GCIRC Rapeseed/Mustard Technical Meeting
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Structure of genetic diversity and elaboration of core collections for the three related *Brassica* species: *B. napus*, *B. oleracea*, *B. rapa*

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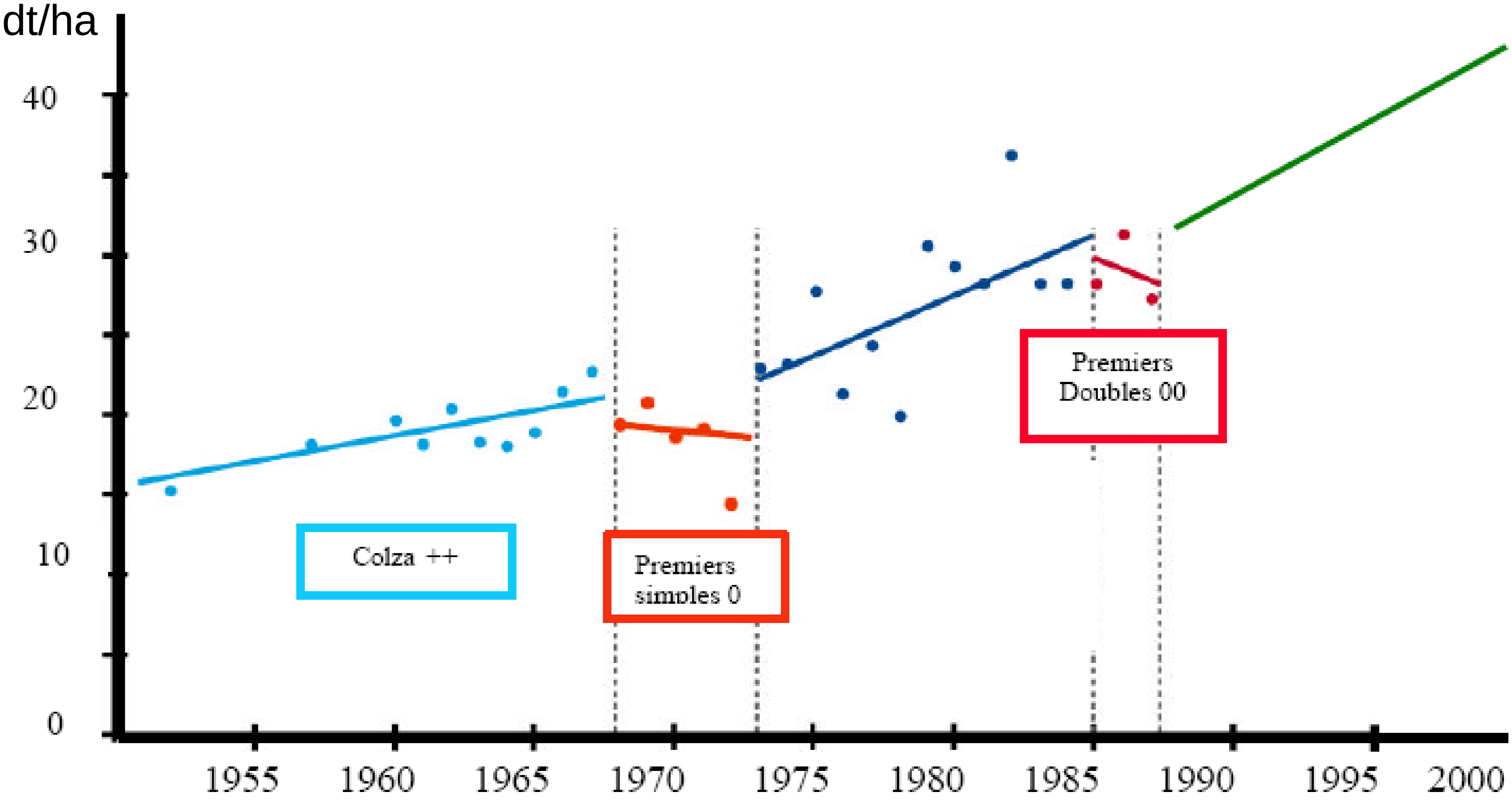
Plougoulm
Ploudaniel
Camaret
Sizun
St Gilles
Rennes
Quimper
Le Rheu
Pont-Scorff

Towards a reduction of exploited *B. napus* diversity



=> Need to broaden *B. napus* genetic diversity by exploiting its progenitors

Source CETIOM

Rationales

- How is Brassica genetic diversity organized?

- How to answer to new breeding challenges ?
  - Exploiting *Brassica* genetic diversity

⇒A real need for defining core collections

Objectives

Study the genetic diversity of

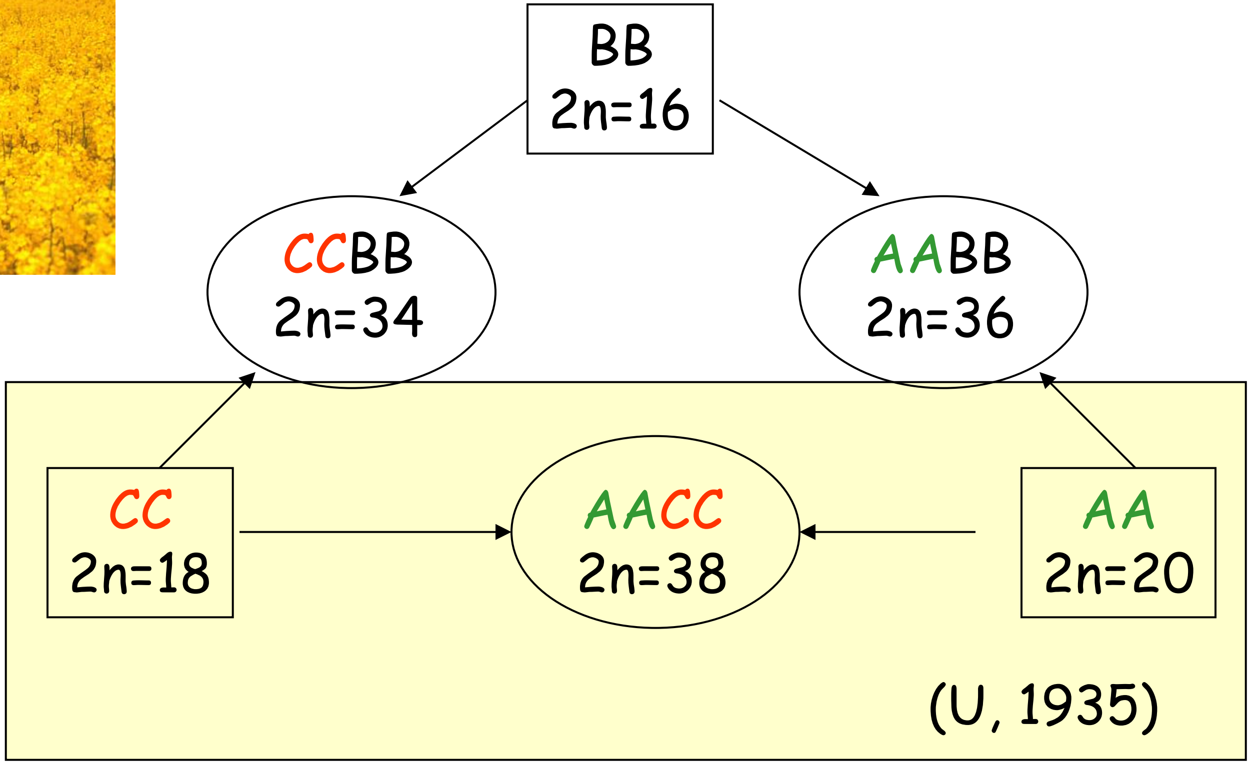
- a semi-autogamous species *Brassica napus*
- two allogamous species : *Brassica oleracea, Brassica rapa*

