Genetic improvement inferences on sustainable use of plant genetic resources and food security

Yasmina EL BAHLOUL

Ista annual meeting 29 May 2023
Verona, Italy

Evolution

Life’s natural process steps

Succession of

Birth: species speciation

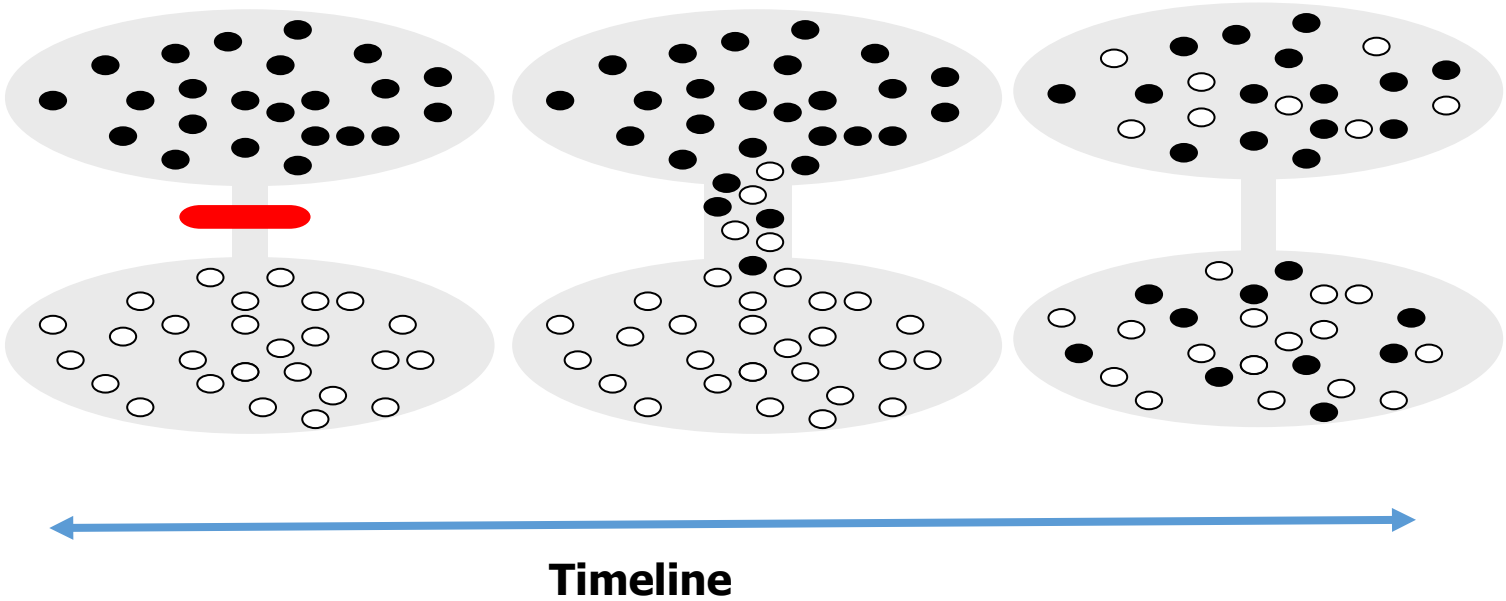
death: species extinction

Evolution

Adaptation :
Phenotypic traits evolution (natural selection) to facing **local environnements constraints**

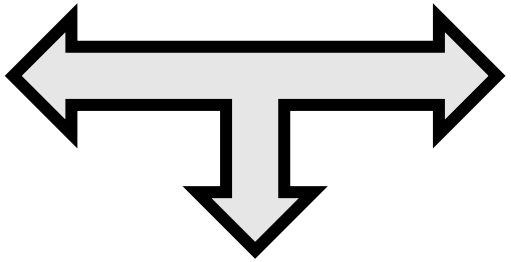
Dispersion:
Seeking appropriate environnement

Gene flow and allelic frequencies



Plant Genetic Ressources = Food Security

How!!

