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Wallonie recherche CRA-W

How to safeguard and actively evaluate local fruit tree genetic resources

'A Belgian example'

Dr. Marc LATEUR, Dr. Baptiste DUMONT, Ir. Alain RONDIA

14.05.2024
First International Training Course, Online

Introduction

https://youtu.be/6JsTUZ-fOFM

1. General context - Pioneers

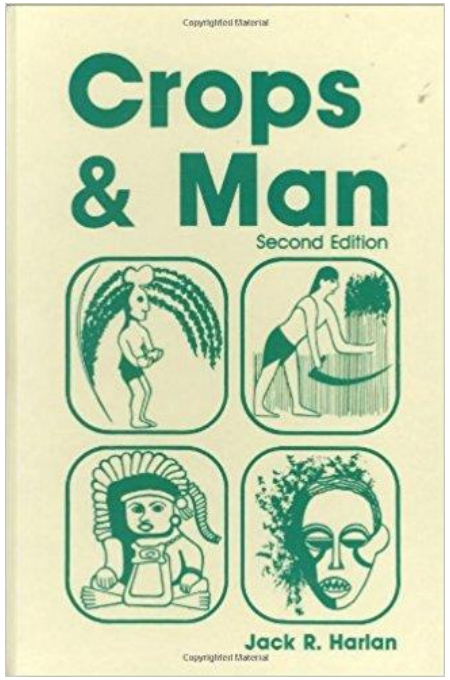
Some historical examples which opened perspectives on Plant Genetic Resources

N. I. Vavilov
30 March, 1939

When penetrating into each country, we wanted to achieve as much as possible: to understand the 'agricultural soul' of that country and its conditions; to master its specific and varietal composition; and to gain the most use from this information while integrating it and the evolution of worldwide agriculture and plant breeding into a single unit.

agriculture. The author has tried to join subjects otherwise difficult to unite, such as geography, botany, agronomy and the history of civilizations into a complete understanding of the fact that it is necessary to do even better than already done. The deeper and the wider

JACK RODNEY HARLAN



1992

1. The global importance of Genetic Resources

Global context : “Second FAO Global Plan of Action” (FAO, 2011)
put emphasis :

- On the contribution of national programmes to the objectives of
- ‘GPA’, ‘CBD’, ‘International Treaty on PGRFA’, ‘Nagoya Protocol’
- On the **ecological, economic, social and cultural values of PGRFA**, including the importance of
- **crop improvement** for increasing **food security**,
- **Adaptation capacity to climate change**

It should be recognized in **national** planning and policies

and in the prioritization and deployment of medium and, particularly, **long-term financial and other resources.**

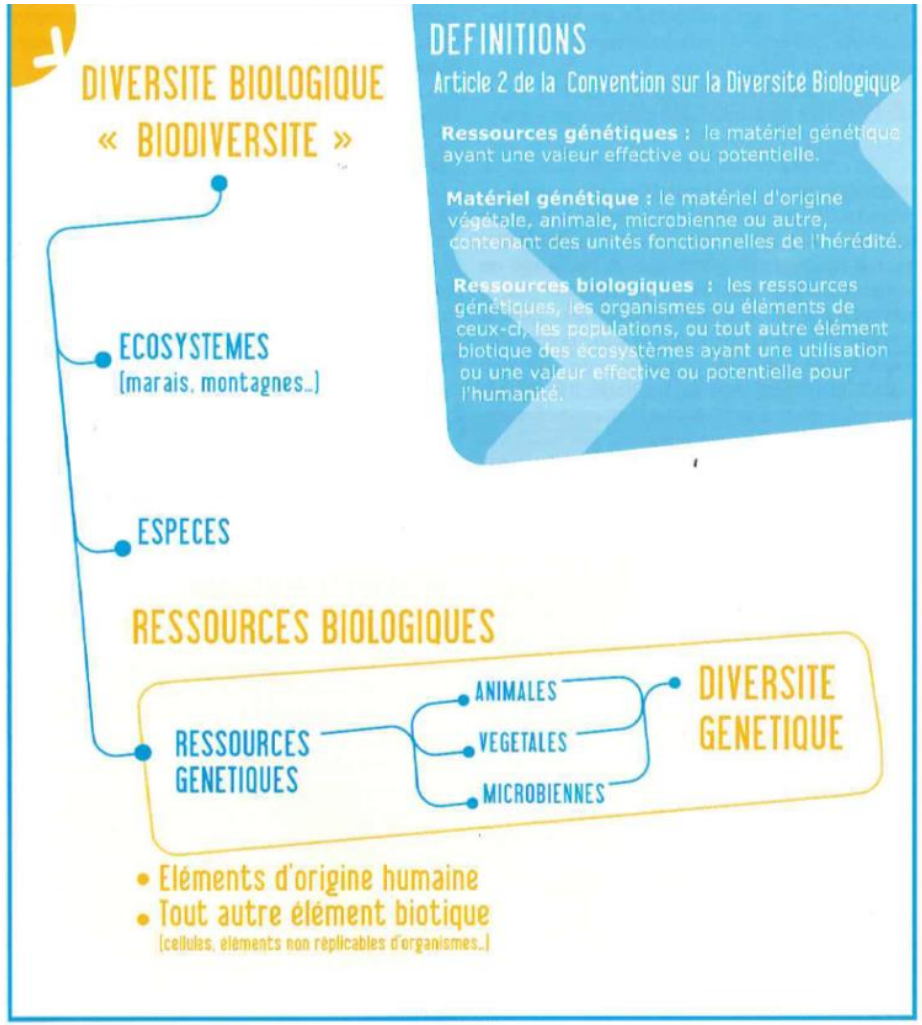
1. The global importance of Genetic Resources

- The adaptive capacity of life depends on biological diversity;
- The adaptive capacity of agriculture depends on biological diversity;
- The adaptive capacity of human being depends on biological diversity;
- Plant Genetic Resources biodiversity is the diversity “reservoir” that needs to be safeguarded, managed and durable used.

1. The global importance of Genetic Resources

- Ecological or ecosystem diversity
- Specific or interspecific diversity (species)
- Genetic diversity or intraspecific diversity (population)
- Cultural diversity (human populations)
- Impacts on food security and on the sustainability of the agriculture...and people!

1. The global importance of Genetic Resources



Genetic resources:

Genetic material of plants, animals and other organisms which is of value as a resource for present and future generations of people.

1. The global importance of Genetic Resources

- *Mankind has been on earth for more than 2 million years, and for 99% of that time it has been a hunter- and gatherer-based society.*

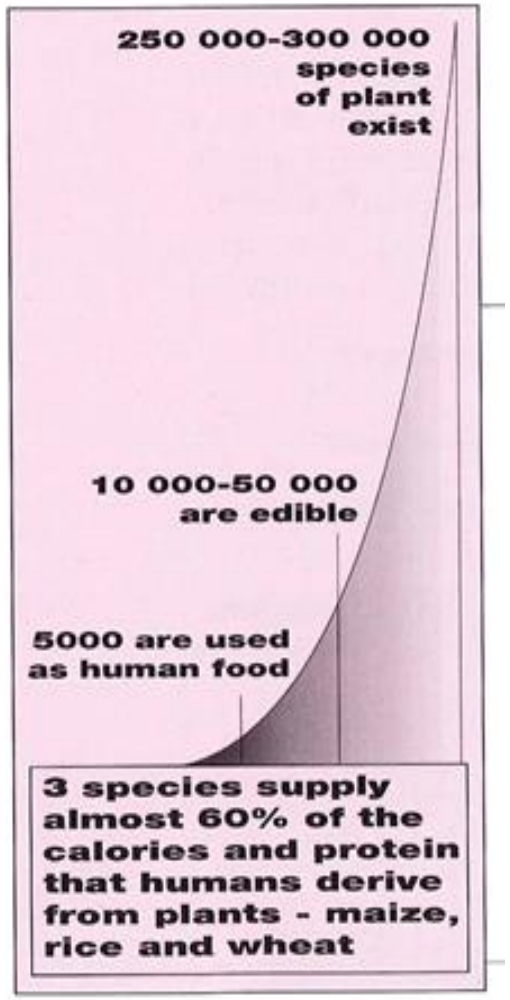
- *It is only in the last 10,000 years that we have been domesticating plants and animals, using metals and developing sources of energy other than the human body...*

- *If we consider that 80 billion men and women have lived on earth since the appearance of the human race, 90% have been hunter-gatherers, only 6% have lived through agriculture, and the remaining few % have lived in industrial societies.*

- *The condition of gatherer-hunter has been the most successful and persistent way of life that man has ever known".*

Lee & De Vore (1968).

1. The global importance of Genetic Resources



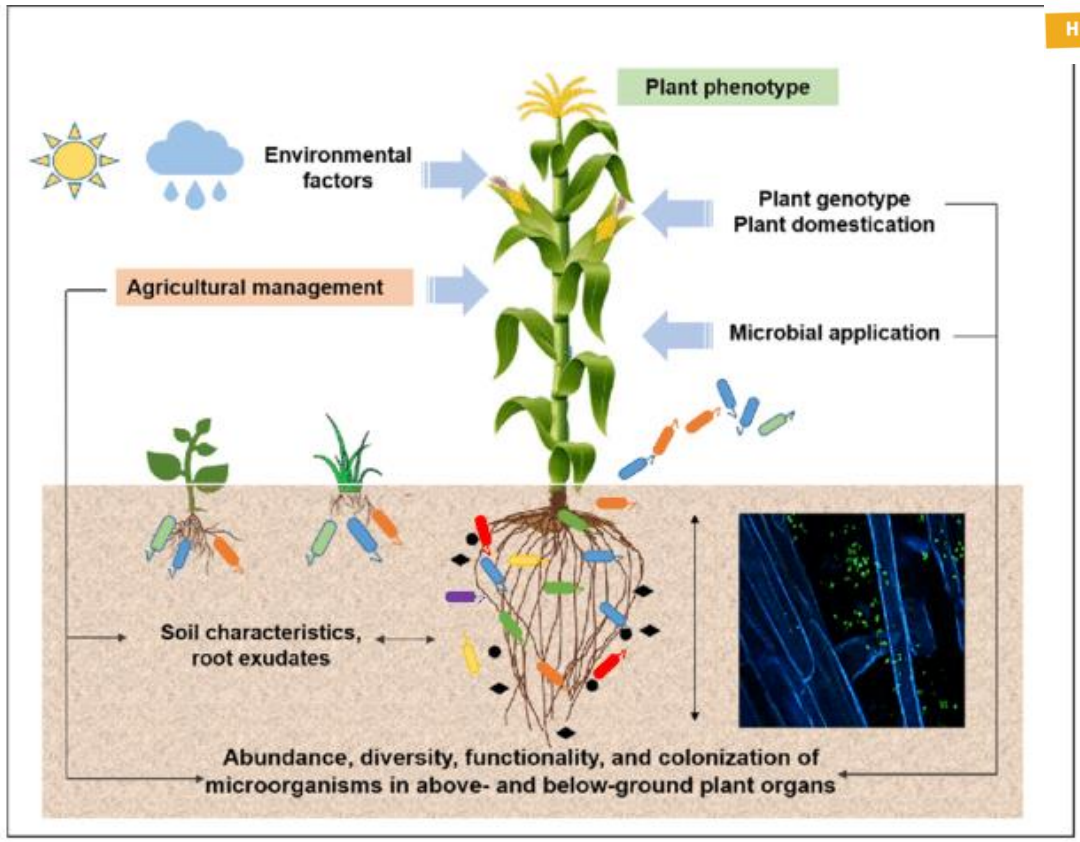
The current erosion in the diversity of plants being consumed by current mankind

1. The global importance of Genetic Resources

Phenotypic diversity

1. The global importance of Genetic Resources

Phenotype >< Genotype



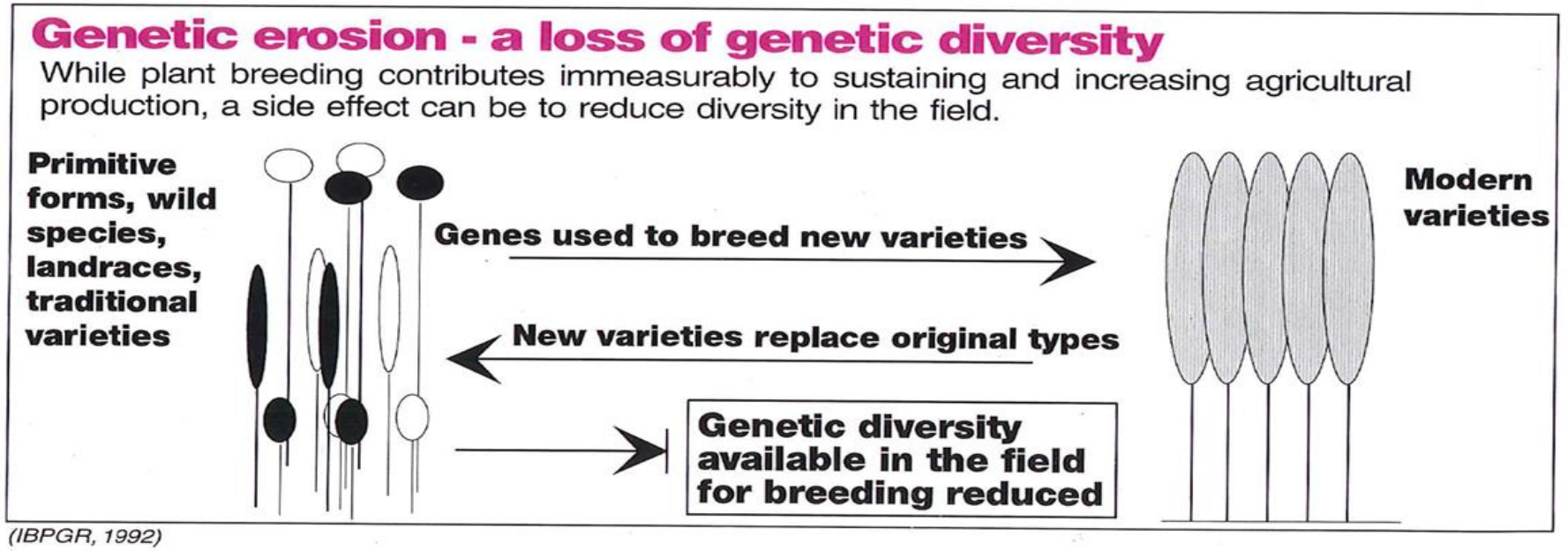
Stéphane Compant, et al. 2019

Genetic diversity

- Genetic diversity is the heritable variability
- Is the basis of selection and crop improvement
- Is an important resource in plant breeding

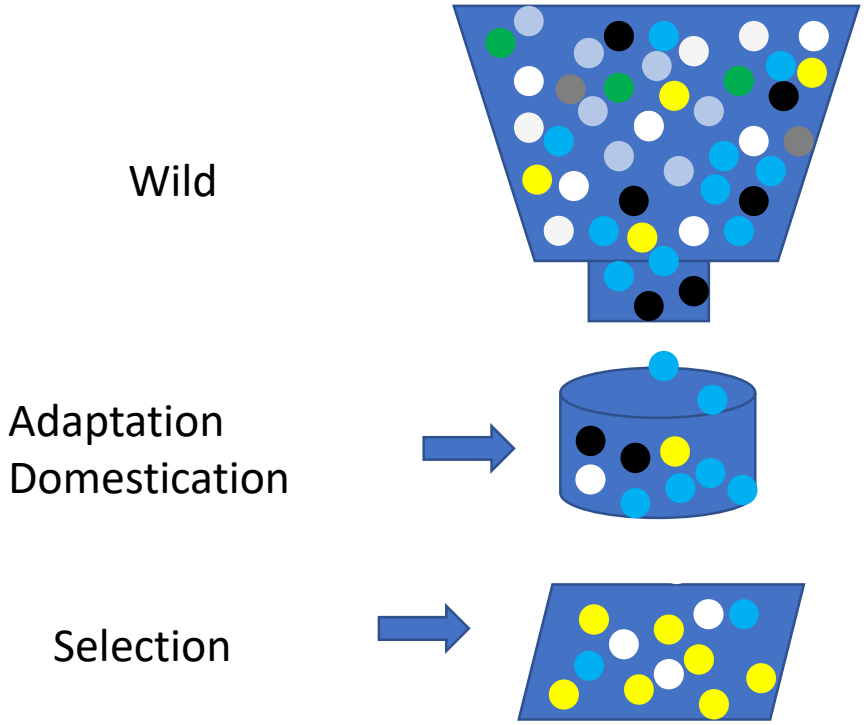
1. The global importance of Genetic Resources

Genetic erosion - loss of genetic diversity = less chance of adaptation capacities