Connect the diversity of *Brassica napus*, *rapa* and *oleracea*

Deliver public core collections to the scientific community

Which available genetic diversity for *Brassica napus* ?

Which diversity ?
Relationships between Brassicae



BB
2n=16

CCBB
2n=34

AABB
2n=36

CC
2n=18

AACC
2n=38

AA
2n=20

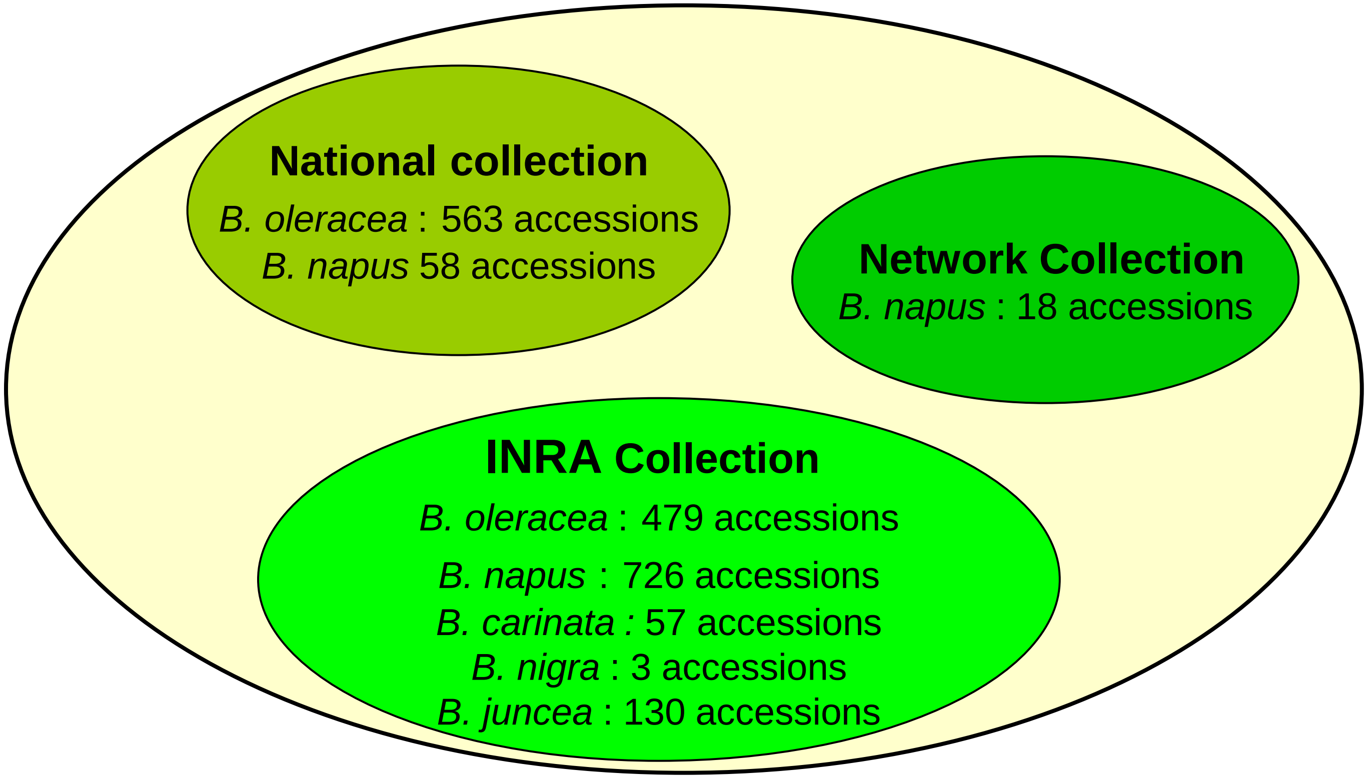
(U, 1935)

Which available genetic diversity for the scientific community ?

Gene banks

Panels, diversity sets and core collections

French Brassica
Genetic Resources Center (BGRC)