Evaluation  **Utilization**

Conservation

in situ ⟷ *ex situ*

Breeding Material

New varieties

Sugar beet

Worldwide wild beets

The sugar beet is the result of human selection

Available germplasm is subject to erosion of variability under selection pressure

Wild species contain exploitable variability for plant breeding programs

Wild beets interest


Beta vulgaris* subsp. *maritima


Beta macrocarpa


Patellifolia patellaris

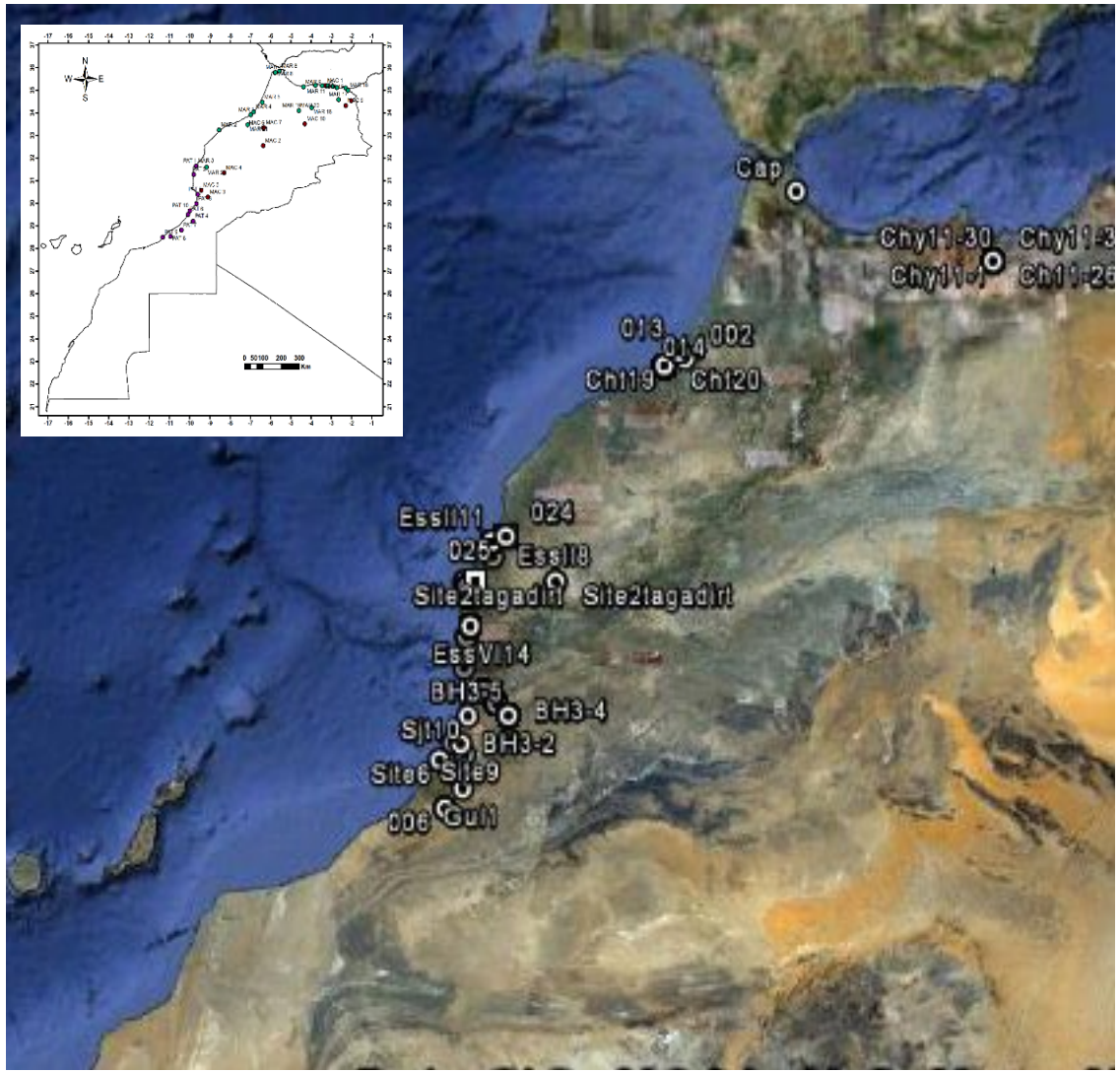
- Monogermy
- Improved economic performance