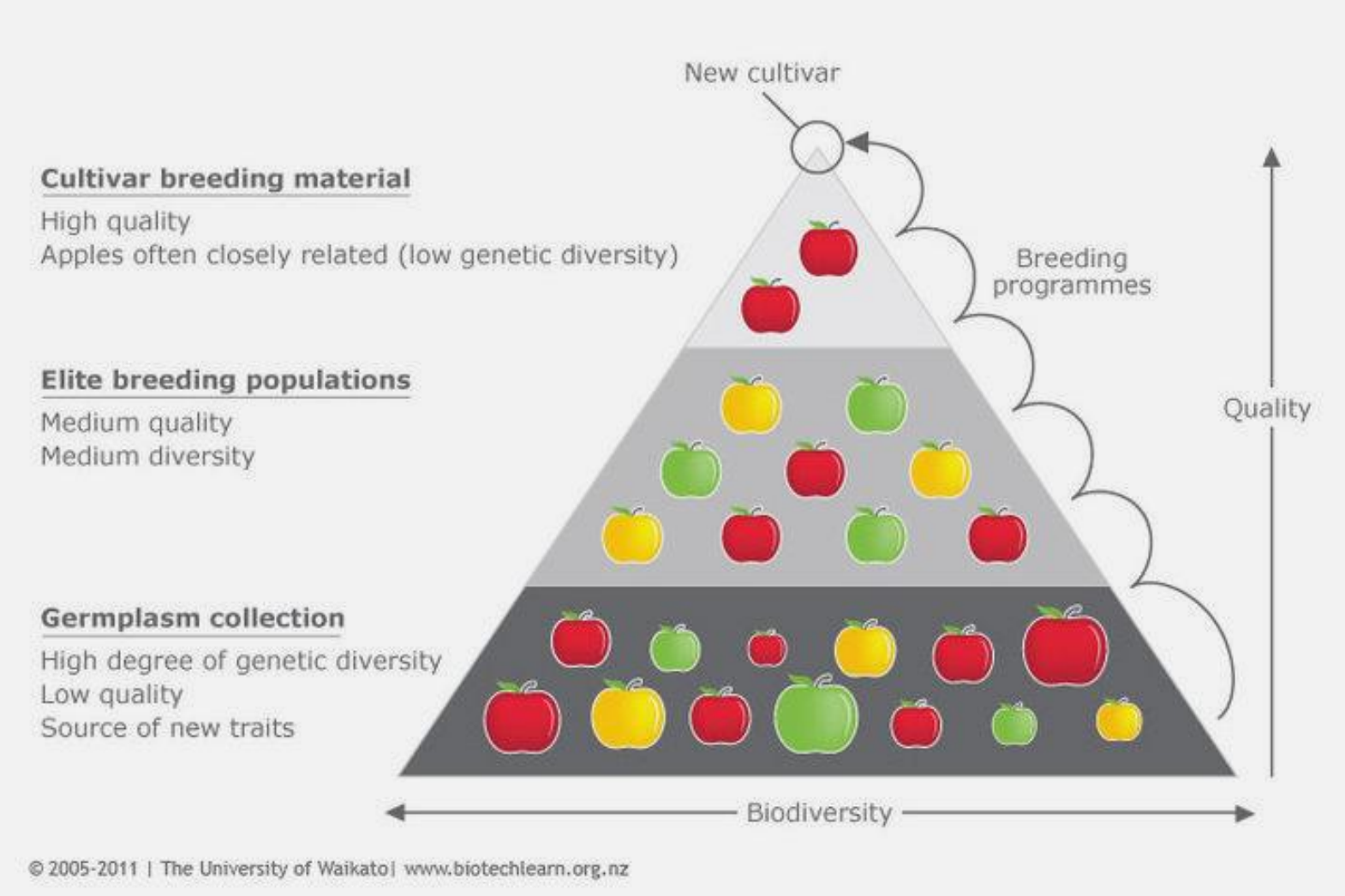
1. The global importance of the Genetic Resources

Reduction of genetic variability: domestication and selection



The extent and distribution of genetic diversity **depends o**n its **evolution**, past **bottlenecks** and **human factors**

1. The global importance of the Genetic Resources



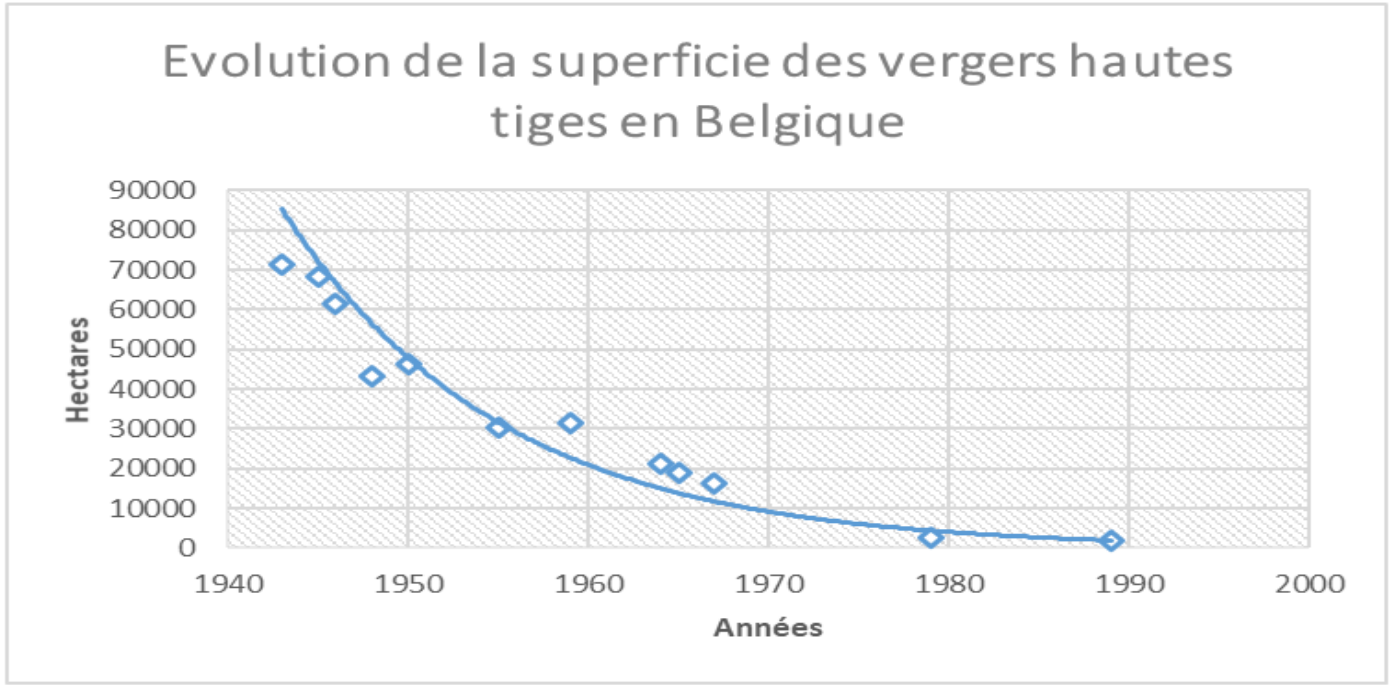
www.biotechlearn.org.nz

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

More than 95 % of the Belgian old orchard meadows have disapeared

Surface in 1943 : 71.319 ha (recensement agricole belge)
Surfaces in 2018 : +/- 1.000 ha (estimated - CRA-W)

Orthophoto plar



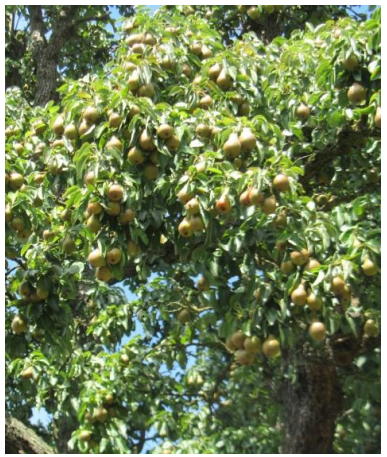
Diversifruits ©

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

High densities, dwarfing rootstocks, quasi monoculture, high input levels, low biodiversity level, high productivity

Standard trees, orchard meadows – Agroforestry
= association trees, animals, grass production.
Many varieties, low inputs
High biodiversity,
Rich Agroecosystem,
Lower fruit production

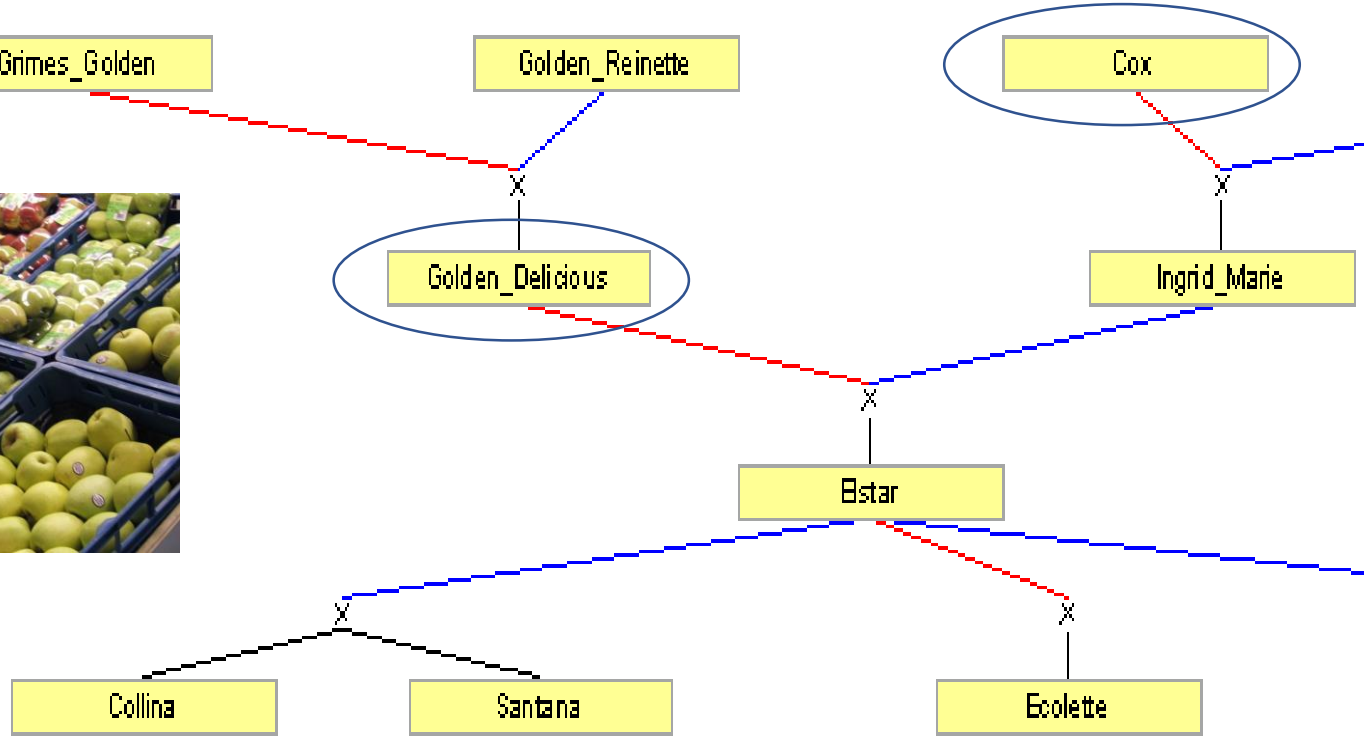
Local adaptability, local and diversity of uses, rusticity, generally pests & diseases tolerances, phenotypic diversity…



3. General context – Current contrast …

Commercial apple growing reachs its limits

Commercial cvs have a very narrow genetic base : 5 commercial cultivars → more than 50% of the world apple production



3. General context – Current contrast …

Commercial apple growing reachs its limits

Commercial cvs have a very narrow genetic base : 5 commercial cultivars → more than 50% of the world apple production

J. Amer. Soc. Hort. Sci. 121(5):773–782. 1996.

Founding Clones, Inbreeding, Coancestry, and Status Number of Modern Apple Cultivars

Dominique A.M. Noiton
The Horticulture and Food Research Institute of New Zealand Ltd, Havelock North Research Center, Havelock North, New Zealand

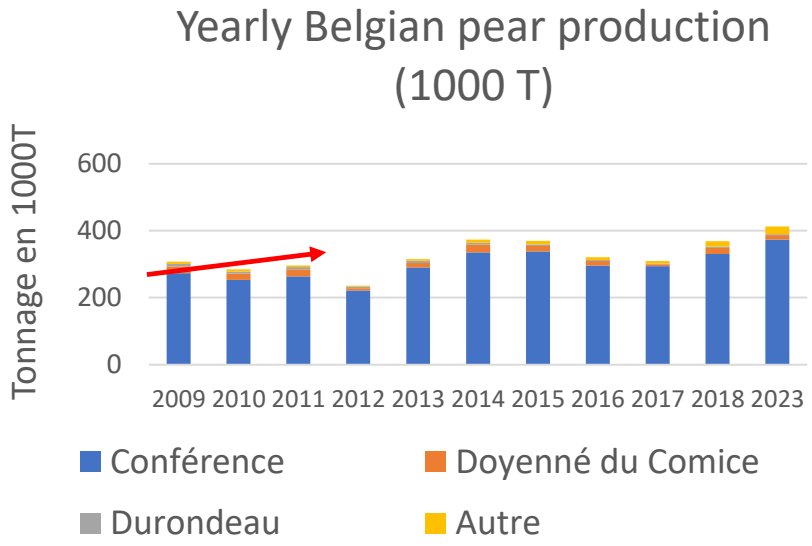
Peter A. Alspach
The Horticulture and Food Research Institute of New Zealand Ltd, Riwaka Research Center, Motueka, New Zealand

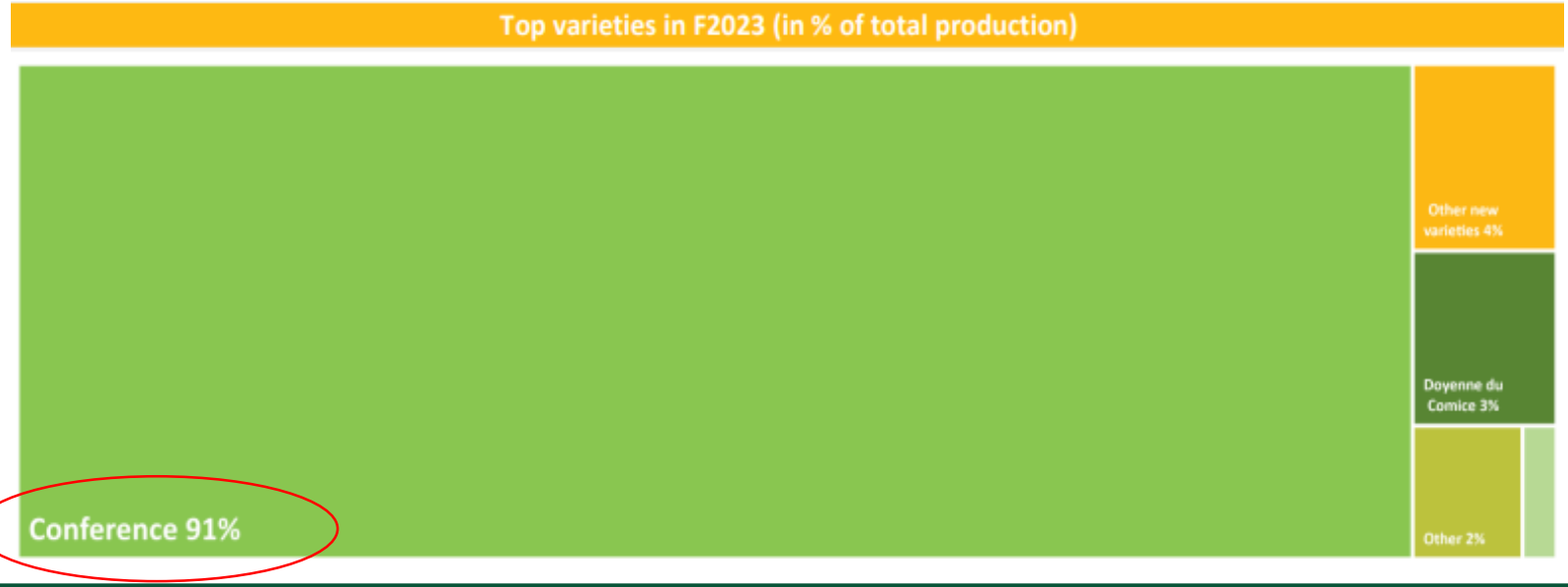
Additional index words. breeding, genetic diversity, *Malus ×domestica*

Abstract. **Pedigrees of apple (*Malus ×domestica* Borkh.) cultivars were used to study worldwide genetic diversity among clones used in modern apple breeding. The most frequent founding clones were 'Cox's Orange Pippin', 'Golden Delicious', 'Red Delicious', 'Jonathan', and 'McIntosh'. Coefficients of coancestry between 50 mainstream cultivars and these clones averaged 0.03, 0.12, 0.07, 0.06, and 0.02, respectively, but they were frequently as high as 0.25 with certain pairings. Among a group of 27 cultivars carrying the *Vf* gene for scab resistance, coefficients of coancestry with the five founding clones were of the same order. Although few of the cultivars sampled were substantially inbred, inbreeding could reach serious levels in their future offspring if current breeding practices are continued. The status effective number was 8 for the mainstream group and 7 for the *Vf*-carrier clones. This indicates clearly that apple breeders are operating with a population of greatly**