National collection

B. oleracea : 563 accessions
B. napus 58 accessions

Network Collection

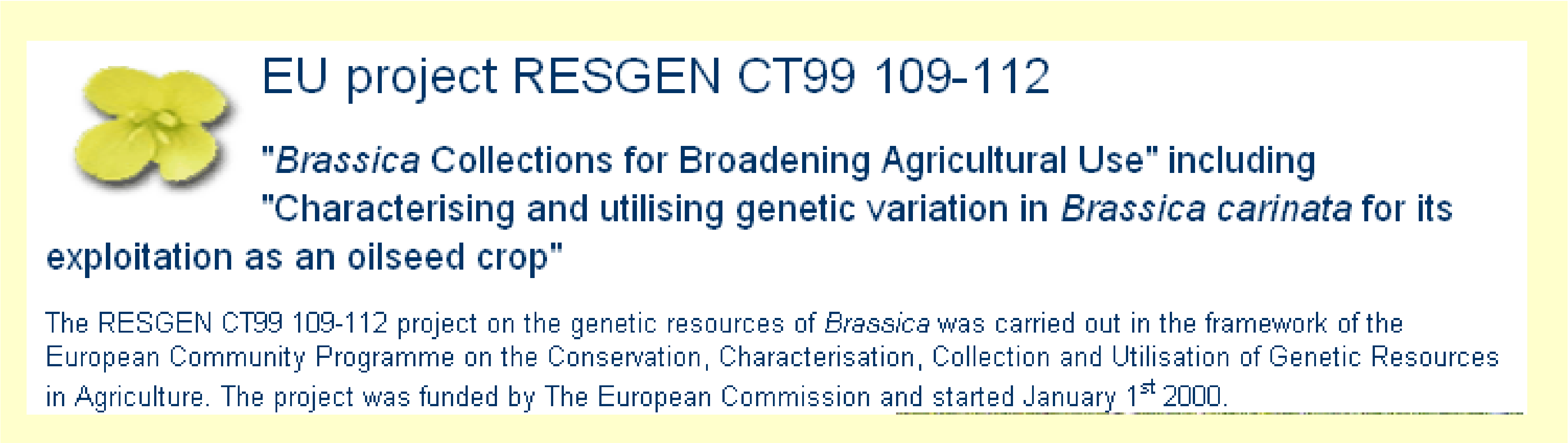
B. napus : 18 accessions

INRA Collection

B. oleracea : 479 accessions
B. napus : 726 accessions
B. carinata : 57 accessions
B. nigra : 3 accessions
B. juncea : 130 accessions

International organisation of *Brassica* diversity study

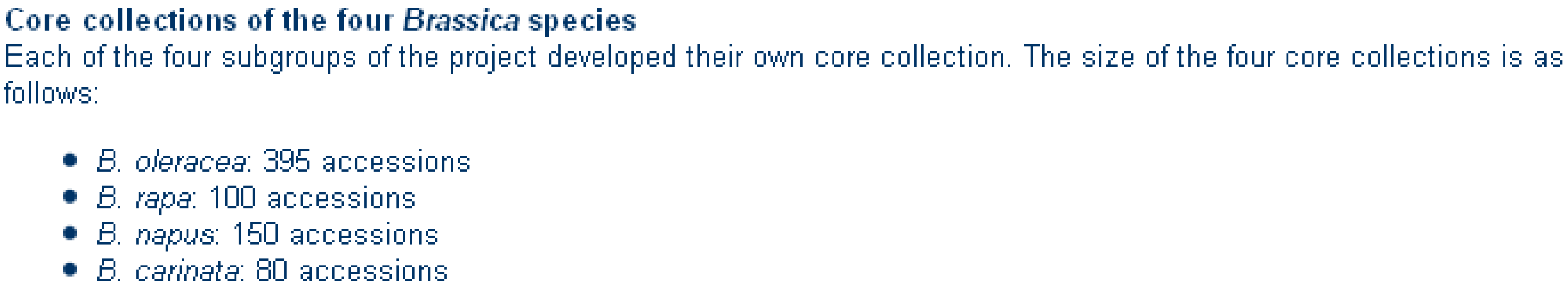
- RESGEN Project
  - *Brassica* core collections



EU project RESGEN CT99 109-112

"*Brassica* Collections for Broadening Agricultural Use" including "Characterising and utilising genetic variation in *Brassica carinata* for its exploitation as an oilseed crop"

The RESGEN CT99 109-112 project on the genetic resources of *Brassica* was carried out in the framework of the European Community Programme on the Conservation, Characterisation, Collection and Utilisation of Genetic Resources in Agriculture. The project was funded by The European Commission and started January 1st 2000.



Core collections of the four *Brassica* species

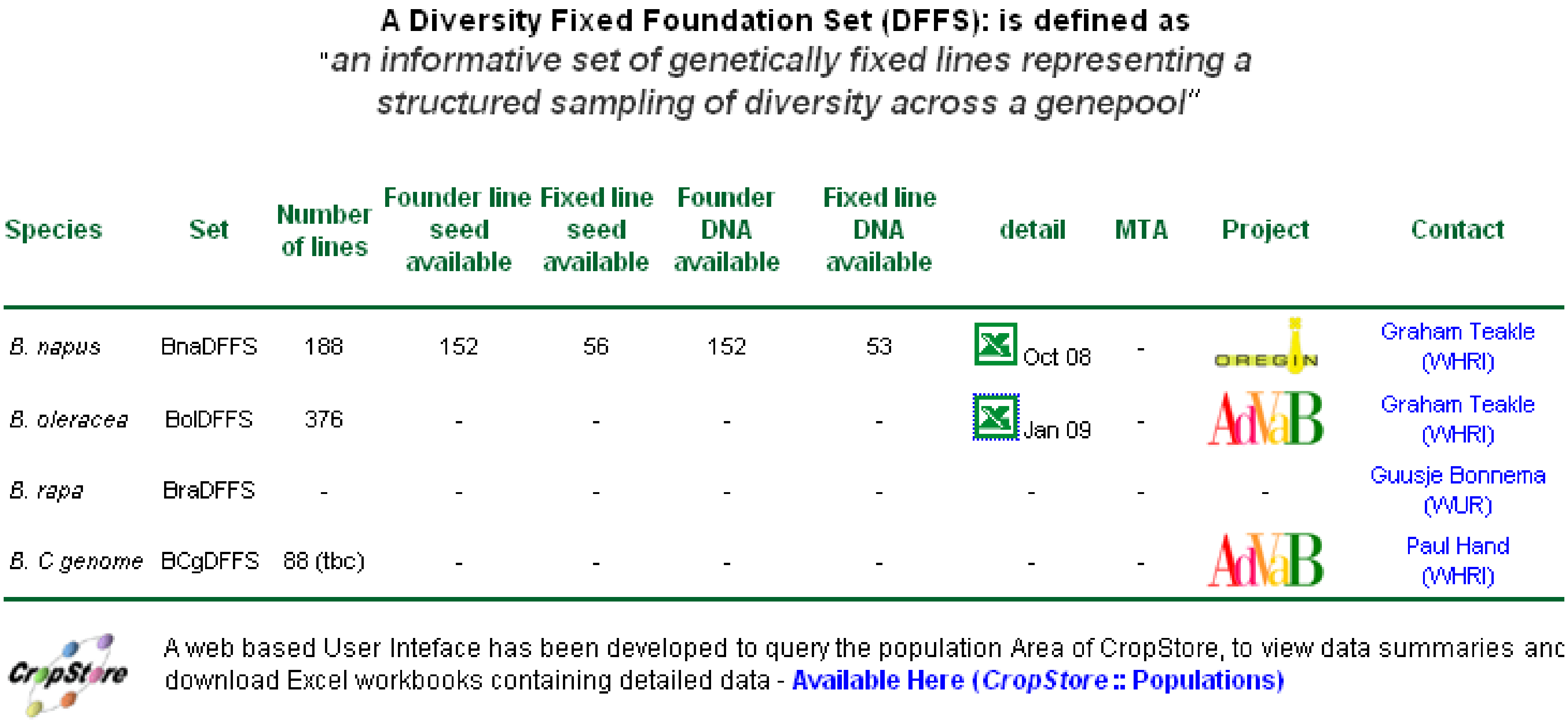
Each of the four subgroups of the project developed their own core collection. The size of the four core collections is as follows:

