlled environment, at temperatures between -20°C to 10°C

### *Some characteristics*

- the most practical and the oldest conservation method known to man
  - applied to plant species producing orthodox seeds
- About 5.5 millions accessions are kept as seed in gene banks all around the world

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## *Ex situ* conservation techniques

***In vitro* maintenance** – to store explants, usually as plantlets, in a sterile environment, on an artificial culture medium.

### *Main features*

- applied to:
  - vegetative propagated plant species
  - species with recalcitrant seeds behaviour

About 37 000 accessions are kept as *in vitro* collections all around the world

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## *Ex situ* conservation techniques

**Field conservation** – to keep the genetic diversity as living plants, either in the field or in pots in a nursery.

### *Main features*

- it is suitable for:
  - vegetative propagated plant species (most of root and tuber crops)
  - species producing recalcitrant seeds
  - long life cycle species (i.e. trees)

About 527 000 accessions are maintained in field collections at the global level.

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## *Ex situ* conservation – additional conservation tools

### **Pollen storage**

- supplements seeds or vegetative plants maintenance
- very useful in breeding works, in making crosses at desired times
- used to control pollination
- pollen viability:
  - is species dependent, and
  - lasts several days, or even minutes
- storage conditions:
  - dried
  - low temperatures
- using specific protocols - haploid plants are developed from pollen cultivation

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## *Ex situ* conservation – additional conservation tools

**DNA storage** – implies a collection of the complete genome or only DNA sequences in refrigerated conditions, each sample being accompanied by inventory information

- Main use of DNA library - isolation of specific, useful genes, which can be transferred to other varieties, species, through genetic engineering
- Regeneration of entire plants from DNA sequences or whole genome is difficult to be achieved

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## *Ex situ* conservation Basic institutions

**Gene Banks** – centres hosting in safe conditions different forms of genetic materials (seeds, *in vitro* culture, field collections, pollen, embryos, DNA)

### *Classification of gene banks:*

– according to the mandate:

- ❖ institutional gene banks
- ❖ community ---- // ----
- ❖ national ---- // ----
- ❖ regional ---- // ----
- ❖ international ---- // ----

– based on the type of genetic material conserved:

- ❖ seed banks – potentially many species and individuals
- ❖ *in vitro* banks - rather few species with many samples
- ❖ field banks ---- // ----
- ❖ pollen or DNA banks – potentially, many species and individuals

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## *Ex situ* conservation Basic institutions

**Botanical gardens** – institutions focussed on conserving wild diversity at species level, for educational and scientific purposes.

### *Main conservation techniques:*

- living plants in field or greenhouses
- seeds
- *in vitro*

# Conservation strategies

## *In situ* conservation

### Advantages

- Dynamic - in relation with environmental changes, diseases, pests
- Conserve the process of evolution and adaptation
- Conserve ecosystem services
- A mean for economic & social development of remote rural communities
- A way to increase farmers' control to crop genetic resources

### Disadvantages

- Identification and access to genetic material is difficult
- Biological resources are threatened by natural and man-directed genetic erosion
- Proper management systems for conservation of CWRs and landraces need to be developed

# Conservation strategies

## *Ex situ* conservation

### Advantages

- Genetic material in collections is well documented
- Access to resources is easy
- Direct control over germplasm
- High security storage, thus low probability to lose material
- Offer a large palette of conservation techniques
- Big amounts of diverse genetic resources could be kept

### Disadvantages

- Static modality of conservation, as the genetic material is maintained off site of its place of origin or development
- Some techniques (*in vitro*, cryopreservation, field) are very costly requiring high level of human & technical resources, or involving large areas of land
- Difficult to maintain genetic integrity & stability of genotypes because of somaclonal variation (*in vitro*)
- In case of seed collections, regeneration can be costly, time-consuming, and potentially exposed to genetic drift

# Exercises

1. Your task is to design the National Programme for Plant Genetic Resources Conservation.
  - What strategies and techniques are you going to adopt for the following categories of plant genetic resources:
    - ❖ plant species producing orthodox seeds (seed can be dried and stored for long periods at reduced temperatures)
    - ❖ plant species producing recalcitrant seeds (seed does not survive drying and freezing, and therefore can not be stored for long term)
    - ❖ vegetatively propagated species
    - ❖ fruit trees species
    - ❖ crop wild relatives
    - ❖ landraces
    - ❖ modern cultivars
    - ❖ Exotic ornamental varieties, ex. species belonging to Cactaceae family
2. What institutions would you involve in conservation activities?