3. General context – Current contrast …

Belgian pear production – First pear producer in EU



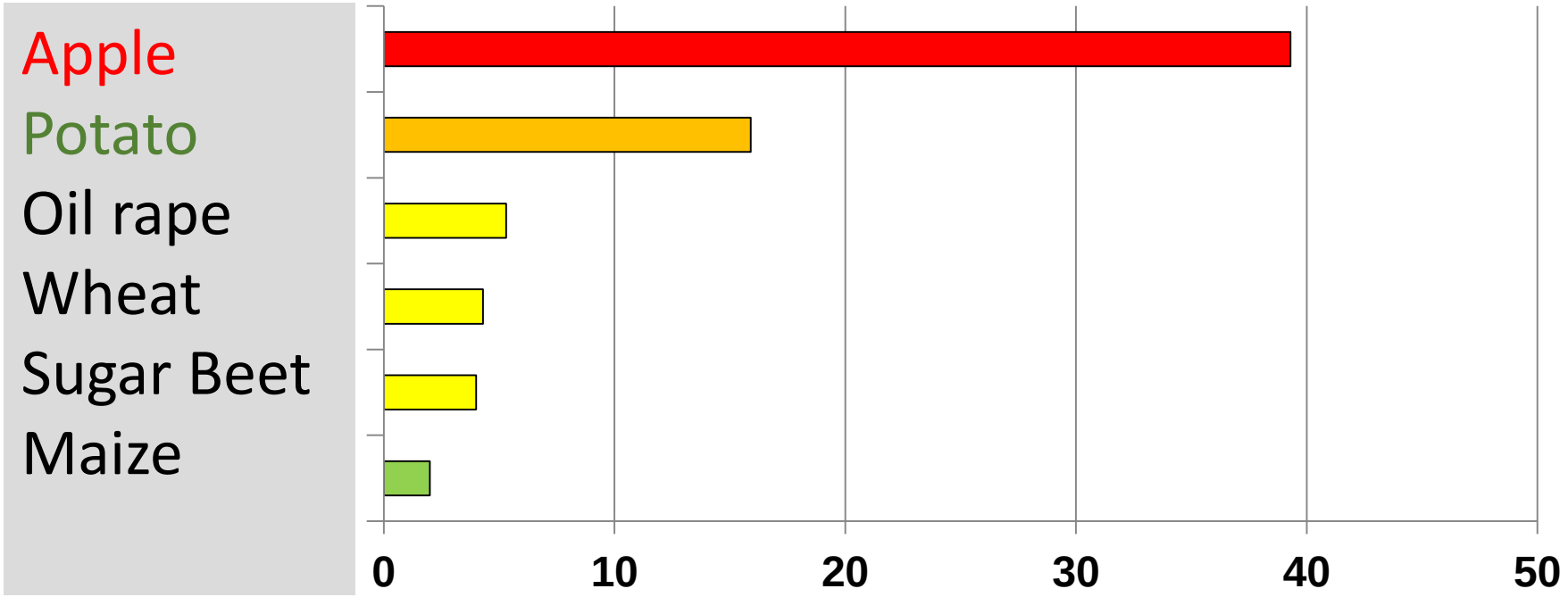


3. General context – Current contrast …

Commercial apple growing reachs its limits

Commercial Apple growing needs one of the highest pesticides input level!

Mean Treatment Frequency Index (Fungicides, Insecticides, Herbicides, Growth regulators) -Sauphanor *et al.* 2009.

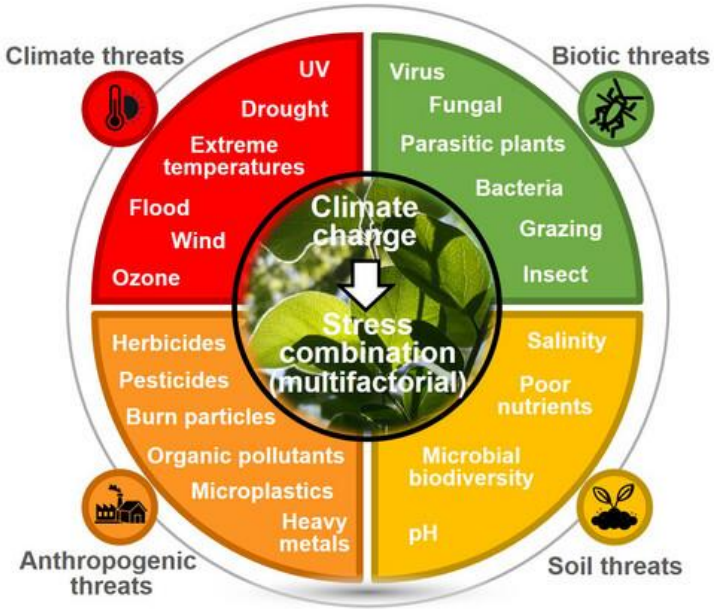


4. Global strategies & importance of Genetic Resources for the future

5 main topics	Diversity	Low input farming systems – Lower risks		Climatic Resilience	Quality	Socio-economical innovations
6 objectives	1. ↗↗ Use of GenRes – genetic diversity + Functionnal Biodiversity	2. ↗↗ Resistance &/or tolerance to pests & diseases	3. ↗↗ Nitrogen *(& fertilizers)* efficiency	4. ↗↗ Flexibility to abiotic stresses (drought,…)	5. ↗↗ Differential Quality – New healthy products	6. ↗↗ Participative approaches & shorter channel chains – Fair Trade

5. Future challenges : Towards better ‘robustness’…

Screening plant varieties/crops/trees for improved robustness:
better dynamic capacities of adaptation to biotic & abiotic stresses




Current Opinion in Plant Biology
Volume 16, Issue 1, February 2013, Pages 62-69
Molecular mechanisms of robustness in plants
Janne Lempe [1, 3], Jennifer Lachowiec [1, 2], Alessandra M Sullivan [1], Christine Queitsch [1]
Show more
https://doi.org/10.1016/j.pbi.2012.12.002
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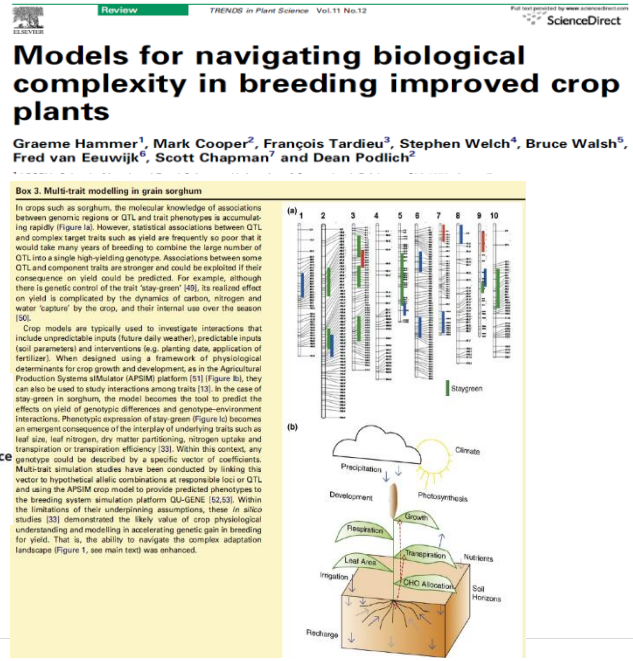
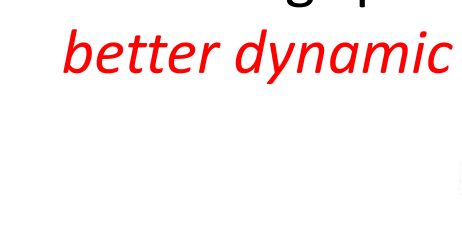
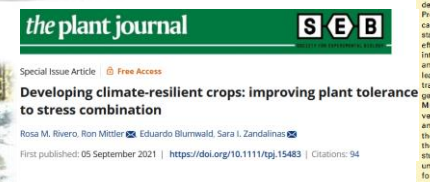

Review
TRENDS in Plant Science Vol.11 No.12
ScienceDirect
Models for navigating biological complexity in breeding improved crop plants
Graeme Hammer[1], Mark Cooper[2], François Tardieu[3], Stephen Welch[4], Bruce Walsh[5], Fred van Eeuwijk[6], Scott Chapman[7] and Dean Podlich[2]
Box 3. Multi-trait modelling in grain sorghum
In crops such as sorghum, the molecular knowledge of associations between genomic regions or QTL and trait phenotypes is accumulating rapidly (Figure Ia). However, statistical associations between QTL and complex target traits such as yield are frequently so poor that it would take many years of breeding to combine the large number of QTL into a single high-yielding genotype. Associations between some QTL and component traits are stronger and could be exploited if their consequence on yield could be predicted. For example, although there is genetic control of the trait ‘stay-green’ [49], its realized effect on yield is complicated by the dynamics of carbon, nitrogen and water ‘capture’ by the crop, and their internal use over the season [50].
Crop models are typically used to investigate interactions that include unpredictable inputs (future daily weather), predictable inputs (soil parameters) and interventions (e.g. planting date, application of fertilizer). When designed using a framework of physiological determinants for crop growth and development, as in the Agricultural Production Systems sIMulator (APSIM) platform [51] (Figure Ib), they can also be used to study interactions among traits [13]. In the case of stay-green in sorghum, the model becomes the tool to predict the effects on yield of genotypic differences and genotype–environment interactions. Phenotypic expression of stay-green (Figure Ic) becomes an emergent consequence of the interplay of underlying traits such as leaf size, leaf nitrogen, dry matter partitioning, nitrogen uptake and transpiration or transpiration efficiency [33]. Within this context, any genotype could be described by a specific vector of coefficients. Multi-trait simulation studies have been conducted by linking this vector to hypothetical allelic combinations at responsible loci or QTL and using the APSIM crop model to provide predicted phenotypes to the breeding system simulation platform QU-GENE [52,53]. Within the limitations of their underpinning assumptions, these *in silico* studies [33] demonstrated the likely value of crop physiological understanding and modelling in accelerating genetic gain in breeding for yield. That is, the ability to navigate the complex adaptation landscape (Figure 1, see main text) was enhanced.
Stay-green
Climate
Precipitation
Photosynthesis
Development
Growth
Respiration
Transpiration
Nutrients
Leaf Area
Irrigation
CHC Allocation
Soil Horizons
Recharge


Annals of Botany 117: 795-809, 2016
doi:10.1093/aob/mcv151, available online at www.aob.oxfordjournals.org
ANNALS OF BOTANY
REVIEW: PART OF A SPECIAL ISSUE ON DEVELOPMENTAL ROBUSTNESS AND SPECIES DIVERSITY
Molecular mechanisms governing differential robustness of development and environmental responses in plants
Jennifer Lachowiec[1], Christine Queitsch[2] and Daniel J. Kliebenstein[3,4,*]


the plant journal SEB
Special Issue Article | Free Access
Developing climate-resilient crops: improving plant tolerance to stress combination
Rosa M. Rivero, Ron Mittler, Eduardo Blumwald, Sara I. Zandalinas
First published: 05 September 2021 | https://doi.org/10.1111/tpj.15483 | Citations: 94

1. The global importance of the Genetic Resources

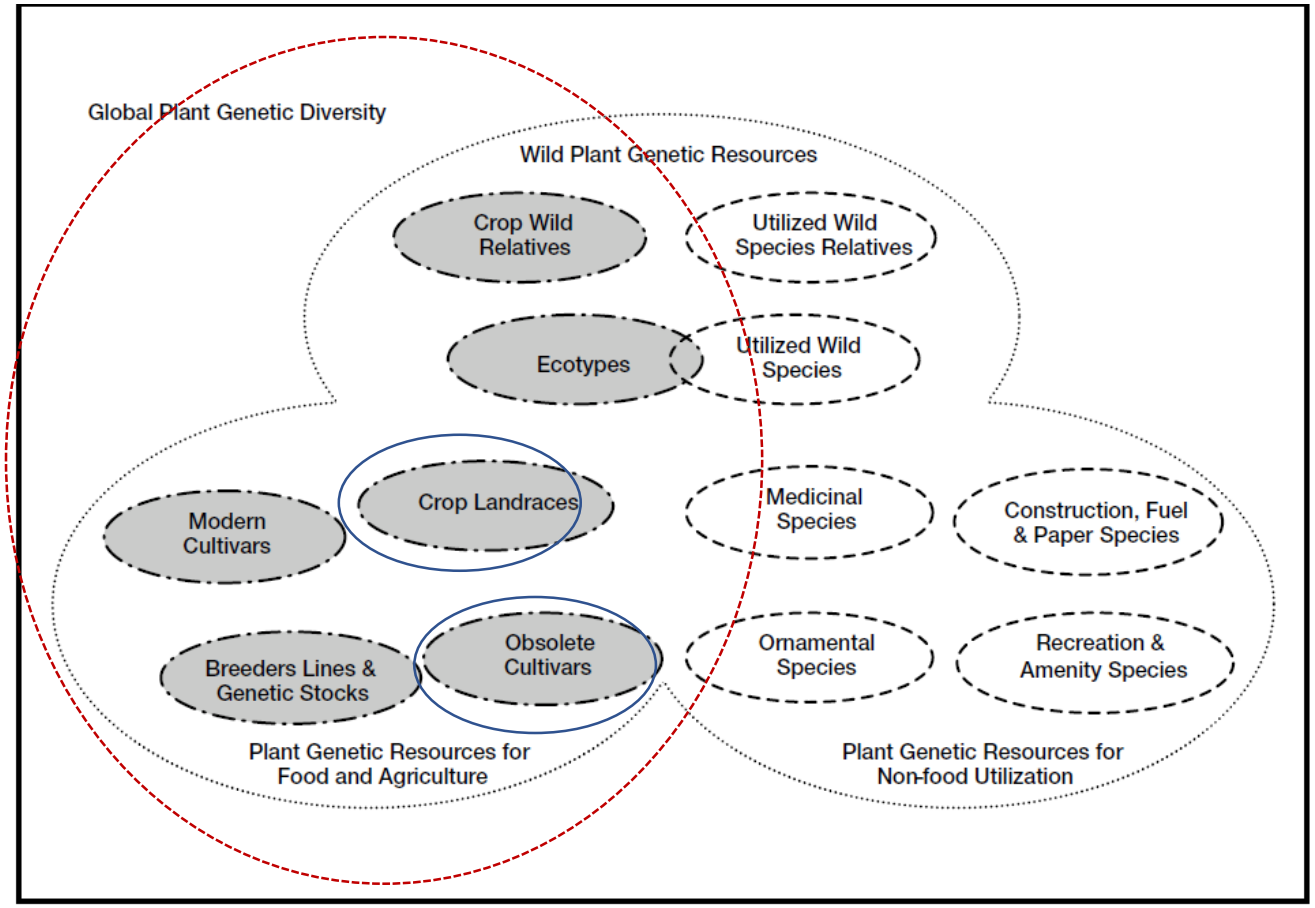


Figure 1.1. Global plant genetic diversity, plant genetic resources for food and agriculture are in shaded circles (modified from Maxted et al. 2008).

Large scope of PGR

1. The global importance of the Genetic Resources

- What does really mean « obsolete cultivars » and « Landrace »?

A current « modern » cvs will be considered as obsolete tomorrow…

Populer (1979) stated that '***old fruit cvs***' are ranked in two main groups:

1. *« Amateur-bred cvs » (before commercial breeding).*

2. *« Landraces » - « Variétés de pays »*

1. The global importance of the Genetic Resources

1. <u>Old named « amateur-bred cvs »</u> (from higher social classes people)

- Places, names of the breeder or 'foundler' + date are published
- Names are of high lexical style and often connected to:
  - ➢ the breeder itself ('*Président Van Dievoet*',…)
  - ➢ his family ('*Hélène Grégoire*', 'Sœur Grégoire',…)
  - ➢ an historical person or event ('*Souvenir de la Reine des Belges*',…)
  - ➢ the high quality of the fruit ('*Beurré Superfin*', '*Cuisse Madame*',…)
- Cvs are recorded in the litterature and very often described in pomological works – Reference descriptions + synonyms…
- Very often found in old commercial documents (catalogs,…) ⇒ cultivated on dwarfing rootstocks & 'espalliers'
- Were/are maintained in many old formal international collections

Luxury fruits

1. The global importance of the Genetic Resources

1. The global importance of the Genetic Resources

Proposal for a « old cvs » classification:

1. *« Ancient »* - Mentionned before 1760
2. *Very old* – mentionned between 1761 and 1850
3. *Old* – raised between 1851 and 1914
4. *Pre-modern* – raised between 1915 and 1945.
5. *Modern* – raised after 1945.

1. The global importance of the Genetic Resources

2. Local « landraces » (from peasantry)

- Breeder and raising dates and places are unknown
- Names are in a simple language often in a dialectical language

('Cwastresse Simple', 'Poire de Fer', 'Poire de Malade',…)

- Cultivars are very often not recorded in published work nor described – no description of reference.
- Very often not found in commercial documents (catalogs,…)
- Are cultivated in orchard meadows as standard trees.
- For 'pear', very often graft incompatibility with Quince.
- Often « robustness », coocking or special uses, large diversity of maturity and 'natural' keeping ability.