- *B. oleracea*: 395 accessions
- *B. rapa*: 100 accessions
- *B. napus*: 150 accessions
- *B. carinata*: 80 accessions

http://documents.plant.wur.nl/cgn/pgr/brasedb/brasresgen.htm

International organisation of *Brassica* diversity study

- RESGEN Project
  - *Brassica* core collections (Institute of Crop Science and Plant Breeding Giessen, Germany)
- BnDFFs «Diversity Fixed Foundation Sets» (OREGIN (www.oregin.info)



A Diversity Fixed Foundation Set (DFFS): is defined as
"an informative set of genetically fixed lines representing a structured sampling of diversity across a genepool"

Species	Set	Number of lines	Founder line seed available	Fixed line seed available	Founder DNA available	Fixed line DNA available	detail	MTA	Project	Contact
B. napus	BnaDFFS	188	152	56	152	53	Oct 08	-	OREGIN	Graham Teakle (WHRI)
B. oleracea	BolDFFS	376	-	-	-	-	Jan 09	-	AdVaB	Graham Teakle (WHRI)
B. rapa	BraDFFS	-	-	-	-	-	-	-	-	Guusje Bonnema (WUR)
B. C genome	BCgDFFS	88 (tbc)	-	-	-	-	-	-	AdVaB	Paul Hand (WHRI)

CropStore

A web based User Inteface has been developed to query the population Area of CropStore, to view data summaries and download Excel workbooks containing detailed data - **Available Here (*CropStore* :: Populations)**

www.oregin.info

International organisation of *Brassica* diversity study

- RESGEN Project
  - *Brassica* core collections
- BnDFFs «Diversity Fixed Foundation Sets» (OREGIN (www.oregin.info)
- *rapa* collection: China – Wageningen (G. Bonnema)
- Collections of Vavilov Research Institute of Plant Industry (*napus*, *rapa* and *oleracea*)

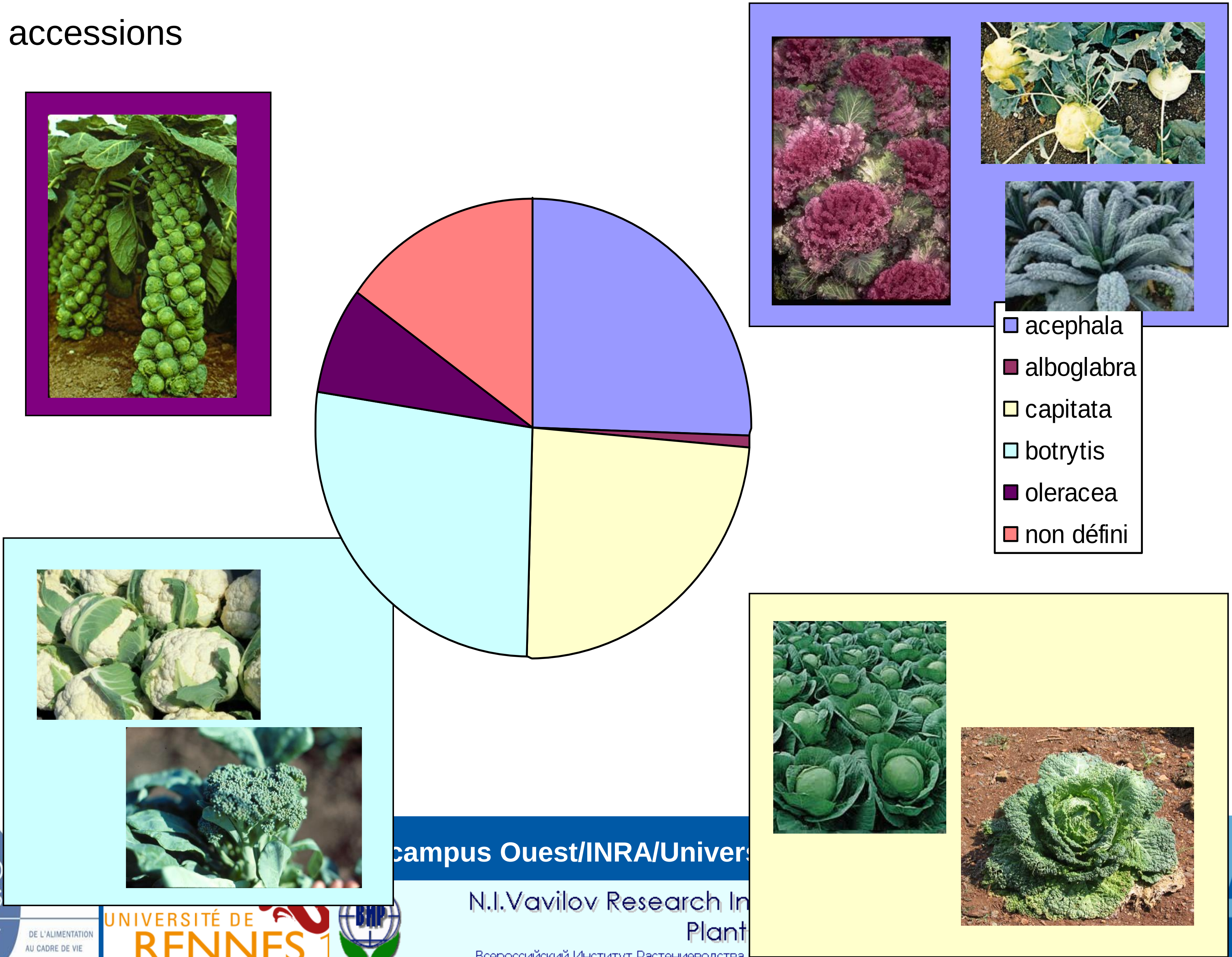
The first target:

Brassica oleracea

Plant material

Brassica oleracea collection

384 accessions



Definition of SSR marker sets

SSR pool
Public markers
582 SSR derived from EST Génoplante
40 SSR Australia (bo)
113 SSR Japan (br)
103 SSR USA (bo)