- Cytoplasmic male sterility
- Release of hybrid varieties (Heterosis) at a lower cost

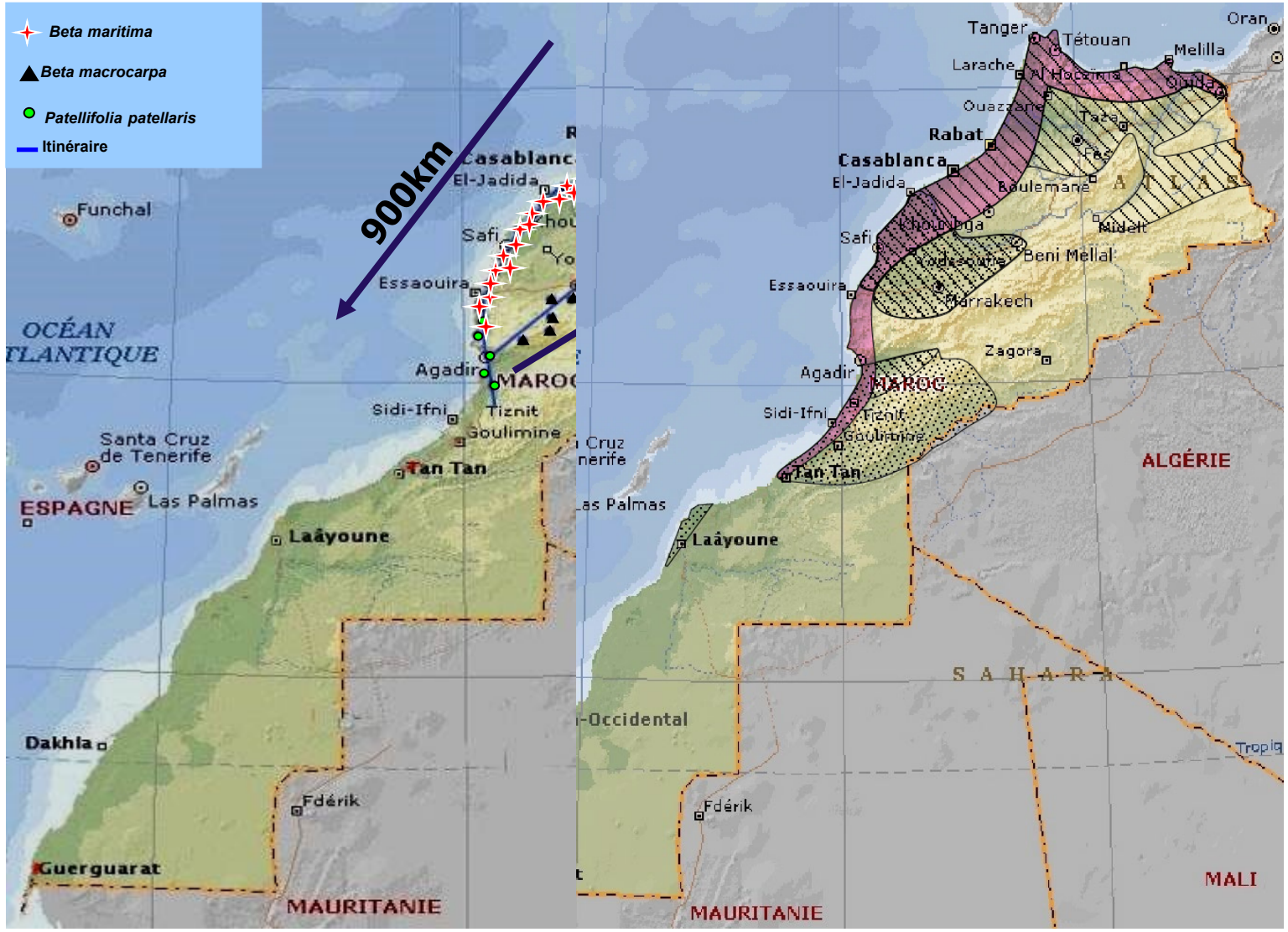
- Resistance to biotic stresses
- Diseases and pests