Subsistence fruits

⇒Problem of old amateur bred named cvs that received throughout their dispersion, sometimes new local names = synonyms

⇒Many so called « local landraces » are often old less known classical cvs…

1. The global importance of the Genetic Resources

"Landraces", usually have a **local name**, (generally) **lack formal crop improvement**, are commonly characterized by a **specific adaptation** to the environmental conditions of the cultivation area (e.g. **tolerant to the biotic and abiotic stresses** of that area) and are closely **associated with uses**, knowledge, habits, dialects and/or celebrations of the people who have developed and continue to grow it' *(adapted from* Negri *et al.,2009)*

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Van Peeren. Cap. xliiij.

Tgheſlacht.

VAn den Peeren ſijn oock veel gheſlachten/ghelijck van den Appelen. Die eene ſijn vroeghe/die andere ſpade/die derde winter Peerē/ſommighe ver gaen oock ende bederuen terſtont/die ander moghen dueren ende langhe tijt bewaert worden/eenighe ſijn ſuet oft ſapachtich / ſommighe vet ende ſmoutachtich/die derde hert ende drooghe ꝛc.alzoo dattet niet wel moghe-lijck en es alle die gheſlachten wel by ordene te ſtellene/ende daer om zoo vermanen wp den Leſer dat hy den ſmaeck van den Peeren meer wil aenmercken / dan dat fatſoen oft tijt van rijpen/want die ſmaeck bethoont ende bewijſt die natuere alderbeſt / ende leert die cracht van den Peeren kennen.

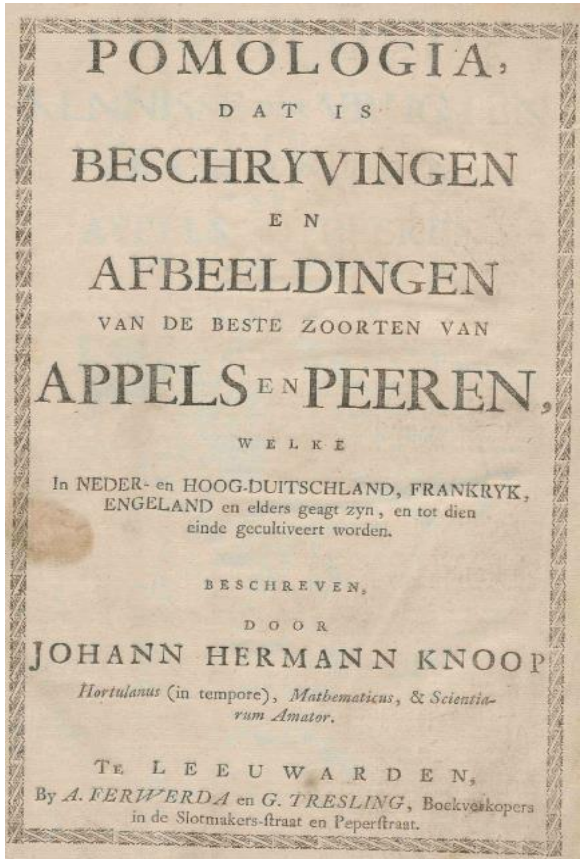
Tfatſoen.

Die Peerboomen worden groot ghelijck die Appelboomē oft grootter ende hooghер ende crijghen groote dicke ſtruycken/ende veel dicke tacken die meeſt recht om hooghe waſſen/ende niet zoo duer oft ouer malcanderen groeyen / ghelijck die tacken van den Appelboomen. Die bladeren ſijn rondachtich/van bouen eſſen ende ſchoon gruen / van onder dickwils wat witachtich. Die vrucht es meeſt langachtich / beneden breet / ende bouen aen den ſteel ſmal/van grootte/fatſoene/verwen/ende ſmaecke/ſeer veelderleye/ als voorſeyt es/in dmiddel van die vruchten ligghen die keernen/gelijck in die appelen.

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Diversity & historical cultural heritage

Hermann KNOOP (1758) (The Netherland) – One of first "Pomologist"



POMOLOGIA,

DAT IS

BESCHRYVINGEN

EN

AFBEELDINGEN

VAN DE BESTE ZOORTEN VAN

APPELS EN PEEREN,

WELKE

In NEDER- en HOOG-DUITSCHLAND, FRANKRYK, ENGELAND en elders geagt zyn, en tot dien einde gecultiveert worden.

BESCHREVEN,

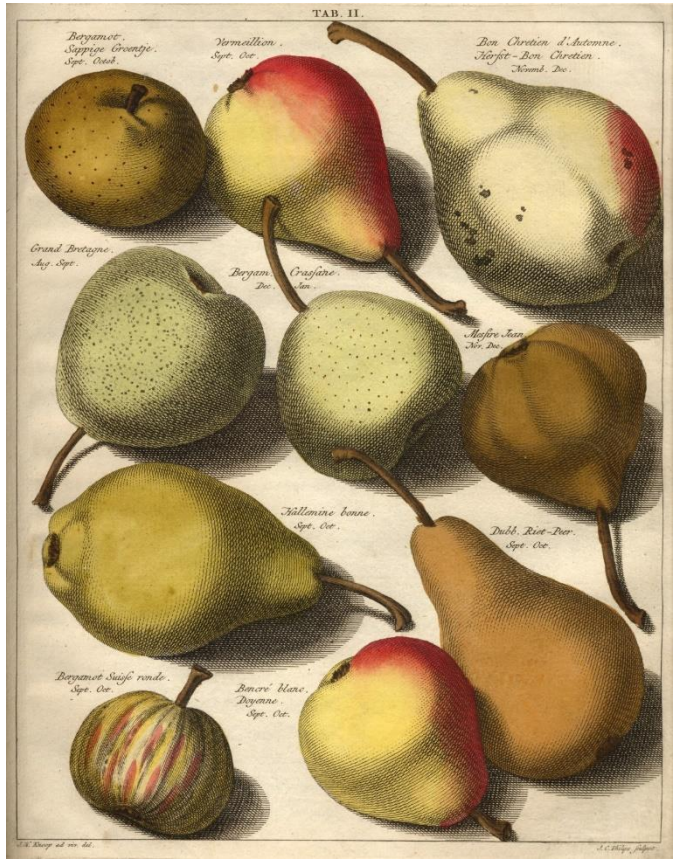
DOOR

JOHANN HERMANN KNOOP

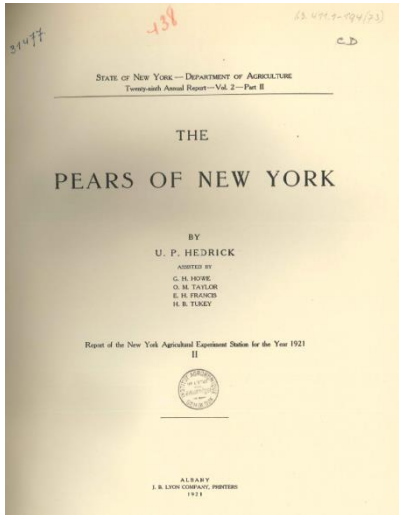
Hortulanus (in tempore), *Mathematicus*, & *Scientiarum Amator*.

TE LEEUWARDEN,

By *A. FERWERDA* en *G. TRESLING*, Boekverkopers in de Slotmakers-straat en Peperstraat.



2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example



STATE OF NEW YORK — DEPARTMENT OF AGRICULTURE
Twenty-sixth Annual Report—Vol. 2—Part II

THE

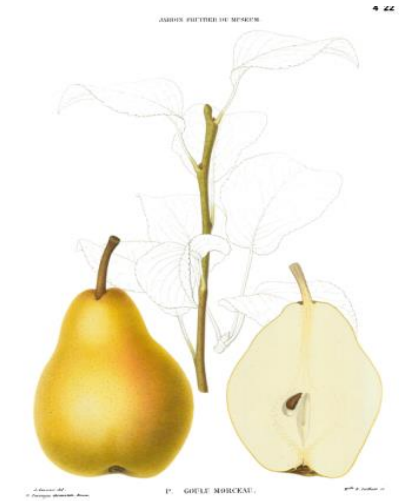
PEARS OF NEW YORK

BY
U. P. HEDRICK

ASSISTED BY
G. H. HOWE
O. M. TAYLOR
E. H. FRANCIS
H. B. TUKEY

Report of the New York Agricultural Experiment Station for the Year 1921
II

ALBANY
J. B. LYON COMPANY, PRINTERS
1921



Nicolas Hardenpont : the first pear breeder (Arbury, J., Pinhey, S., 1997)

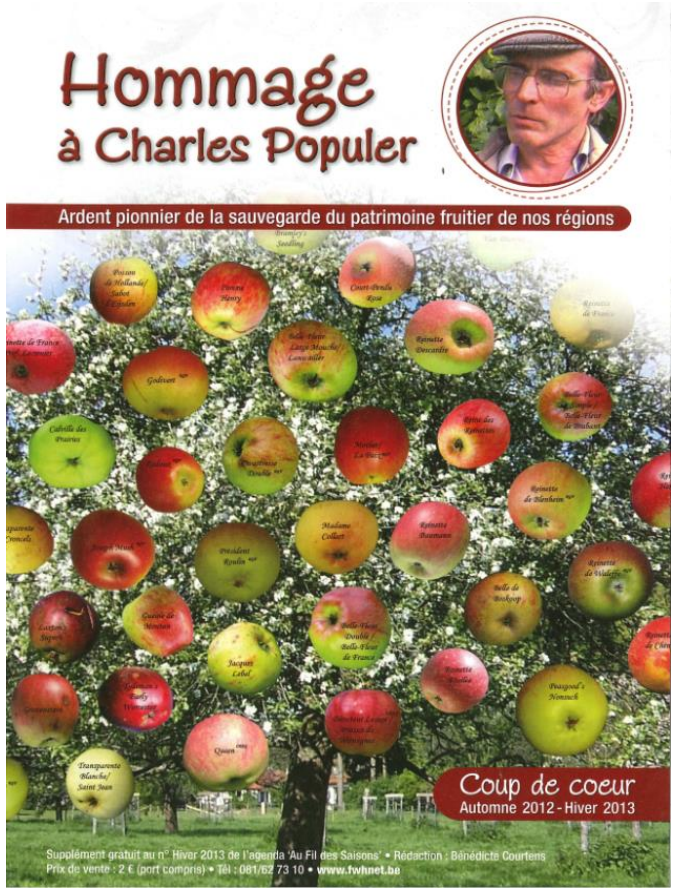
Pear-breeding began in Belgium about 1730, when Nicolas Hardenpont, 1705–1774, a priest in his native town of Mons, made a large sowing of pear seed with a view of obtaining new pears of superior quality. Time

began, but no one as yet had hybridized pears. Lastly, nearly all pears, before the Belgians began to improve them, were crisp or breaking in flesh, the *crevers* of the French, while the soft-fleshed, melting pears, the *beurrés* of the French, were as yet hardly known. Now, mostly owing to the work of the Belgians, the buttery pears predominate.

THE PEAR IN BELGIUM

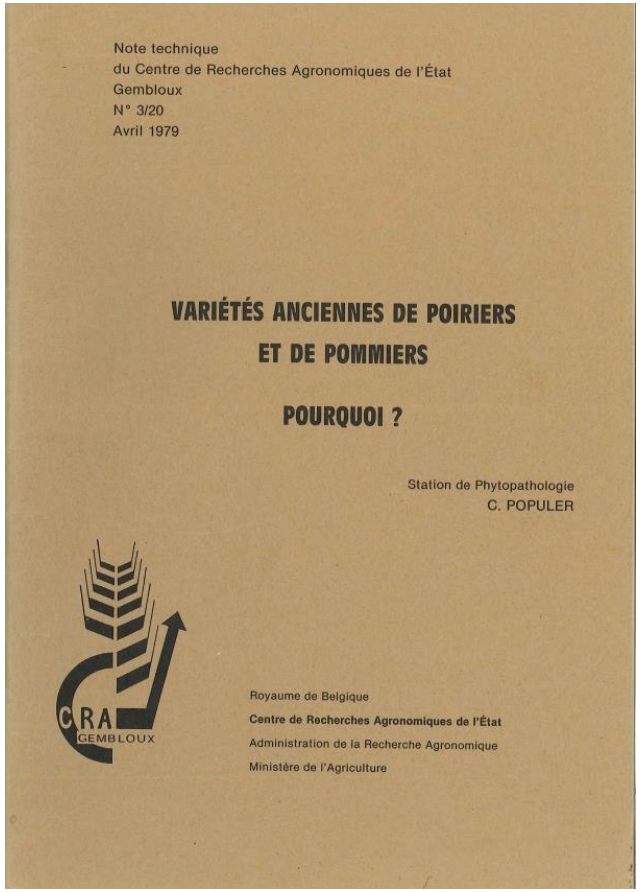
Providence ordained Belgium to produce the modern pear.

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example



Start of a programme for saveguarding Fruit tree Genetic Resources at CRA-W since **1975** :

- Prospections in collections and countryside private orchards.


Note technique
du Centre de Recherches Agronomiques de l'État
Gembloux
N° 3/20
Avril 1979

VARIÉTÉS ANCIENNES DE POIRIERS
ET DE POMMIERS

POURQUOI ?

Station de Phytopathologie
C. POPULER

CRA GEMBLOUX

Royaume de Belgique
Centre de Recherches Agronomiques de l'État
Administration de la Recherche Agronomique
Ministère de l'Agriculture

Evaluation of disease tolerance and agronomic traits in NON SPRAYED evaluation orchards (since 1979!)

1. The global importance of the Genetic Resources

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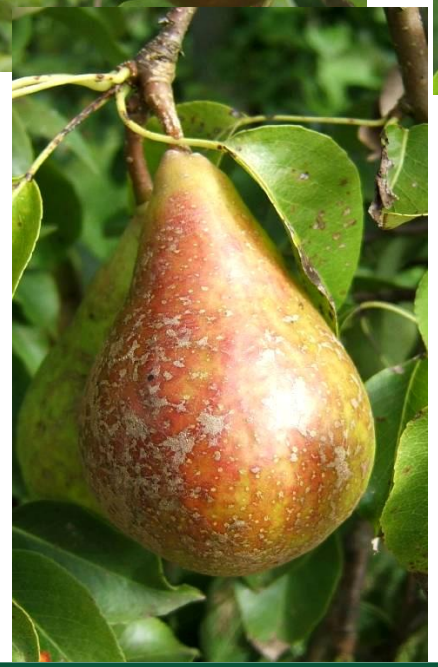
1. The global importance of the Genetic Resources

Poire de Pâques

Immortelle

1. The global importance of the Genetic Resources



1. The global importance of the Genetic Resources







1. The global importance of the Genetic Resources

Back to the roots…many interesting traits identified in the large diversity of old cultivars through priority work of long term scientific evaluation activities.

⇒ Higher rusticity, robustness and tolerance to abiotic stresses
⇒ Tolerance to pests and diseases (cvs released before PPP use – before 1875)
⇒ Long keeping ability without sophisticated cold systems
⇒ Large diversity of forms, colours, tastes, uses, healthy nutriments…

2. Saveguarding & Evaluation of Fruit Tree Genetic Resources

Collecting historical & ethnobotanical information:

- Uses
- Dialect names
- Tree & fruit traits,…

COLLECTING

Ethno-botany
Passeport data

Data Bases

Time
(Years)

0

1

Collecting what? Definition of priorities – Case by case, taking into account objectives, budget, facilities,…:

- Belgian historical origin;
- Grown formerly in Belgium or in surrounded countries with same pedo-climatic conditions;
- Very old cvs – raised before 1850 – before fungicide use;
- Local, regional landraces with oral tradition of uses
- Conservation of the largest diversity >< « work collections »
- Expressing robustness, tolerance to biotic/abiotic stresses
- Specific outstanding traits (aroma, taste, very long natural keeping ability, no alternance,….)