Quality indice
Position on genetic map
DnxY

1st SSR choice
- Quality
- distribution on maps

80 SSR Agriculture Canada
BBSRC England
Celera

Private markers
130 SSR Trait Genetics

Position on Traits Genetics map

2nd SSR Choice depending on pilote project
12 napus
6 oleracea
6 rapa

Set 76 SSR rapa ⟷ Set 76 SSR napus ⟷ Set 76 SSR oleracea

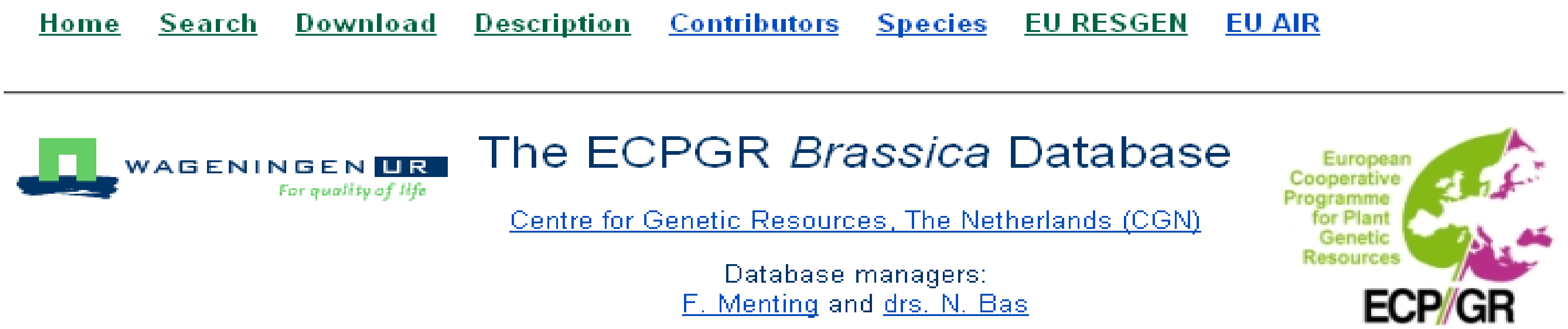
Data mining

Definition of an analysis strategy based on *Brassica oleracea* data

Current results

Study of 384 *B. oleracea* accessions using 22 SSR

General strategy



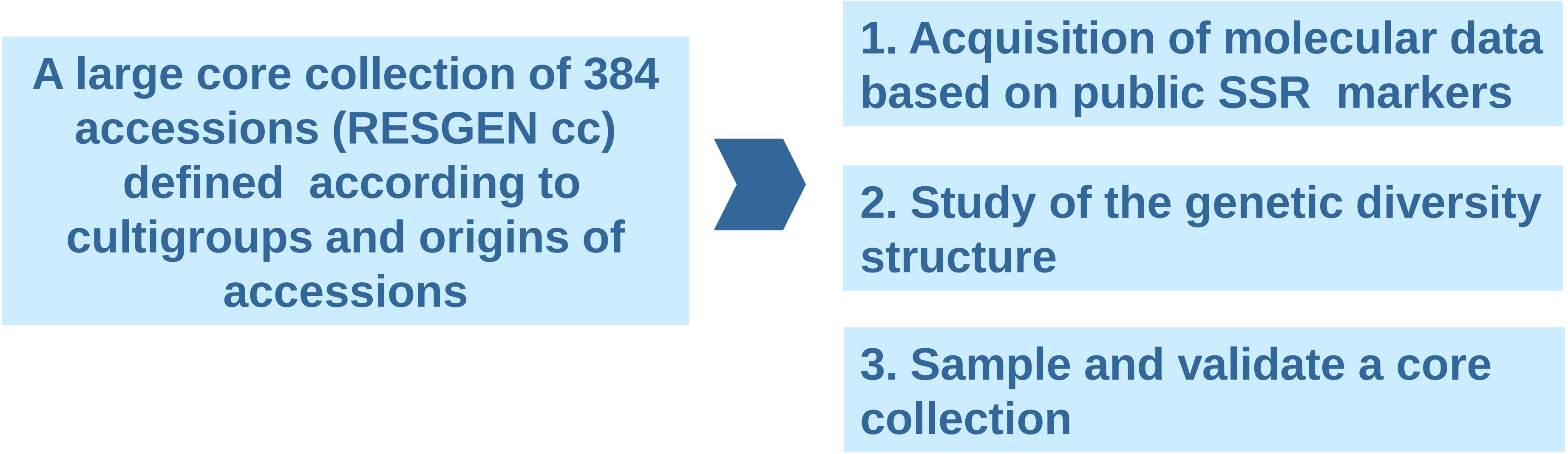
Home Search Download Description Contributors Species EU RESGEN EU AIR

The ECPGR *Brassica* Database

Centre for Genetic Resources, The Netherlands (CGN)

Database managers:
F. Menting and drs. N. Bas

http://documents.plant.wur.nl/cgn/pgr/brasedb/default.htm



A large core collection of 384 accessions (RESGEN cc) defined according to cultigroups and origins of accessions