- Resistance to abiotic stresses
- Drought, salinity, cold

Prospection and collection of main wild beet relatives species in Morocco



Update WBR distribution in Morocco



Collection WBR sites 2018

What was collected

✓ **3 categories:**

- **B. maritima cross pollinated distributed along the Atlantic coast up to 30 km with altitude from 0 to 400 m from sea level**

Beta maritima

All soil types, saline and non-saline, pH neutral

- **B. macrocarpa cross pollinated widely distributed inside the country without specific requirement of pedoclimatic conditions**

Beta macrocarpa

balanced soils with different salinity levels, slightly alkaline neutral pH

- **P. patellaris self pollinated restricted to the south-west coast**

  Altitude from 0 to 230 m from sea level

Patelifolia patellaris

light, non-saline soils, alkaline pH

Morphological evaluation of collected populations

120 populations analysed Controled conditions Green house

50 B maritima 50 B macrocarpa 20 P patellaris

20 Agromorphological traits

48 000 observations **2400** genotypes

Interspecific diversity of leaves and petioles pigmentation

B. macrocarpa

B. maritima

P. patellaris

Interspecific diversity of growth habit

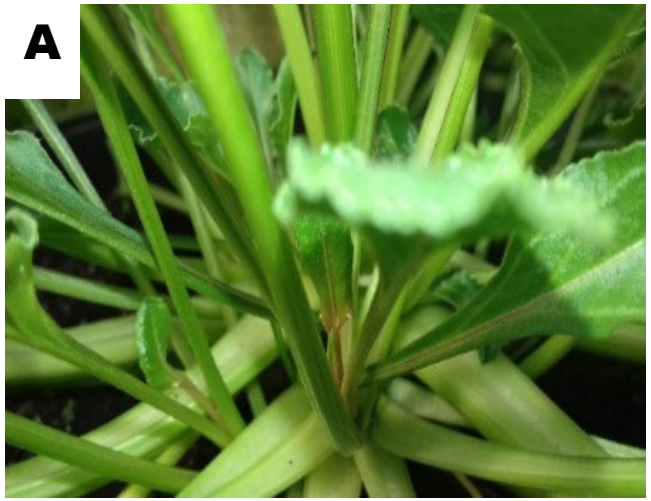
B. maritima erect growth

P. patellaris creeping growth

B. macrocarpa semi elongated growth

Morphological evaluation of WBR genotypes

A = *B. v.* subsp. *maritima*, B = *B. macrocarpa*, C = *P. patellaris*.