2. Saveguarding & Evaluation of Fruit Tree Genetic Resources

Collecting historical & ethnobotanical information:

- Uses
- Dialect names
- Tree & fruit traits,…

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Ethno-botany
Passeport data

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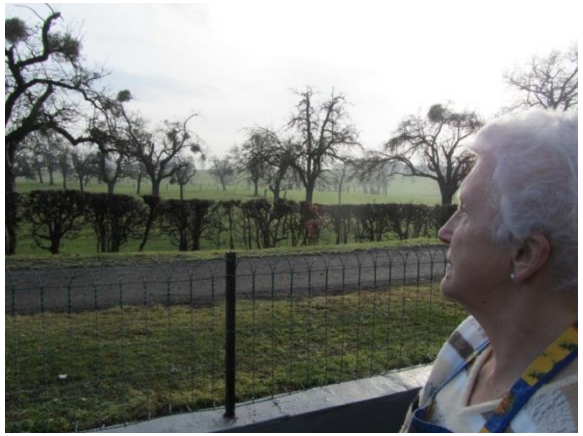
Time
(Years)
0
1



2. Saveguarding & Evaluation of Fruit Tree Genetic Resources

COLLECTING

Ethno-botany
Passeport data

Data Bases

Time
(Years)

0

1

2. Saveguarding & Evaluation of Fruit Tree Genetic Resources

Centre Wallon de Recherches Agronomiques
Département Sciences du Vivant –
Unité Amélioration & Biodiversité

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a.rondia@cra.wallonie.be

http://certifruit.be/ &
http://www.biodimestica.eu

Wallonie recherche CRA-W

ANNEE 2020 - 2021

FICHE INTRODUCTION	N°
NOM PROVISOIRE : «ABBESSE DE MOULAND HEILRIMONT »	
ORIGINE DU NOM: Pomologique existant / Tradition orale / Nom donné par donneur / par collecteur	
DATE INTRODUCTION : 23/08/2020	N° FRUIT FICHE D'IDENTIFICATION :

INFORMATEUR / PROSPECTEUR :	Genre: Homme / Femme
Pays: Belgique	Nom: JACQUY & BEATRICE COLLIN
Région: Prov Liège Vallée Amblève	Prénom:
Code postal &Ville: 4987 LA GLEIZE	Année naissance:
20, HEILRIMONT	Tél fixe:
EMail :	Gsm:
Autre (passion, site web,...) :	

COORDONNEES ET INFORMATIONS SUR LE LIEU DE PRELEVEMENT :	
Echelle: 1 à 5 =>: 1=Faible, 5=Fort Orientation: N, NE, E, SE, S, SO, O, NO	
Pays:	Sol Fertilité (1 à 5):
Région:	Sol lourd (1 à 5): limon Pédofaune, quantité de vers de terre (1 à 5):
	Erosion visible (1 à 5):
Isolé: Oui / Non	Situation
Lieu: Bord champ / Bord route / Champ / Forêt	Talus
Jardin / Parc / Prairie / Station recherche	Sommet, Fond de Vallée, Pente
Verger	Si pente, pourcentage de pente:
Si verger, orientation axe principal du verger:	Si pente, orientation pente:
	Si vallée, orientation axe vallée:
	Exposition aux vents dominants (1 à 5):

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Lieu: Bord champ / Bord route / Champ / Forêt	Talus
Jardin / Parc / Prairie / Station recherche	Sommet, Fond de Vallée, Pente
Verger	Si pente, pourcentage de pente:
Si verger, orientation axe principal du verger:	Si pente, orientation pente:
	Si vallée, orientation axe vallée:
	Exposition aux vents dominants (1 à 5):

ESPECE : Pomme - Poire - Prune - **Cerise** - Pêche - Autre :	
Hauteur de tige : 2 m	HT plus de 85 ans– MT – BT & Age de l'arbre tige
Diamètre du tronc (cm) : 65-75 cm	Variété ancienne
Résistance moniliose : 3	Très Bonne – Moyenne – Faible
Résistance craking : 3	Très Bonne – Moyenne – Faible
Production : Très bonne	Très Bonne – Moyenne – Faible
Alternance :	Oui / Non

FICHE INTRODUCTION N°	
NOM PROVISOIRE 'ABBESSE DE MOULAND HEILRIMONT'	NOM POMOLOGIQUE :
DATE INTRODUCTION :23/08/2020	N° FRUIT FICHE D'IDENTIFICATION : PHOTO :

FRUIT PERIODE:
Période cueillette: Juillet / Août 1ère quinzaine / Août 2ème quinzaine –
Sept. 1ère quinzaine / Sept 2ème quinzaine / Fin Sept Début Oct.
Oct.1ère quinzaine / Oct. 2ème quinzaine – Nov.

Période maximale de conservation: Août / Sept. / Oct. / Nov / Déc / Jan / Fév / Mars / Avril et pl

DESCRIPTION DU FRUIT :	Hauteur du fruit (mm): assez petit
Couleur : Rouge très foncé, très long pédoncule	Largeur du fruit (mm):
Stries:	Longueur pédoncule (mm) :
Pourcentage de rugosité %: 0	Fruit côtelé (1=pas de côtes à 9=très côtelé):
Densité lenticelles: Faible – Moyenne - Forte	Ouverture Mouche (1=Fermé à 3=Ouvert): 1

CARACTERISATION GUSTATIVE DU FRUIT (échelle de 1 à 9):	Cote Globale : 8
Fermeté : 8	Acidité :6
Jutosité : 6	Epiderme :
Arôme : 7	Amertume :
Sucre : 8	Astringence :

USAGE DU FRUIT: Table ++ / Table / Cuisson / Jus / Cidre / Sirop

SCHEMA, REMARQUES, HISTOIRE, USAGES,...

Très ancien arbre, cerise très sucrée, tient très longtemps s/arbre – se consomme durant 10 à 15 Jours début à mi-juillet. Excellent de table et à cuire. Jus très foncé.

COLLECTING

Ethno-botany
Passeport data

Data Bases

Time
(Years)
0
1

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

COLLECTING

Ethno-botany
Passeport data

Data Bases

Time
(Years)

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Centre Wallon de Recherches Agronomiques
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Wallonie recherche CRA-W

ANNEE 2020 - 2021

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Isolé: Oui / Non	Erosion visible (1 à 5):
Lieu: Bord champ / Bord route / Champ / Forêt / Jardin / Parc / Prairie / Station recherche / Verger	Situation Talus Sommet, Fond de Vallée, Pente Si pente, pourcentage de pente:
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USAGE DU FRUIT: Table ++ / Table / Cuisson / Jus / Cidre / Sirop

SCHEMA, REMARQUES, HISTOIRE, USAGES,...

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2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

COLLECTING

Ethno-botany
Passeport data

Data Bases

Time
(Years)
0
1

Label	National Inventory code	Institute code	Institute acronym	Accession number	Initial accession name	Accession name type	Pomologic name	Consensus Name
PASSPORT DATA	HOLDING INSTITUTE INFORMATION (Hld)			ACCESSION INFORMATION (Acs)				
DB FIELD NAME	NICODE (0)	INSTCODE (1)	INSTACRONYM	ACCENUMB (2)	ACCENAME (11)	ACCENAMETYPE (M2)	POMNAME	EUONYM (P13)
Proposed New Field Name	HldInstCty	HldInstCode	HldInstAcro	AcsNum	AcsName	AcsNameType	AcsNamePomo	AcsNameEU
Characteristics	Open 'FAO-WIEWS-Institute-Codes-2009.xls' file	Open 'FAO-WIEWS-Institute-Codes-2009.xls' file	Open 'FAO-WIEWS-Institute-Codes-2009.xls' file	specific number of the holder	All letters in capitals, without any accent	1. Existing historical name 2. Oral tradition 3. Donor name 4. Collector name	First letter upper-case and all accents	To link better the synonyms and duplicates, the euonym is a "Consensus" name for a group of synonyms which should be convenient for cross-referencing.
Example	Ex: BEL	Ex: BEL019	Ex: CRA-W	Ex: CRA-Py-866	Ex: BEURRE D'HARDENPONT	Ex: 1	Ex: Beurré d'Hardenpont	BEURRE D'HARDENPONT

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

COLLECTING

Ethno-botany
Passeport data

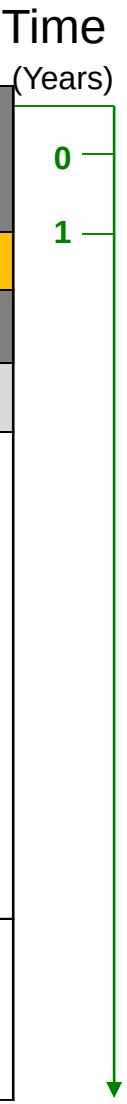
Data Bases

Time
(Years)
0
1

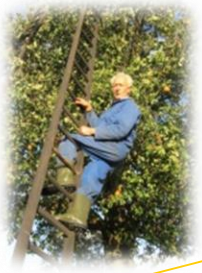
Synonyms	Validation of material	Identification of material	Ploidy	Ancestral data	Ancestral data of the father	Ancestral data of the mother	Status of sample (Biological status)	Health status	Historical Country of Origin	Collecting/acquisition source	Type of germplasm storage
										COLLECTING INFORMATION (Col)	
SYNONYMS (P10)	ACCENAMECHECK (M3)	IDENTIF (P6)	PLOIDY (M8)	ANCEST (21)	ANCESTFATH (M9)	ANCESTMOTH (M10)	SAMPSTAT (20)	HEALTHSTATUS (P7)	ORIGCTYHIST (M5)	COLLSRC (22)	STORAGE (27)
AcsSyno	AcsNameCheck	AcsNameCheckWay	AcsPloidy	AcsParent	AcsParentFather	AcsParentMother	AcsBioStatus	AcsHealthStatus	AcsCtyOrigHist	ColSrc	ColStorage
List of the most used synonyms with their respective book references in brackets	0. False 1. Valid 2. To be checked 3. Unknown 4. Looks like	1. verified, comparing data from phenotypic observations and from pomology reference books 2. verified, using molecular markers 3. verified, using molecular markers and comparing data from phenotypic observations and from pomology reference books 4. verified, using other identification methods (Elaborate in REMARKS field) 9. not verified	0. Undefined 1. Haploid (1n) 2. Diploid (2n) 3. Triploid (3n) 4. Tertaploid (4n) 6. Hexaploid (6n) 9. Aneuploid (?n)	Mother x father, open pollinated or pedigree information or some ancestors, …	Information about FATHER grandparents	Information about MOTHER grandparents	100) Wild 110) Natural 120) Semi-natural/wild 200) Weedy 300) Traditional cultivar/landrace 400) Breeding/research material 410) Breeder's line 411) Synthetic population 412) Hybrid 413) Founder stock/base population 414) Inbred line (parent of hybrid cultivar) 415) Segregating population 420) Mutant/genetic stock 500) Advanced/improved cultivar 999) Other (Elaborate in REMARKS field)	1. free (<2 years) 2. free (>2 years) 3. free (<2 years) visual 4. free (>2 years) visual 8. not free 9. health status not yet controlled	Historical country of origin (some varieties can have multiple origin => Multiple Values allowed, separated by a semicolon (Eg: BEL;NLD)	**10**=Wild habitat **20**=Farm or cultivated habitat **30**=Market or shop **40**=Institute, Experimental station, Genebank **50**=Seed company **60**=Weedy, disturbed or ruderal habitat **99**=Other (Elaborate in Remarks field)	**10=seed collection** **20**=Field collection **30**=in vitro collection (Slow growth) **40**=Cryopreserved collection **50**=DNA Collection **55**=Greehouse collection **99**=Other (elaborate in REMARKS field). Multiple values allowed, seprated by a semicolon (Eg 20;30)
Beurré d'Aremberg (MTI-etal1);Beurré d'Hardenpont d'Hiver (LER1); Butirra d'Hardenpont d'Inverno (PTZ1); Glou Morceau (HED1); Goulu Morceau (MTI-etal1);Hardenpont d'Hiver (ELL1);Hardenpont Vajkörte (PTZ1);Hardenpontova Maslovka (PTZ1); Hardenponts Butterbirne (PTZ1);Hardenponts Winterbutterbirne (PTZ1);Mantecosa de Hardenpont (MTI-etal1);Untoasa Hardenpont (PTZ1)	Ex: 1	Ex: 1	Ex: 2				Ex: 300	Ex: 9	Ex: BEL	Ex: 40	Ex: 20

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Rootstock	Fruit use	Plant use	Tree Form	Plant use
SPECIFIC ORDCHARD FRUIT TREE				
ROOTSTOCK (P5)	FRUITUSE (P9)	PLANTUSE (P10)	TREEFORM (M6)	TREEUSERS (M7)
OrdRootStock	OrdFruitUse	OrdPlantUse	OrdTreeForm	OrdTreeUsers
On which rootstock is the accession maintained? Multiple rootstocks are not allowed.	1. Table /Dessert 2. Cooking (home made + industry) 3. Food processing juice 4. Food processing cider 9. Other, elaborate in remarks fields	**1**=clonal rootstock **2**=clonal interstock **3**=seedling rootstock **4**=ornamental/pollinator **5**=dual or multiple purpose use **6**=botanical(wild) species **7**=other **8**=timber **9**=no use	1. HT, Standard 2. HT/BT, Standard/Dwarf 3. BT, Dwarf 4. BT Espalier, Dwarf Espalier 9. Other, elaborate in remark field	1. Amateur 2. Public – Traditional / Education 3. Private - Commercial / Processing 9. Other, elaborate in remark field
Ex: Quince A	Ex: 1	Ex: 5	Ex: 3	Ex: 1



2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example



COLLECTING

PROPAGATION

CONSERVATION

Regeneration

EVALUATION

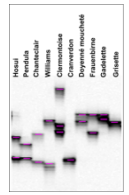
NETWORK of duplication REPOSITORY ORCHARDS
On farm conservation

Ex situ REPOSITORY ORCHARDS

Non-sprayed EVALUATION ORCHARS

FIRST & SECOND SCREENING's

Ethno-botany
Passeport data



EVALUATION & CHARACTERIZATION

Data Bases

Traceability
HACCP

Time
(Years)

0

1

3

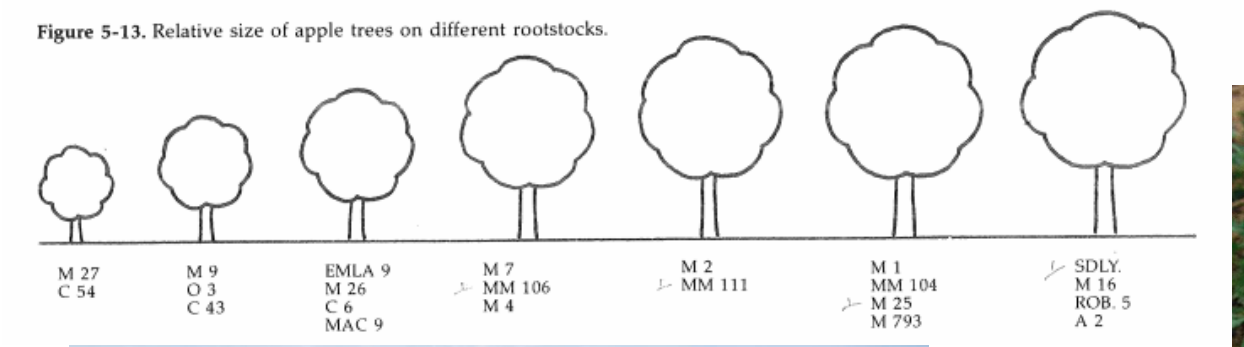
9

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example





2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example



2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

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2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Common protocols and tools for characterisation and evaluation of *Malus/ Pyrus* genetic resources – an ECPGR project.

Marc Lateur, Matthew Ordidge, Monika Höffer & Charles-Eric Durel

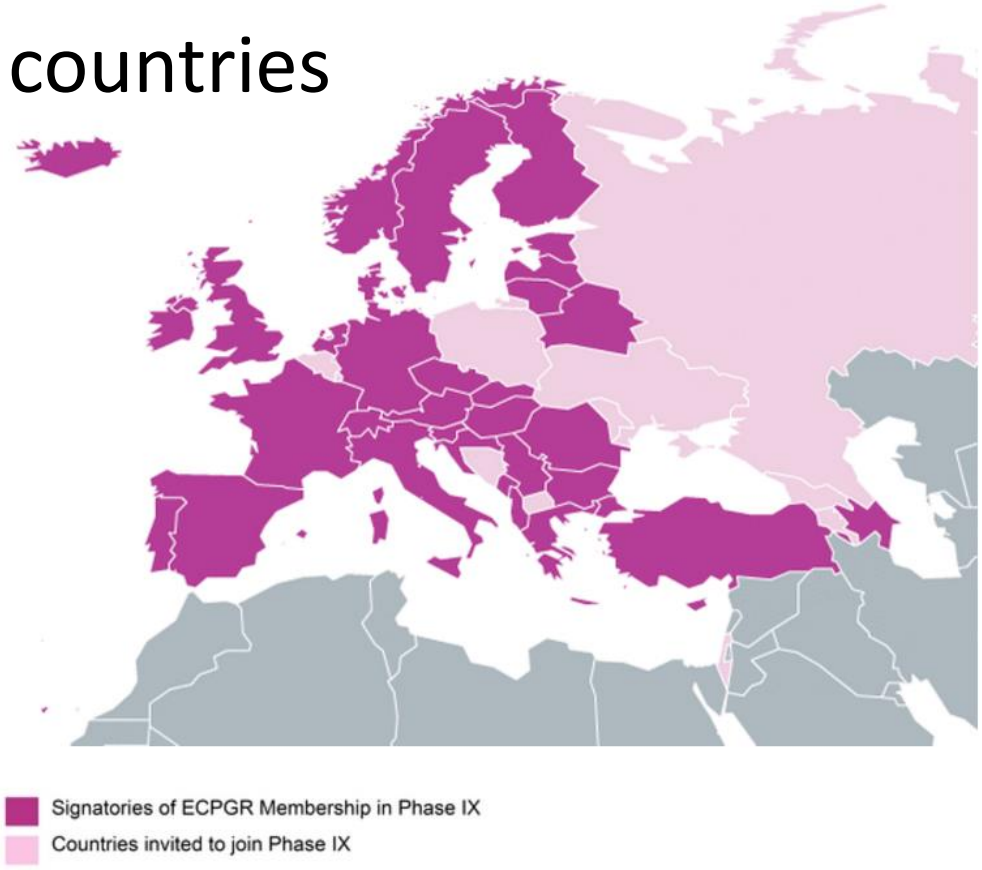
What is ECPGR ?

ECPGR is a collaborative Programme among most European countries, aiming at ensuring the long-term conservation and facilitating the utilization of plant genetic resources in Europe.