1. Acquisition of molecular data based on public SSR markers

2. Study of the genetic diversity structure

3. Sample and validate a core collection

Methods: Definition of core collection

2. Study of genetic diversity structure

Bayesian approach
Software structure 2.2

Group definition and affiliation of accessions to groups

3. Sampling core collection

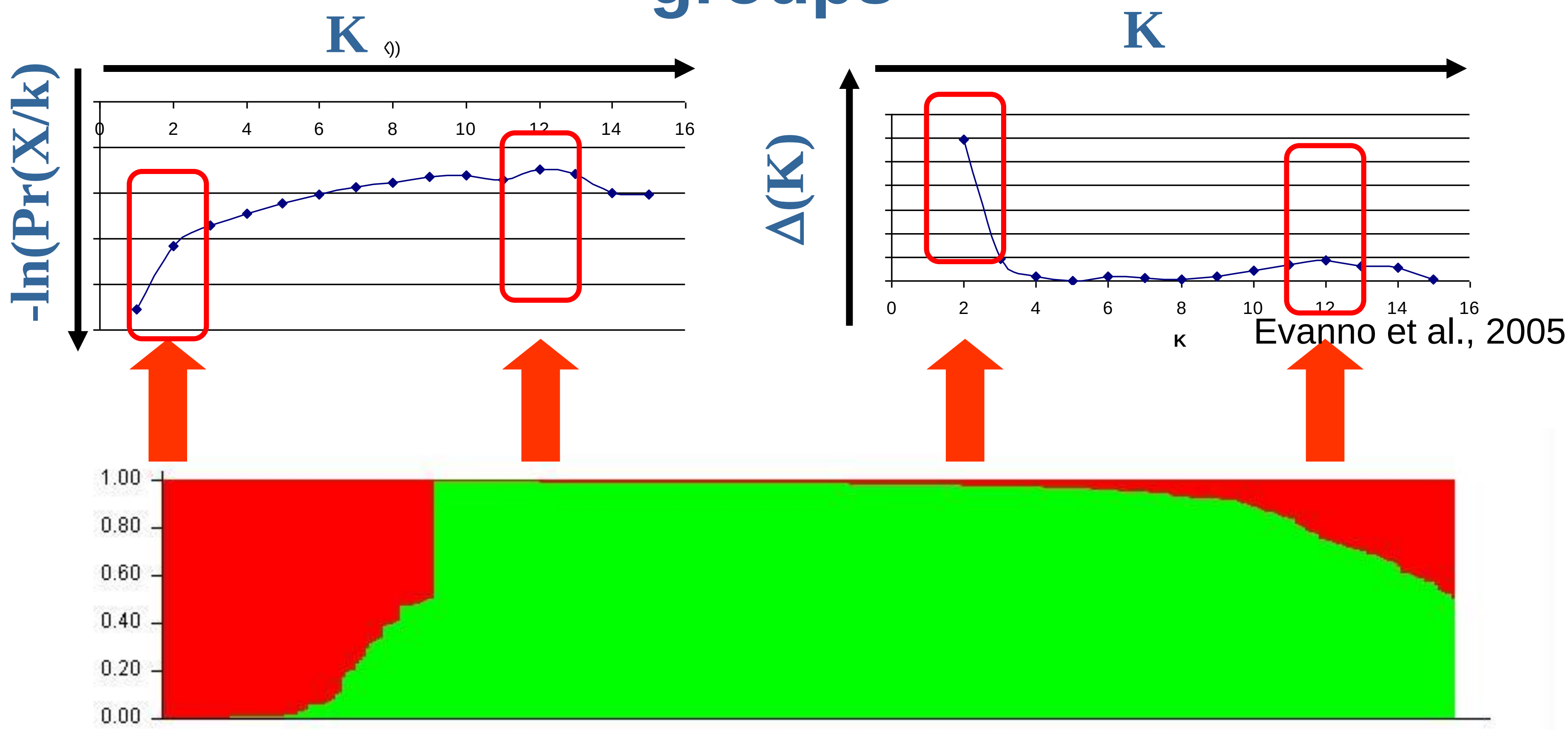
Maximisation (M)
(MSTRAT software)

Methods based on diversity structure results

Random (R)

Constant (C) **Logarithmic (L)** **Proportional (P)**

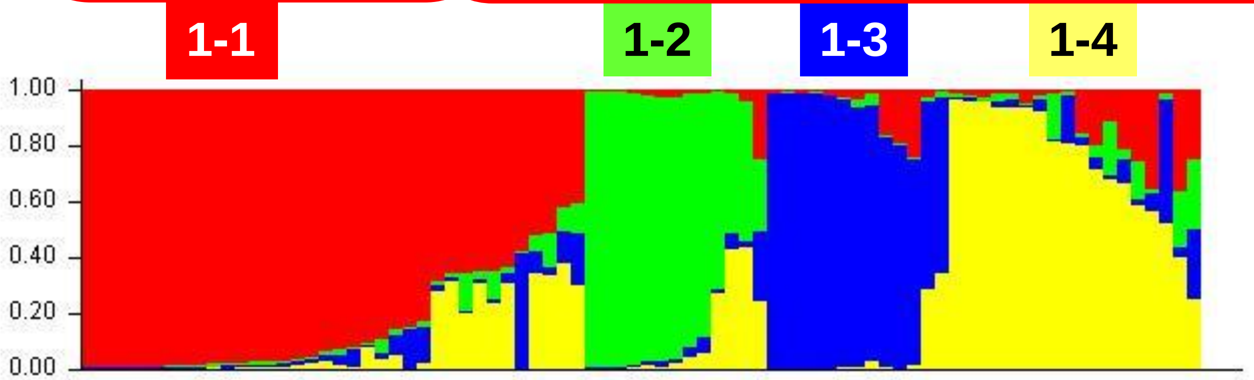
2 - Structure of the collection revealed by a bayesian approach: from 2 to 15 groups