Green petiole

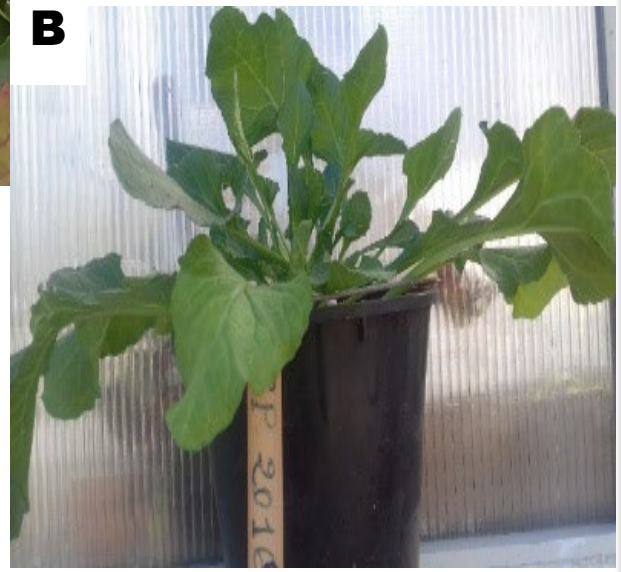
Red petiole

Green leaf

Pigmented leaf

Pigmented stem

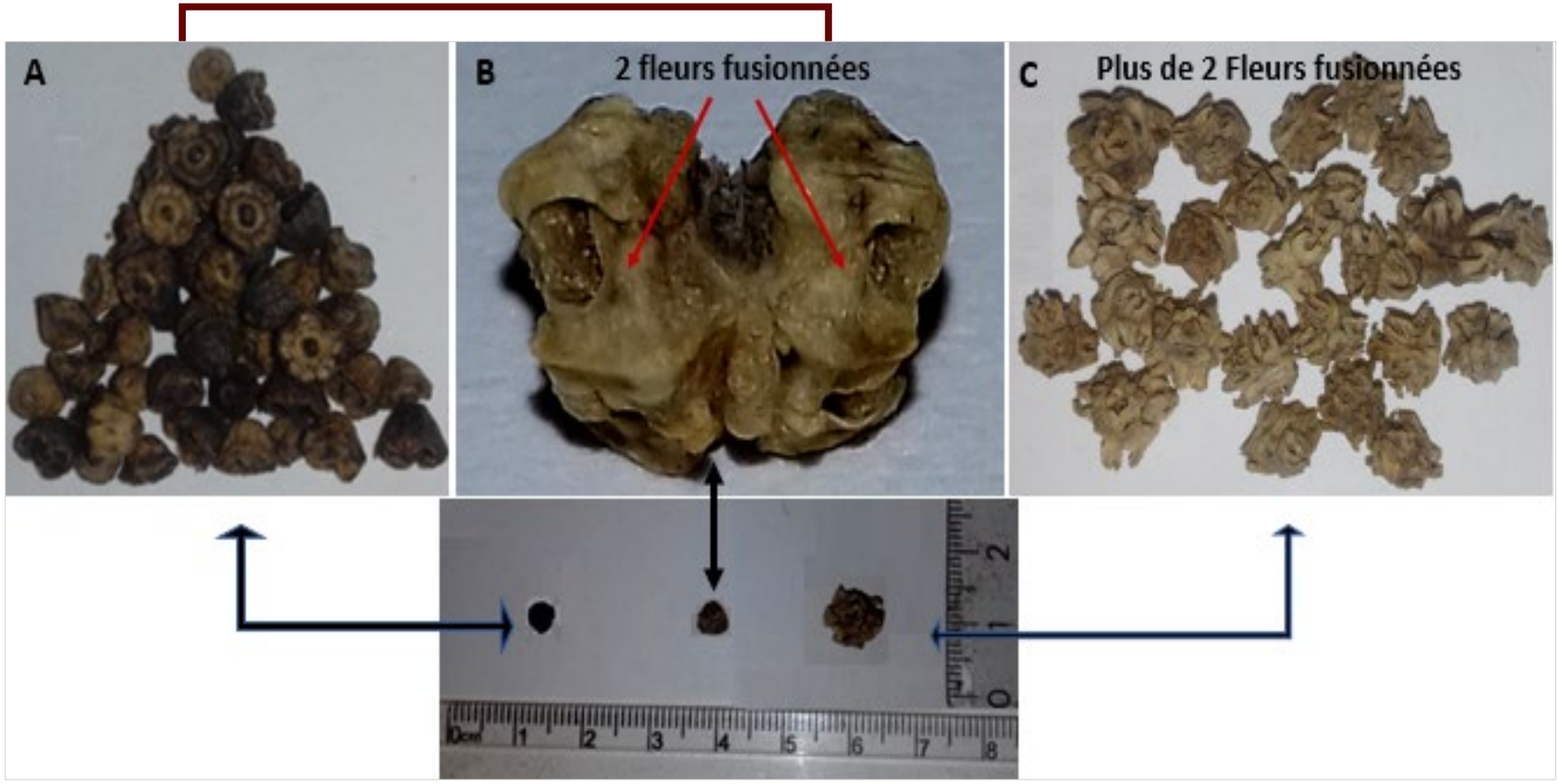
Elongated Plant



Semi elongated erect plant

Erect plant

Germy categories (A) graines monogermes seeds *P. patellaris,* (B) graine bigerme seeds *B. v.* subsp. *maritima* (C) multigerme seeds *B. macrocarpa*



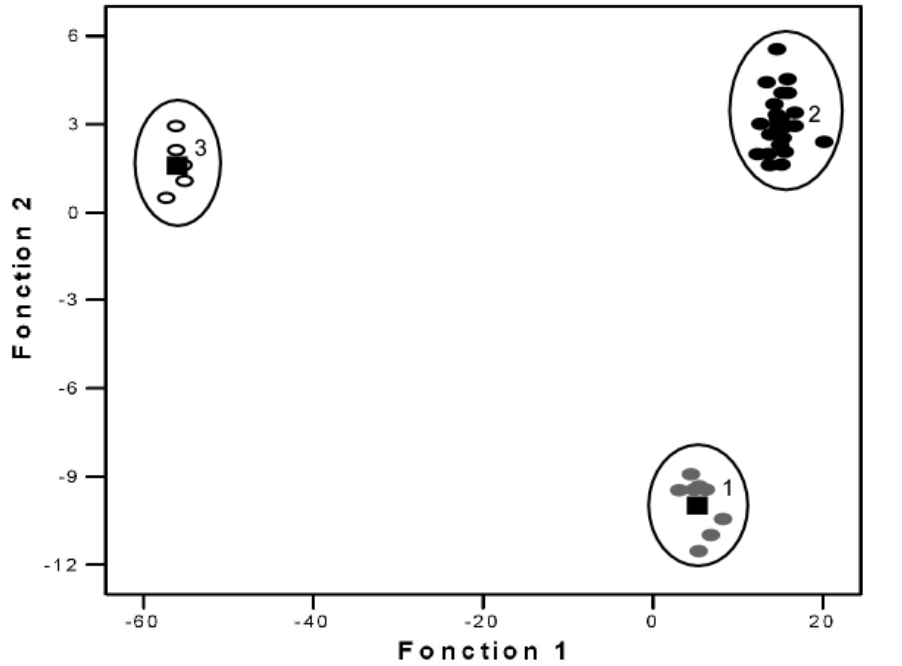
Molecular genetic diversity analysis of moroccan WBR

Locus	N	Nombre d'allèles	PIC
BV2	415	6	0,56
BV3	415	10	0,78
BV5	415	13	0,89
BV6	415	10	0,84
BV7	415	13	0,86
BVMS160	415	8	0,70
BVMS67	415	8	0,74
BVMS77	415	6	0,65
BVMS86	415	11	0,84
BVMS98	415	7	0,68
SB04	415	8	0,76
SB06	415	8	0,82
Total		108	

Genetic diversity parameters of 12 microsatellite markers with (B. maritima, B. macrocarpa, P. patellaris