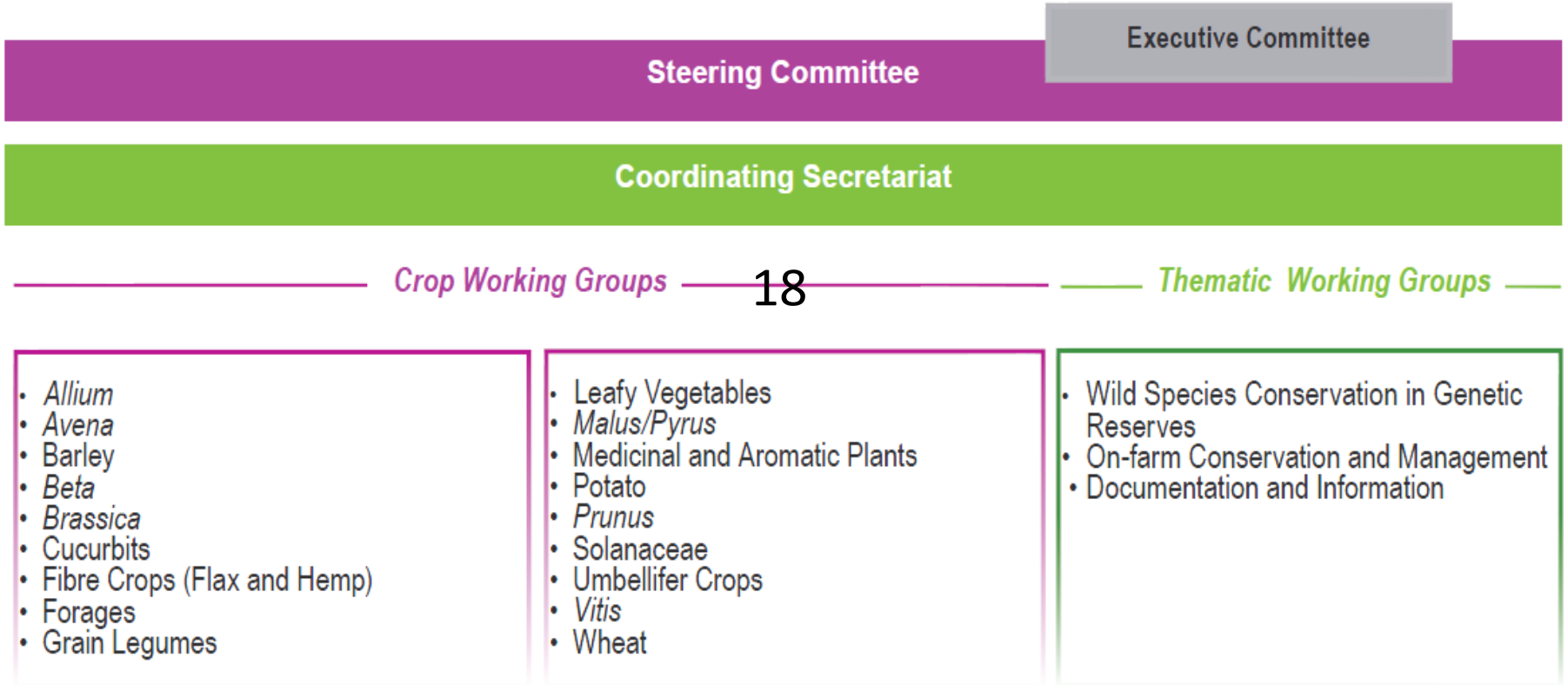
www.ecpgr.cgiar.org/

Phase IX (2014-2018)

- Annual budget ca. € 520k from 38 countries
- Letters of Agreement signed by 33 countries



Structure


Executive Committee
Steering Committee
Coordinating Secretariat
Crop Working Groups
18
Thematic Working Groups
• Allium
• Avena
• Barley
• Beta
• Brassica
• Cucurbits
• Fibre Crops (Flax and Hemp)
• Forages
• Grain Legumes
• Leafy Vegetables
• Malus/Pyrus
• Medicinal and Aromatic Plants
• Potato
• Prunus
• Solanaceae
• Umbellifer Crops
• Vitis
• Wheat
• Wild Species Conservation in Genetic Reserves
• On-farm Conservation and Management
• Documentation and Information

Objective 1 : To finalize and edit in electronic format "ECPGR methods and descriptor lists for the Characterization and Evaluation of apple & pear genetic resources" documents.

Context:

- Many descriptors for different users and goals
- Need to define common protocols and methods
- Need to enlarge the list of reference cultivars adapted to main European climates
- Need to create specific EVALUATION descriptors & priorities

ECPGR common protocols and tools for characterization and evaluation of Malus/ Pyrus genetic resources

ECPGR Characterization and Evaluation Descriptors for Apple Genetic Resources

Apple (*Malus x domestica*)

M. Lateur, E. Dapena, D. Szalatnay, M. E. Gantar, A. Guvader, I. Hialmarsson, M. Höfer, L. Ikase, M. Kellerhals, G. Lacis, M. Militaru, C. Miranda Jiménez, G. Osterc, J-B. Rey, A. Rondia, K. Volens, M.K. Zelikovič, M. Ordidge

ECPGR Characterization and Evaluation Descriptors for Pear Genetic Resources

PEAR

(Pyrus communis)

M. Lateur, D. Szalatnay, M. Höfer, M. Bergamaschi, A. Guvader, I. Hialmarsson, M. Militaru, C. Miranda Jiménez, G. Osterc, A. Rondia, T. Sotiropoulos, M.K. Zelikovič, M. Ordidge

ECPGR common protocols and tools for characterization and evaluation of Malus/ Pyrus genetic resources

Necessity to define common « reference cultivars »

Since many scores are relative, it is important to have representatives from a minimum set of common reference cultivars (ideally, a minimum of 2/3) in each characterization/evaluation site. Recommended cultivars for general comparison are listed below and are based on a survey of the members of the ECPGR *Malus/Pyrus* Working Group:

- Alkmene
- Åkerö
- Ananas Reinette (syn. Reinette Ananas)
- Discovery
- Golden Delicious
- Ingrid Marie
- James Grieve
- Jonathan
- King of the Pippin (syn. Reine des Reinettes, Winter Goldparmäne)
- Reinette de Champagne
- Winter Banana
- White Transparent (syn. Transparente Blanche)

Phenology stages

Table 1bis. Phenology stages - Table of comparison and conversion between Fleckinger method, CRA-W method and the reference BCCH method for assessing phenological flower stages for apple.

Characters observed	Symbol			Flowering stages	Field observations
	Fleckinger	CRA-W	BBCH Code		
Buds opening	D	V	53	Green bud - tight cluster	Flowers are individualized, but still completely enclosed in their calyx
	D3		54	Mouse-ear stage	Green leaf tips 10 mm above bud scales ; first leaves separating
			55	Flower buds visible but still closed	
	E	VB	56 & 57	Green-pink bud stage	Flower corolla just visible between the petals
	E2	B	59	Balloon stage - pink bud	Corolla swollen, free from the sepals
	F1	BF1	61		Few first flowers are half opened (≤ 5%)
Flowers opening	F2	F1	62	Start of flowering	Some flowers are opened (± 10%)
	F3	*F12*			(X)
	F3	F2	64	Middle flowering	About 50% of the flowers are opened
	F4	F3	65	Full flowering	All or > 90 % of all flowers are opened and almost all the anthers are still filled with pollen
Anthers dehiscence				Start of withered anthers	(X)
		F4			All flowers are opened but the proportion of withered anthers is ≤ 25%
		F45		End of functional anthers	(X)
		F5			All or nearly all the flowers are opened but almost all the anthers are withered (80 to 100%)
Petals fall	G	C1	66	Start of petals' fall	Some flowers have lost petals (≤ 10%)
		C12			(X)
		C2	67		About 50% of the petals have fallen
	H	C3	69	End of petals' fall	90 to 100% of the petals have fallen

Relative 'Flowering period'

1.1 Flowering phenology (*Priority 1*)

When flowering intensity is very low (fewer than 5% of the buds are flower buds), it is not representative to evaluate the flowering season. It is useful to note and/or assess the flowering intensity of the trees by using the assessment key defined in **Table 1**. The relative flowering season of a cultivar (**Table 2**) can then be assessed by comparison against the flowering period of reference cultivars. It is recommended that for standardization, Golden Delicious is considered as a central point for all areas. For this comparison; the reference flower stage can be either 'F' (BCCH: 61), or 'F2' (BCCH: 65).

Table 2. Relative flowering season (adapted from Lateur and Populer, 1996) - * *Added ref. cvs from OCVV/CPVO*

State	Flowering period	Indicative difference in average days	Example of reference cultivars
1	Extremely early		Anna*, Ein Shemer*
2	Very early	-9	White Transparent, Gravensteiner, Stark Earliest, Sobera, Princesa
3	Early	-6	Boskoop, Idared, Alkmene, Rosy Glow, James Grieve, Discovery
4	Early/medium	-3	Granny Smith, Tydeman's Early Worcester, Jonathan, Cox's Orange Pippin
5	Medium	0	Jacques Lebel, Elstar, Golden Delicious, Glockenapfel, Jonagold, King of the Pippin, Ingrid Marie
6	Medium/late	+3	Reinette Etoilée (syn. Rote Sternreinette), Belle-Fleur de France, Gala, Golden Orange
7	Late	+6	Court-Pendu Rouge (syn.Court-Pendu Plat, Königlicher Kurzstiel), Belle-Fleur de Brabant, Rome Beauty
8	Very late	+9	Reinette de France, Spätblühender Taffetapfel, Feuillemorte*
9	Extremely late		

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Relative ‘Fruit time ripening’

1.1 Time of fruit ripening for harvest (harvest maturity) (*Priority 1*)

It is recommended that the optimal date of picking be recorded during at least four to six representative seasons. It should be possible to estimate the average optimal harvest date and classify accessions as per **Table 7**.

It is noted that the range below may not be wide enough to represent the full range of ripening times across Europe and this descriptor should be optimized further accordingly in the future.

Table 7. Relative harvest maturity - * Added ref. cvs from OCVV/CPVO

State	Harvest maturity	Examples of reference cultivars	Approximate and indicative periods of picking for north-western Europe (Lateur)	Approximate difference to south-western Europe (days, based on cv. Golden Delicious)
1	Extremely early	Earlier than White Transparent	July–August	More than -55
2	Very early	White Transparent	Early August	-55 to -40
3	Early	Jerseymac, Discovery, Tydeman’s Early Worcester, Melba, Surise*	End August	-39 to -26
4	X	James Grieve, Gravenstein, Alkmene, Transparente de Croncels, Auksis	Early September	-25 to -11
5	Medium	Gala, Elstar, Cox’s Orange Pippin	Mid-September	± 10
6	X	Golden Delicious, Jonagold	End Sept–Early October	+11 to +25
7	Late	Idared, Melrose	Early October	+26 to +39
8	Very late	Fuji, Glockenapfel, Granny Smith, Cripps Pink*	Mid-October	+40 to +55
9	Extremely late	Later than Fuji, Glockenapfel, Granny Smith, Cripps Pink*	End October–November	> +55

‘X’: Intermediate rating.

ECPGR common protocols and tools for characterization and evaluation of Malus/ Pyrus genetic resources

1.5 Fruit shape (*Priority 1/2*) - * *Added ref. cvs from OCVV/CPVO*

We recommend, as a first characterization step, estimating to which of the main groups in **Figure 3** an accession belongs. The ratios between the fruit's height and width, and between the width of the eye basin and stalk cavity can then be estimated, or preferentially measured (further details in **Annexes 1 & 2**) and accessions can be scored using the scale given in **Table 11**.

1 = globose
1 = kugelförmig
1 = sphérique
(Golden Noble, Resi)*

4 = flat
4 = abgeplattet
4 = aplatie
(Court-Pendu Plat)

6 = conical
6 = kegelförmig
6 = conique
(Adam's Pearmain, Treboux, Jonagold)*

8 = truncate conical
8 = stumpf kegelförmig
8 = tronconique
(Kidd's Orange Red)

11 = oblong (cylindric)
11 = rechteckig
11 = rectangulaire
(Gravensteiner, Mutsu)

Images from: Studium der Pomologie (1877), E. Lucas (adapted by Szalatnay)

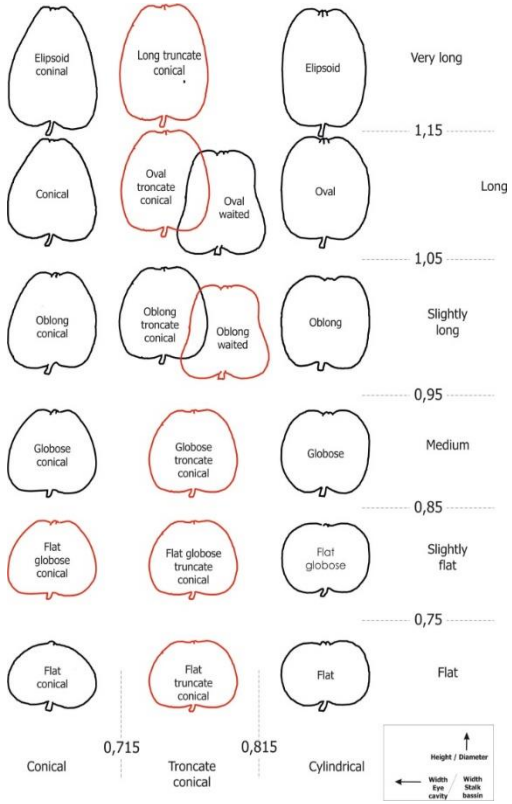

Figure 3. Global mean fruit shapes with illustration of the main fruit shapes (Szalatnay 2006).

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2.8 Fruit size (*Priority 1*)

At least 12 representative fruits should ideally be evaluated over a minimum of four to six years. An average score can then be assigned according to **Table 14**. The most straightforward measure of fruit size is based on weight, but since average fruit diameter is more common in commercial classification, indicative values for both are included. It should be noted that these indicative values will differ across locations and growing systems.

Table 14. Fruit size (adapted by Szalatnay and Lateur) - ** Added ref. cvs from OCVV/CPVO*

State	Fruit size	Average diameter (mm)	Average weight (g)	Example of reference cultivars
1	Extremely small	< 45mm	< 40	
2	Very small	46–50	41–60	Golden Harvey, Api Etoilé
3	Small	51–55	61–80	Akane, Miller's Seedling
4	Small to medium	56–60	81–100	Alkmene*
5	Medium	61–70	101–150	Cox's Orange Pippin
6	Medium to large	71–80	151–200	Holsteiner Cox, Gravensteiner*
7	Large	81–90	201–250	Mutsu, Boskoop
8	Very large	91–100	251–320	Bramley's Seedling
9	Extremely large	> 100	> 320	Jumbo, Howgate Wonder

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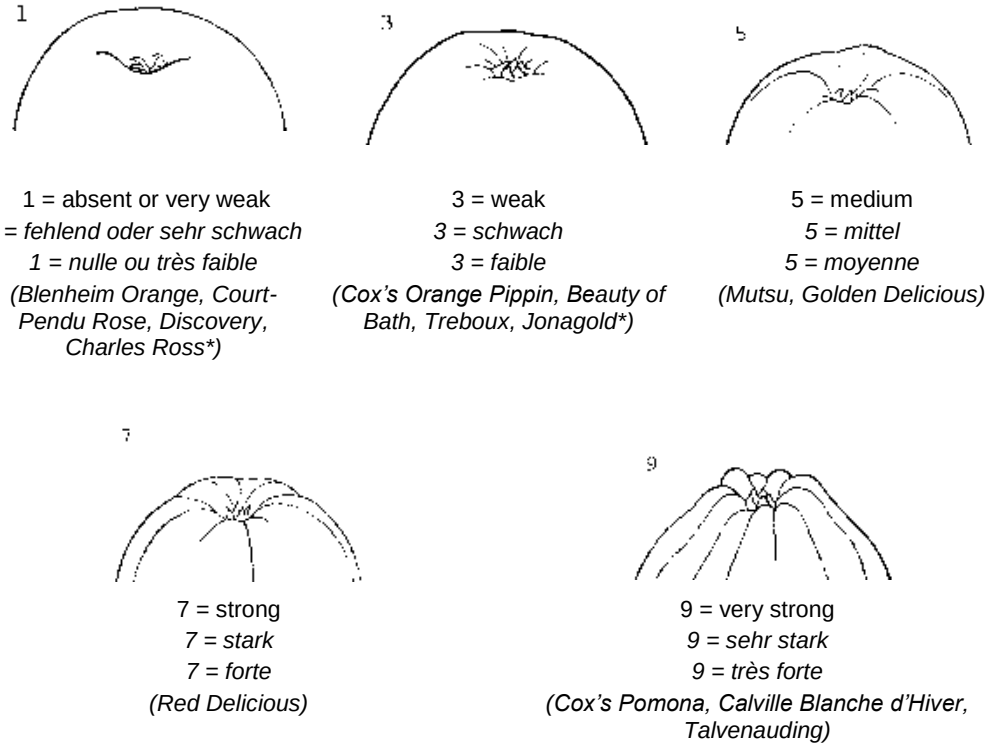
1.5 Fruit crowning at apex (*Priority 2*) - ** Added ref. cvs from OCVV/CPVO*

Crowning should be scored relative to the images in **Figure 5** and classifications in **Table 15**.
It should be noted that this character is sensitive to fruit size.