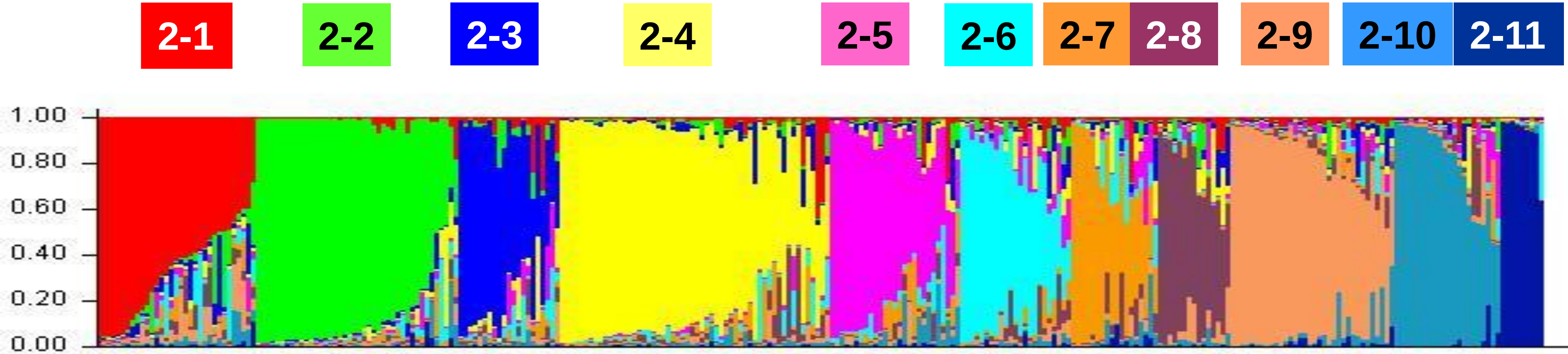
Evanno et al., 2005

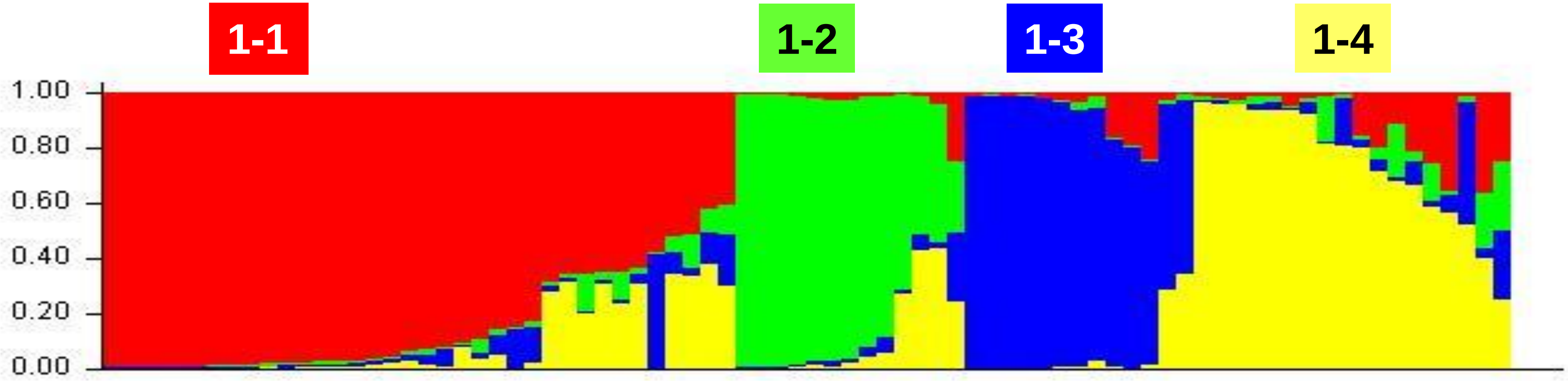
Cauliflowers and Broccoli

Broccoli and others cultigroups



80 accessions



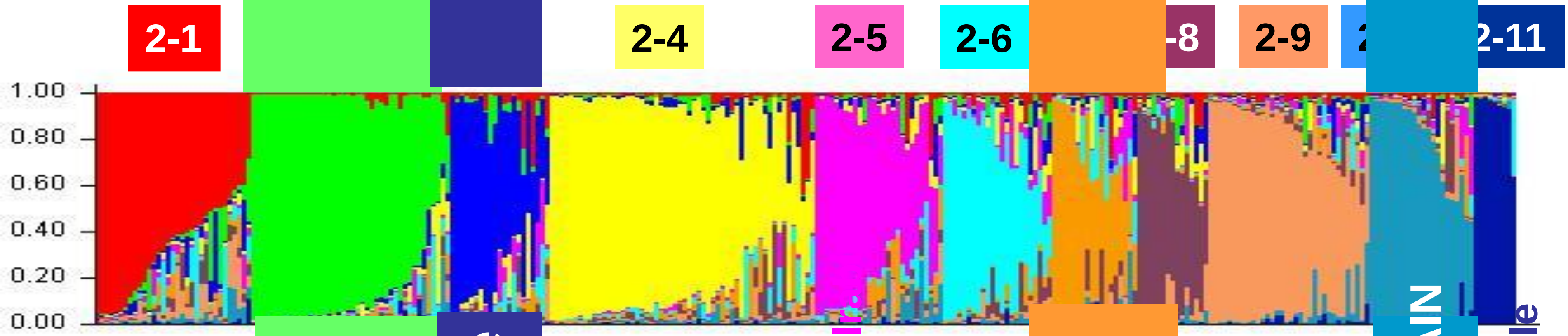


Cauliflowers
ALL ORIGINS

Broccoli

Cauliflowers
FRANCE

Others



300 access

B. o. acephala
acephala medullosa
marrow-stem kale

B. Oleracea gemmifera
Brussels sprouts

B.o. acpehala sabellica curly kale

B.o. capitata
cabbage

B.o. botrytis italica (broccoli)
B.o. acephala gongylodes - Kohl
(chou-rave) (ITALY)

B.o. hilarionis, campestris,

All cultigroups
EGYPT, TURKEY SYRIA

B.o. capitata costata, acephala
Cabbgae, tronchuda cabbage, kale
PORTUGAL SPAIN

B.o. capitata alba white cabbage SPAIN

B.o. acephala alboglabra – chinese kale

Cultigroup aphic origin are
good indic tructure

3 - Estimation of core collection size

Constant (C) **Proportional (P)** **Logarithmic (L)** **Maximisation (M)** **Random (R)**