1 = absent or very weak
1 = fehlend oder sehr schwach
1 = nulle ou très faible
(Blenheim Orange, Court-Pendu Rose, Discovery, Charles Ross)*

3 = weak
3 = schwach
3 = faible
(Cox's Orange Pippin, Beauty of Bath, Treboux, Jonagold)*

5 = medium
5 = mittel
5 = moyenne
(Mutsu, Golden Delicious)

7 = strong
7 = stark
7 = forte
(Red Delicious)

9 = very strong
9 = sehr stark
9 = très forte
(Cox's Pomona, Calville Blanche d'Hiver, Talvenauding)

Figure 5. Illustration of different types of crowning at apex of fruit (**Table 15**).

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3.2 Fruit-bearing habits (*Priority 2)*

Overall fruit-bearing habits can be assessed in a single year (**Table 28**). Ideally, they should be assessed on trees that have not been overly pruned and generally on established trees of 5–10 years old. For further detail of descriptions, see **Figure 14**.

Table 28. Fruit-bearing habits (Lespinasse, 1977, Watkins and Smith, 1982) - * *Added ref. cvs from OCVV/CPVO*

State	Fruit-bearing type	Main fruit position	Indicative tree form	Reference cultivars
1	Columnar	On spurs only	Very few branches	Wijcik, Bolero, Waltz
2	Type I	Numerous short spurs that are long-lived. Fruit zone close to the trunk.	Upright with sparse branching and narrow crotches.	Starkrimson, Reinette Clochard, Joseph Musch
3	Type I - II	Intermediate		Boskoop
4	Type II	On spurs mainly, with fruit zone moving slightly away from the trunk.	More frequent branching (than type I) resulting in tree spreading with age.	King of the Pippin (Reine des Reinettes), Cox's Orange Pippin, Blenheim Orange, Schone van Boskoop, White Transparent
5	Type II - III	Intermediate		
6	Type III	On spurs and shoots that are 1–3 years of age. Tendency for the fruit zone to move towards the outside of the tree.	Spreading with frequent branching and wide crotches.	Golden Delicious, Jonagold, Pinova, Auksis, Jonathan, Akane
7	Type III - IV	Intermediate		Priam, Idared
8	Type IV	Mostly at the end of 1-year-old shoots. Strong tendency for fruiting at the extremities of branches.	Upright main scaffold with frequent branching and narrow crotches. Tendency to droop and for the based part of shoots to be without fruit or leaves.	Granny Smith, Tydeman's Early, Idared, Cortland, *Rome Beauty**

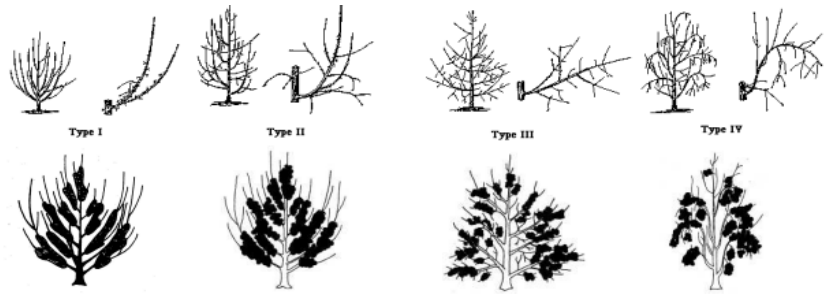


Figure 14. Types of global fruit-bearing habits (reproduced from Lespinasse, 1977).

1. Disease and pest susceptibility

For pest and disease susceptibility assessment, it is particularly important to note details of the management scheme for fungicide and insecticide application for at least five years preceding the first evaluation. It is strongly recommended to not spray evaluation orchards for several seasons before the evaluation process (ideally, at least five years or more ideally => never spray!).

For each disease, you also need reference cvs (e.g. for apple scab : 'Golden Delicious', 'Gala', 'Cripp's Pink')

It is also important to carefully check that the pest/disease is homogeneously distributed inside the plot and useful to plant sufficient susceptible control cultivars throughout the field to help identify the occurrence of localized infections.

The most widely used assessment keys are based on a global approach for the assessment of the intensity of the pest/disease.

Intensity forms the sum of two components: incidence and severity

Incidence is the qualitative 'presence' and 'absence' of symptoms (generally defined by the proportion of organs affected by at least one symptom);

Severity is the quantitative proportion of a surface, length or volume of an organ infected by the disease. In some instances, when more precision is needed on the type of resistance, it can be necessary to evaluate incidence and severity independently.

Based on empirical facts, evaluator has the capacity to discriminate exponential differences of symptoms and specific key percentages (no small differences)
=> for '**incidence ' = exponential assessment scales + 'intermediate ratings'**

Table 32. Incidence assessment key for apple scab, either on leaves or fruits **(*Priority 4*)**

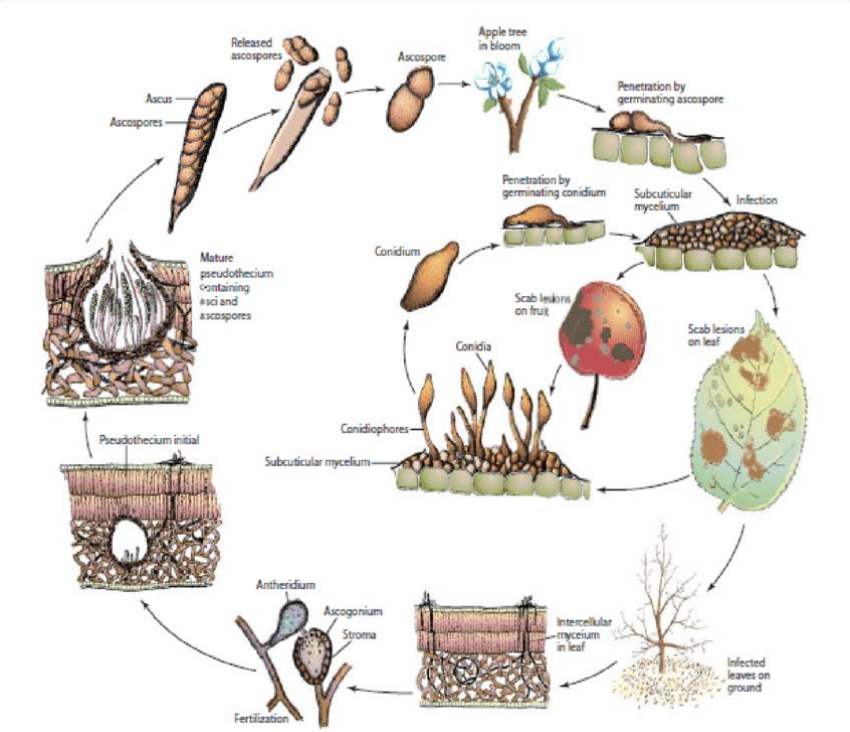
State	Mean proportion of infected organs with at least one visible symptom on leaves or fruits (%)
1	0
2	]0–1]
3	]1–5]
4	X
5	± 25
6	X
7	± 50
8	X
9	> 90

'X': Intermediate rating.

ECPGR common protocols and tools for characterization and evaluation of Malus/ Pyrus genetic resources

For each pest & disease – need to know:

- biological cycle
- when is it the best period for the best expressed symptoms
- Which are the different forms of symptoms/cvs/organs



Example of scab severity on leaves

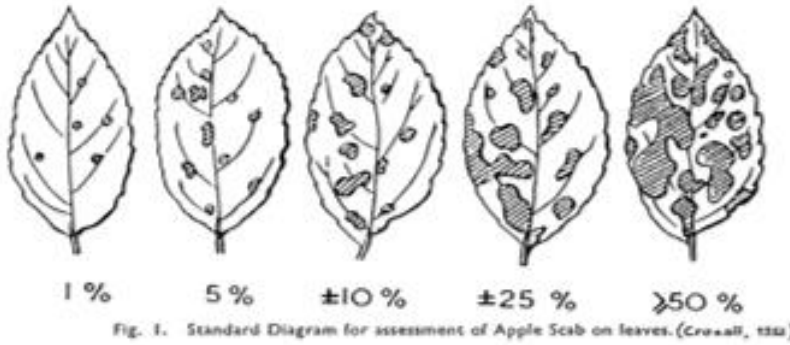


Fig. 1. Standard Diagram for assessment of Apple Scab on leaves. (Croxall, 1952)

Figure 15. Assessment of scab severity on leaves (reproduced from Croxall et al, 1952)

1.1 Scab (*Venturia inaequalis*) (*Priority 2*)

At least one observation should be made per year at the end of the growing season. If possible, though, it is recommended to assess leaf scab two or three times in the season to be able to evaluate the primary and secondary infections. It is much easier to make the assessment when leaves are dry.

The most common and easiest way for assessing the intensity of symptoms on leaves, fruits and twigs is based on the use of **global assessment** scales that take into account and integrate into one global score the incidence and severity status (**Tables 30** and **31**).

Table 30. Global assessment scale for Scab infection on **leaves** (adapted from Lateur and Populer, 1996)

State	Field observations	Visual rating estimation	
		Incidence (%)	Severity (%)
1	No visible symptom	0	
2	A few small scab spots are detectable on close scrutiny of the tree	≤ 1	
3	Scab immediately apparent, with lesions very thinly scattered over the tree	> 1–5	-
4	X	X	-
5	Infection widespread over the tree, majority of leaves with at least one lesion	≥ 50	≤ 5
6	X	≥ 50	X
7	Heavy infection; multiple lesions or more large surfaces covered by scab on most leaves. Partial leaf fall	≥ 50	± 25
8	X	≥ 50	X
9	Maximum infection; leaves black with scab often fallen	≥ 50	> 75

'X': Intermediate rating.

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Examples of scab symptoms on pear (*Venturia pyrina*)

=> On twigs

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Examples of scab symptoms on pear (*Venturia pyrina*)

=> On leaves and young fruitstwigs

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Assessement of global foliage quality = one way to assess level of 'robustness' ?

4.7 Global tree foliage health (*Priority 3*)

Assessment should be based on overall appearance, and will represent a combination of disease tolerance, robustness and good nutrients uptake efficiency indicated by healthy green leaves. (**Table 44**).

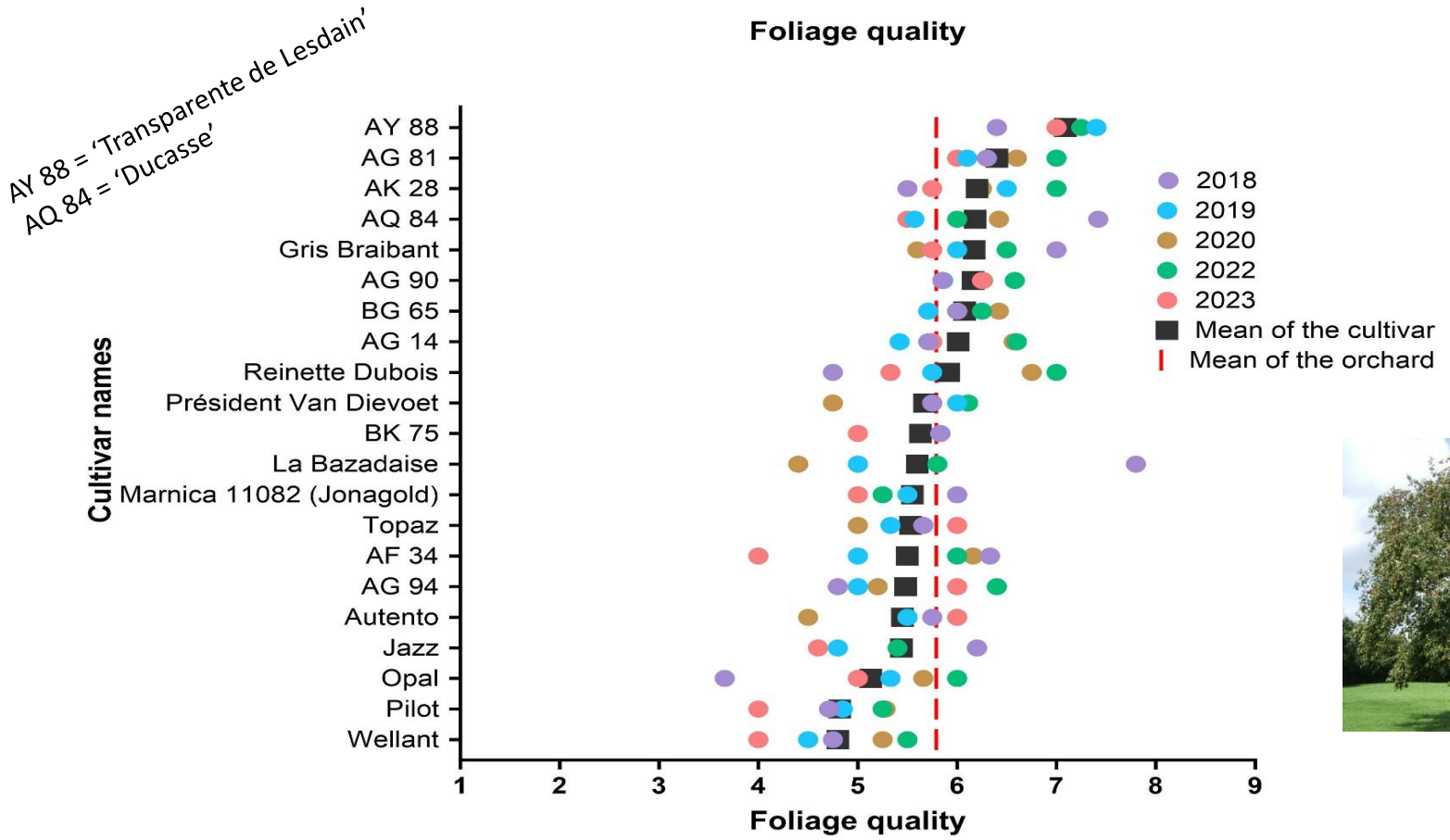
Table 44. Assessment scale for global tree foliage health

State	Appearance
1	Extremely low health foliage (> 90% of leaves suffering diverse heavy foliar deficiencies)
2	X
3	Low health foliage (± 75% of leaves suffering diverse heavy foliar deficiencies)
4	X
5	Medium health foliage (± 50% of leaves without foliar deficiency)
6	X
7	High health foliage (± 75% of leaves without foliar deficiency)
8	X
9	Extremely high health foliage (> 90% of leaves without any foliar deficiency)

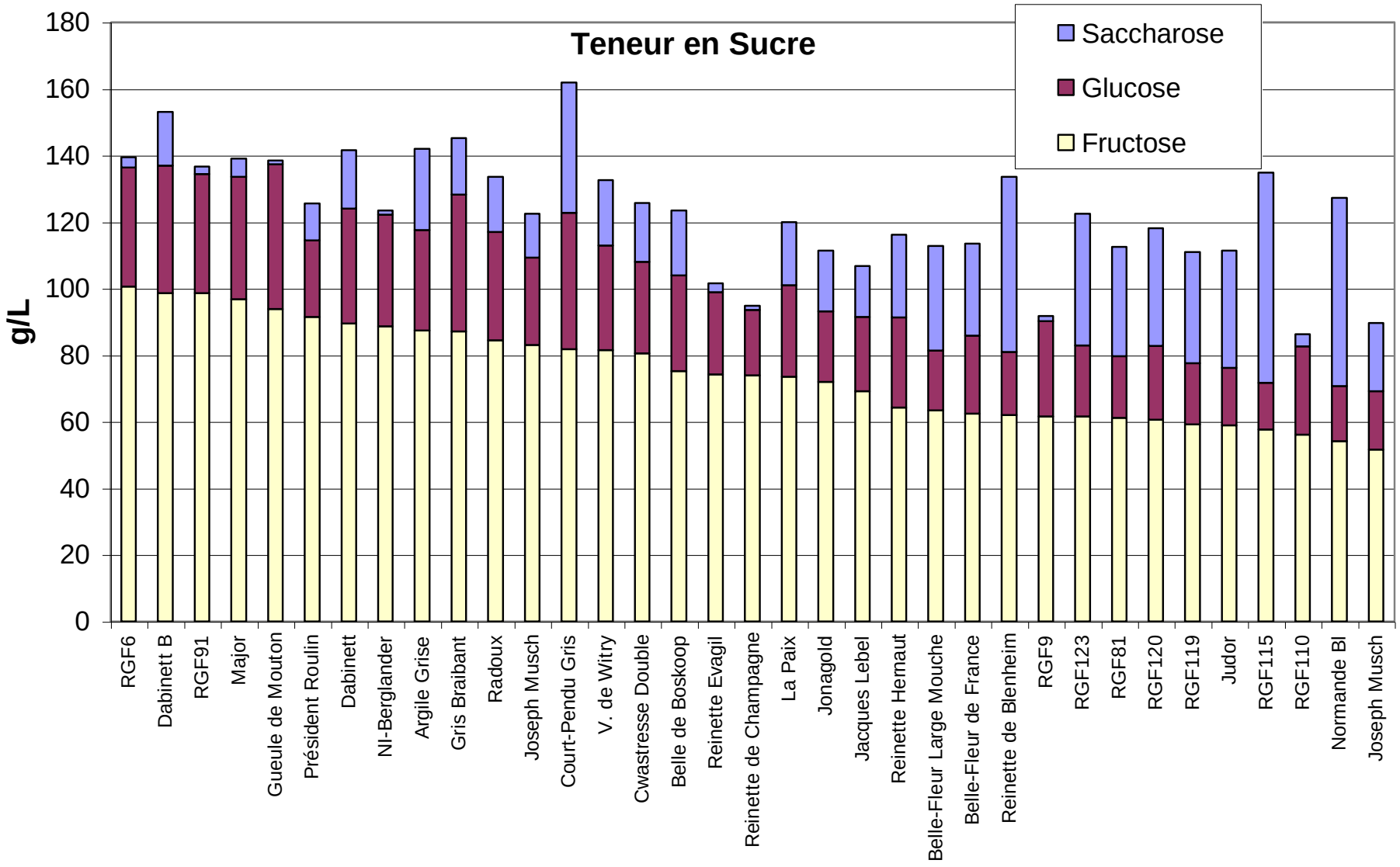
'X': Intermediate rating

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

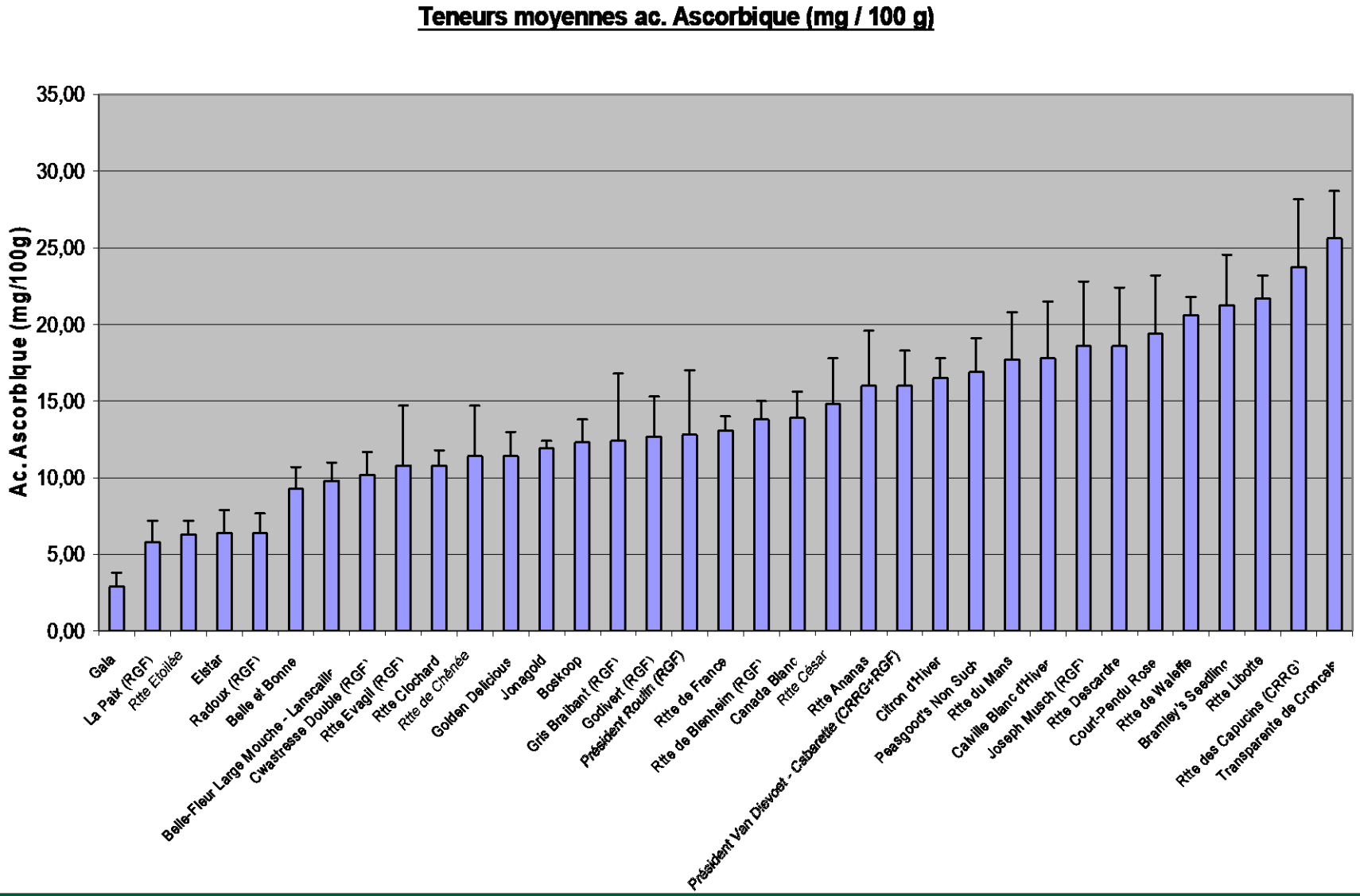
Example of cvs evaluation for this trait



Analysis of the sugar content



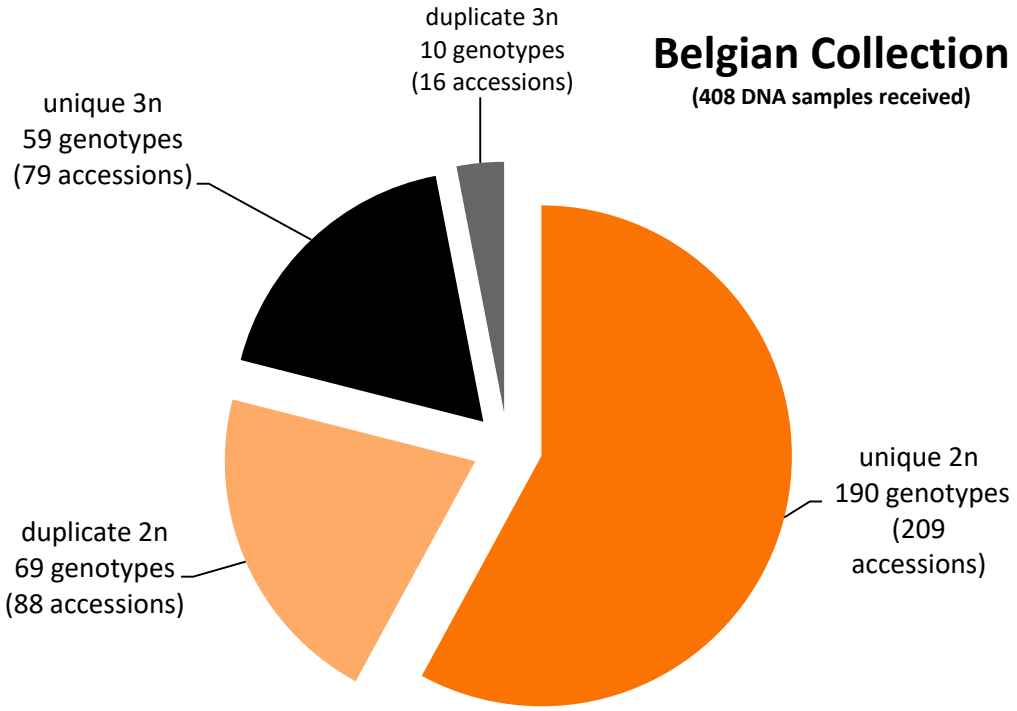
Analysis of the Vitamin C content

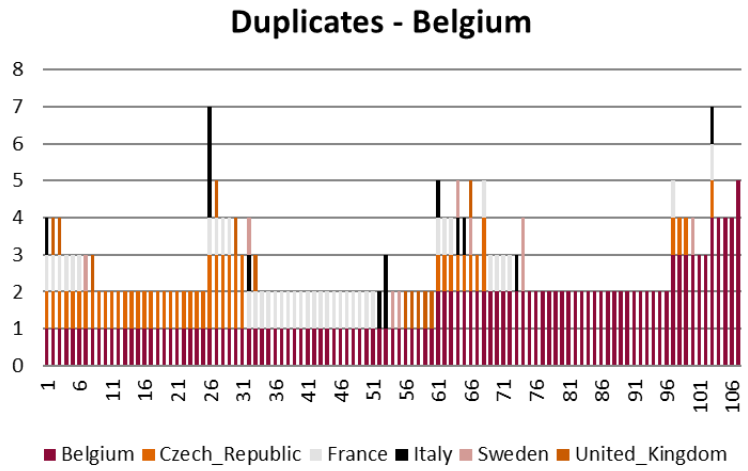


2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Study of true to type status of a representative apple sample of CRA-W collections (SSR's)

Durel *et al.* (2016)





2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

We still have to cross-check genetic, phenotypic and historical data,
Since:

(1) Mutants often occur


‘Reinette du Canada’ – ‘Blanche’ & ‘Grise’


‘Eijsdener Klumpke’ & ‘Grondsvelder Klumpke’


‘Court-Pendu’ – ‘Rose’ & ‘Gris’

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

We still have to cross-check genetic, phenotypic and historical data,
Since: (2) There are variety "populations" – sub-types

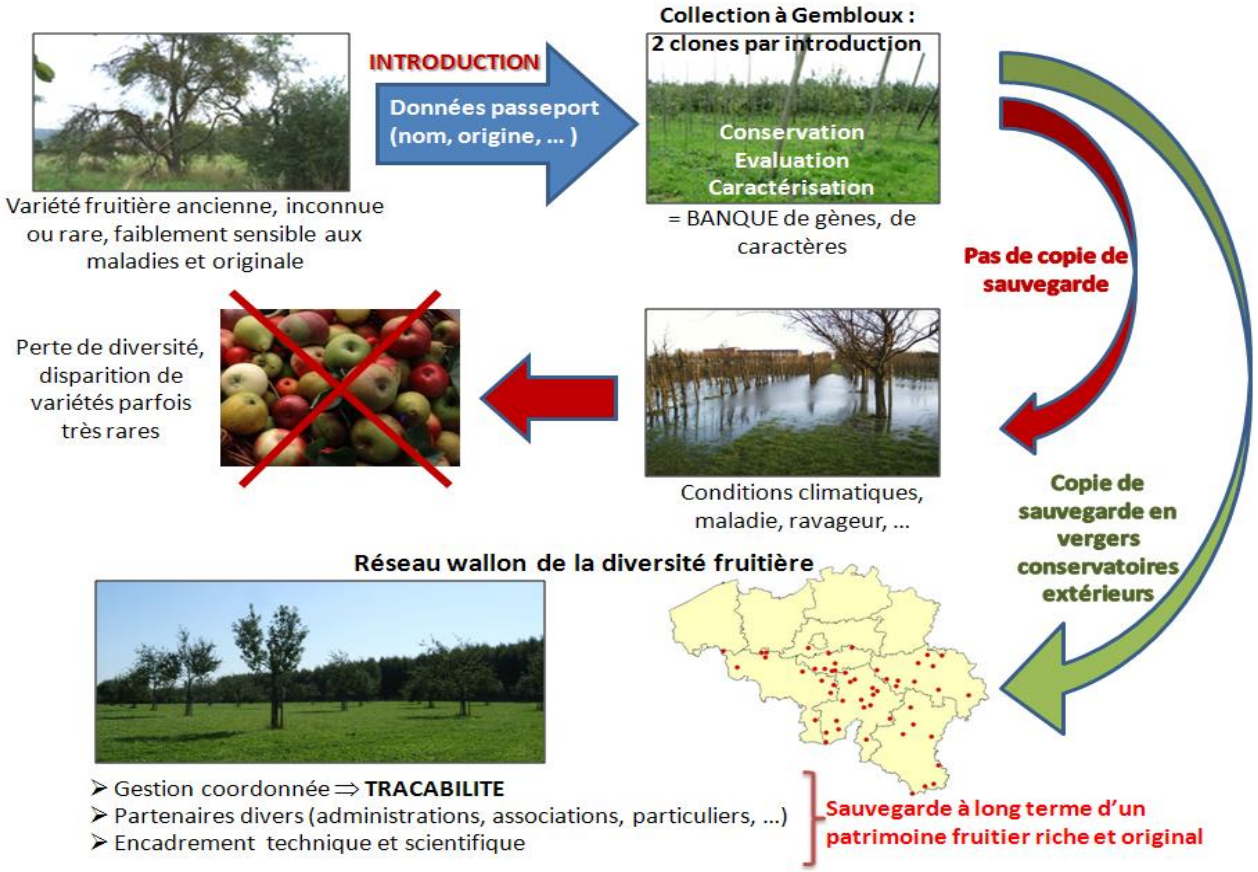
Sainte Germaine – De L'Estre – Reinette de Brive

Les 13 accessions de plusieurs origines de cette population présentent des phénotypes différents mais 1 seul profil moléculaire.

'Belle-Fleur Large Mouche' ('Lanscailler', 'Balleau', 'Rabaël', …)

2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Building a coordinated orchard network for duplication or our *ex situ* collection – **On farm conservation** of 1200 old cvs accessions.

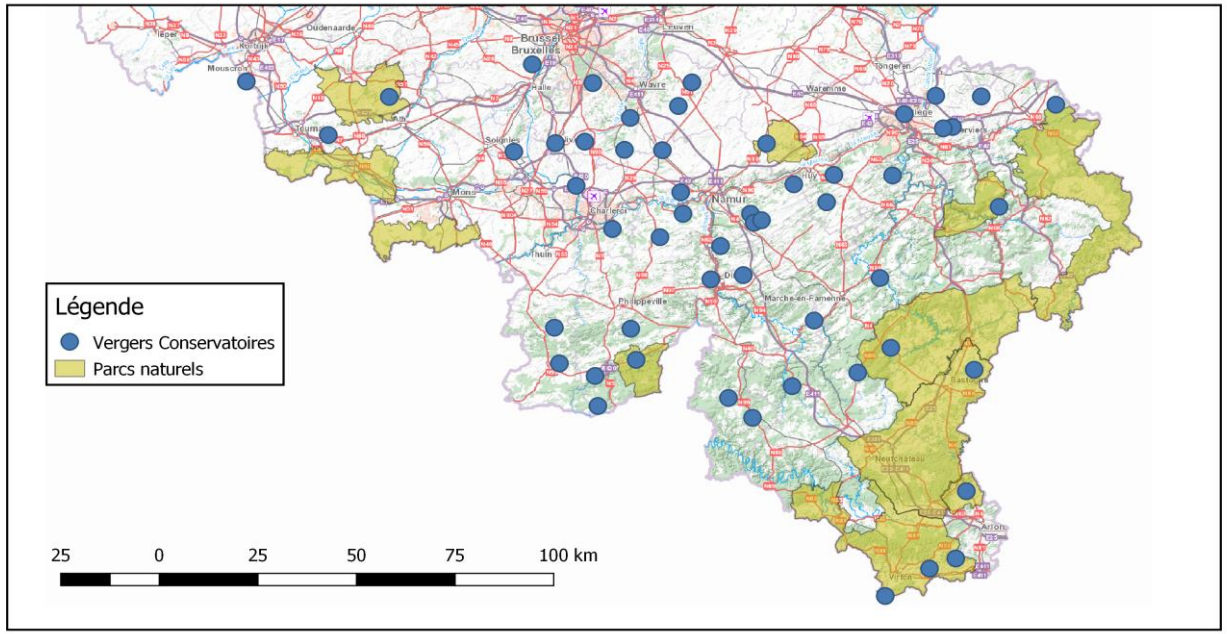


2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Building a coordinated orchard network for duplication or our *ex situ* collection – **On farm conservation** of 1200 old cvs accessions.

Since 2005, 72 ha of repository orcharc are planted in
8 geographical regions

1. **Hainaut occidental**
2. **Brabant Wallon**
3. **Namur/Condroz**
4. **Sambre et Meuse/Charleroi**
5. **Calestienne**
6. **Ardenne**
7. **Lorraine**
8. **Liège/Canton de l'Est**



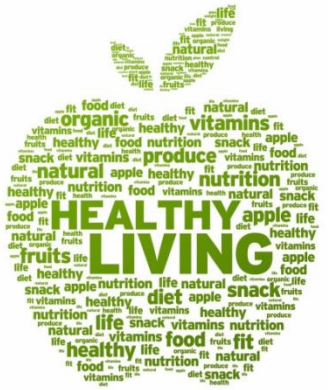
2. Safeguarding Pome Fruit Genetic Resources (PFGR) – Belgian example

Repository orchard meadows

Conclusions

- We need to identify and conserve a broad diversity spectum of phenotypic traits and genetic alleles
- Cultural heritage and traditionnal knowledges are complementary aspects to our objective to safe conserve Genetic Resources.
- Long term evaluation activities are too less implemented – make use of long term evaluation in unsprayed trial orchard is a key point
- Robustness, tolerance/durable resistance to pest & diseases, healthy & quality traits are more and more important ones !!

A friend's advice…



Thank you for your attention!

InnOBreed

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HORIZON EUROPE

Wallonie recherche CRA-W

How to safeguard and actively evaluate local fruit tree genetic resources ?

Dr. Marc LATEUR, Dr. Baptiste DUMONT, Ir. Alain RONDIA

14.05.2024
First International Training Course, Online