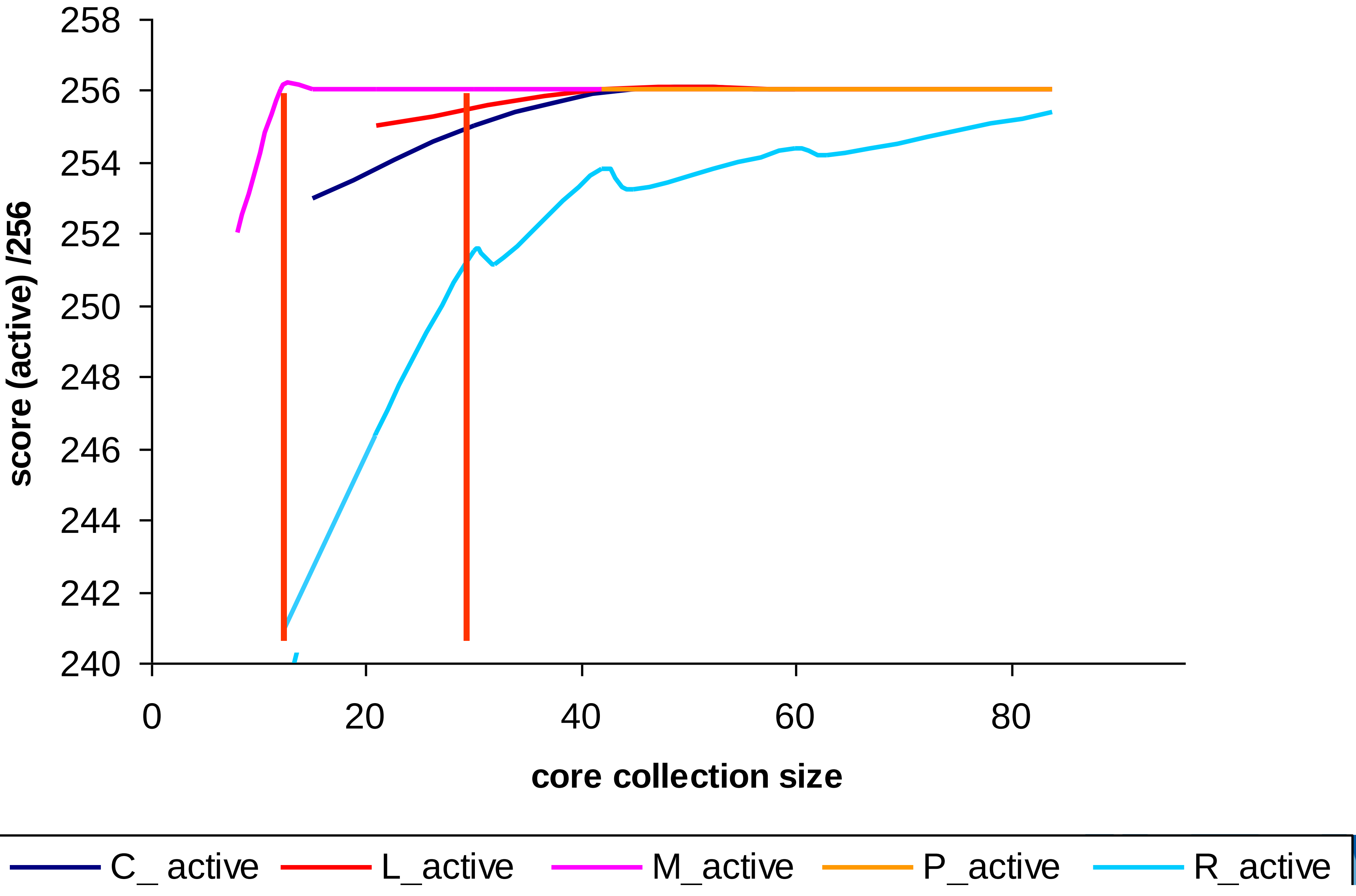
Collection structure

group	size
1-1	16
1-2	13
1-3	13
1-4	18
2-1	33
2-2	42
2-3	21
2-4	56
2-5	27
2-6	23
2-7	18
2-8	15
2-9	34
2-10	22
2-11	9

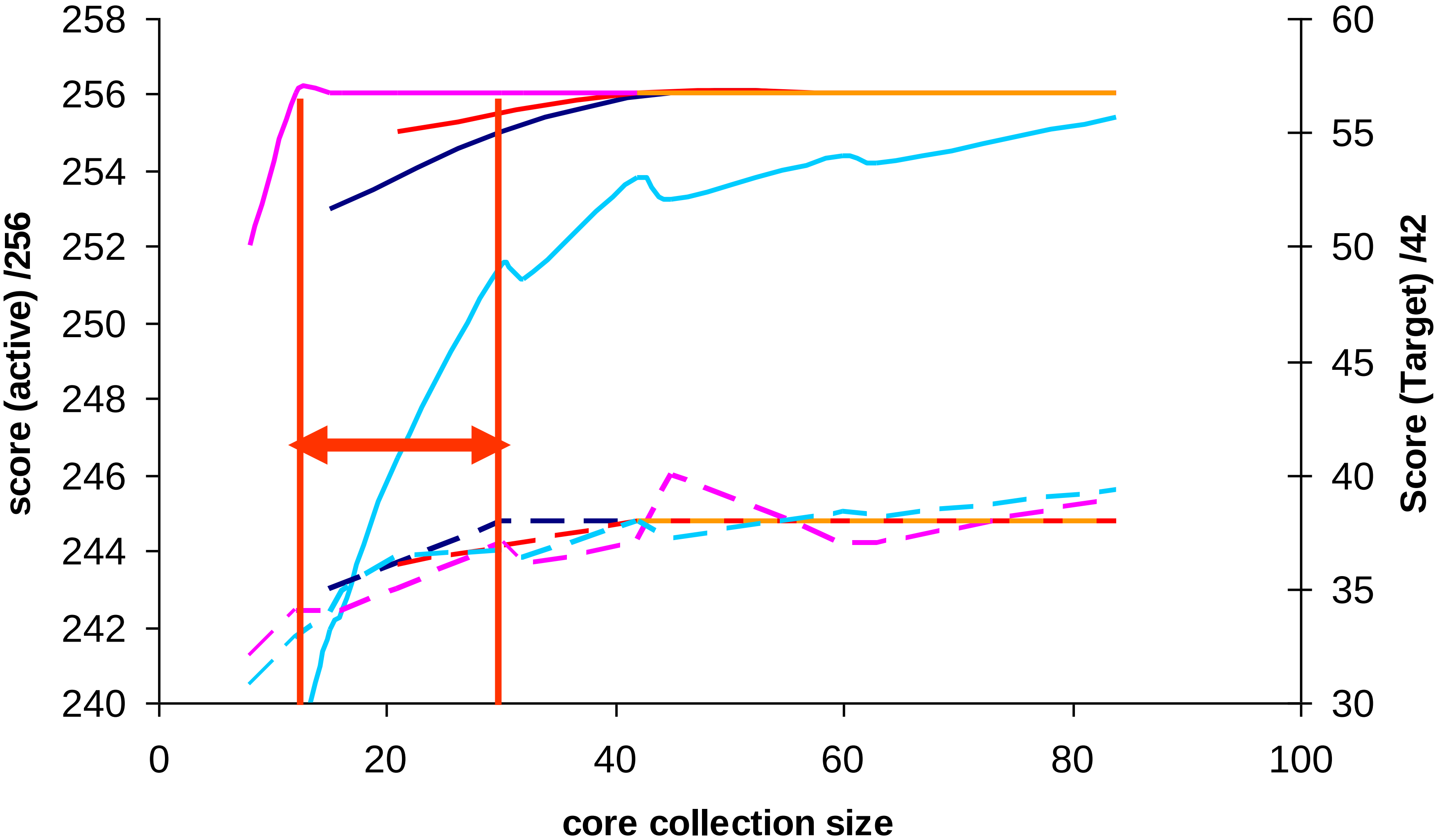
cc sizes tested

	C	P	L	M	R
8				X	X
15	X			X	X
16				X	X
21			X	X	X
30	X			X	X
32				X	X
42		X	X	X	X
45	X			X	X
60	X			X	X
63			X	X	X
84		X	X	X	X

Allele capture with the different strategies



Towards nested core collections



Perspectives

- The presented results are preliminary
  - Completed with more SSR
  - Completed with targeted markers such as SNP defined in QTL regions.

- B. napus core collection in 2009

collaborations

- Thanks to genbank curators who provided the seeds
- platform INRA Clermont-Ferrand / GAP Division

- WUR
- Vavilov Plant Institute

WAGENINGEN UR
For quality of life

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- Open to other collaborations

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