Discriminant Factor Analysis : wild beet relatives collected in morocco

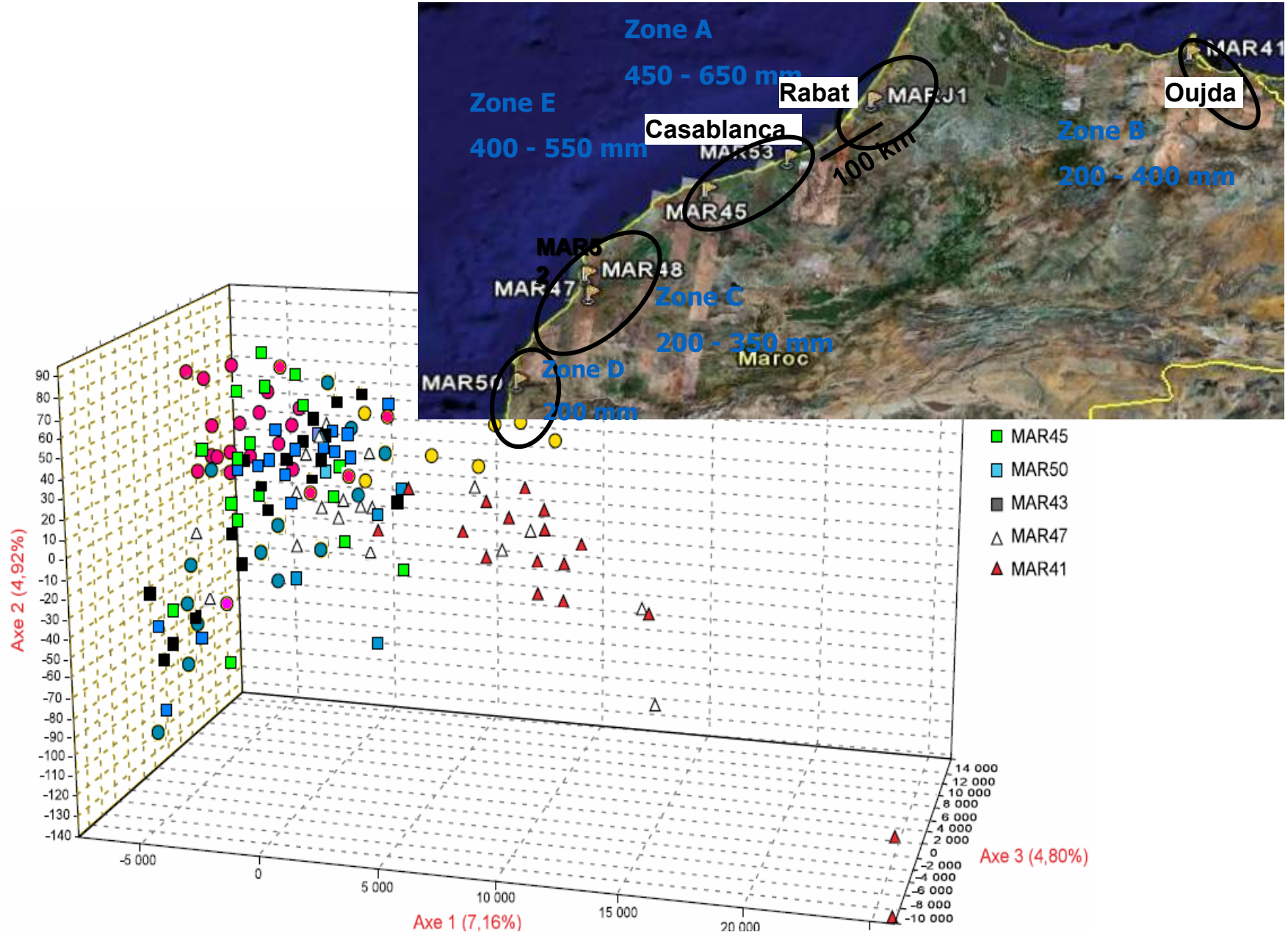
F1 explains 96,3% of total variability
F2 explains 3,7%



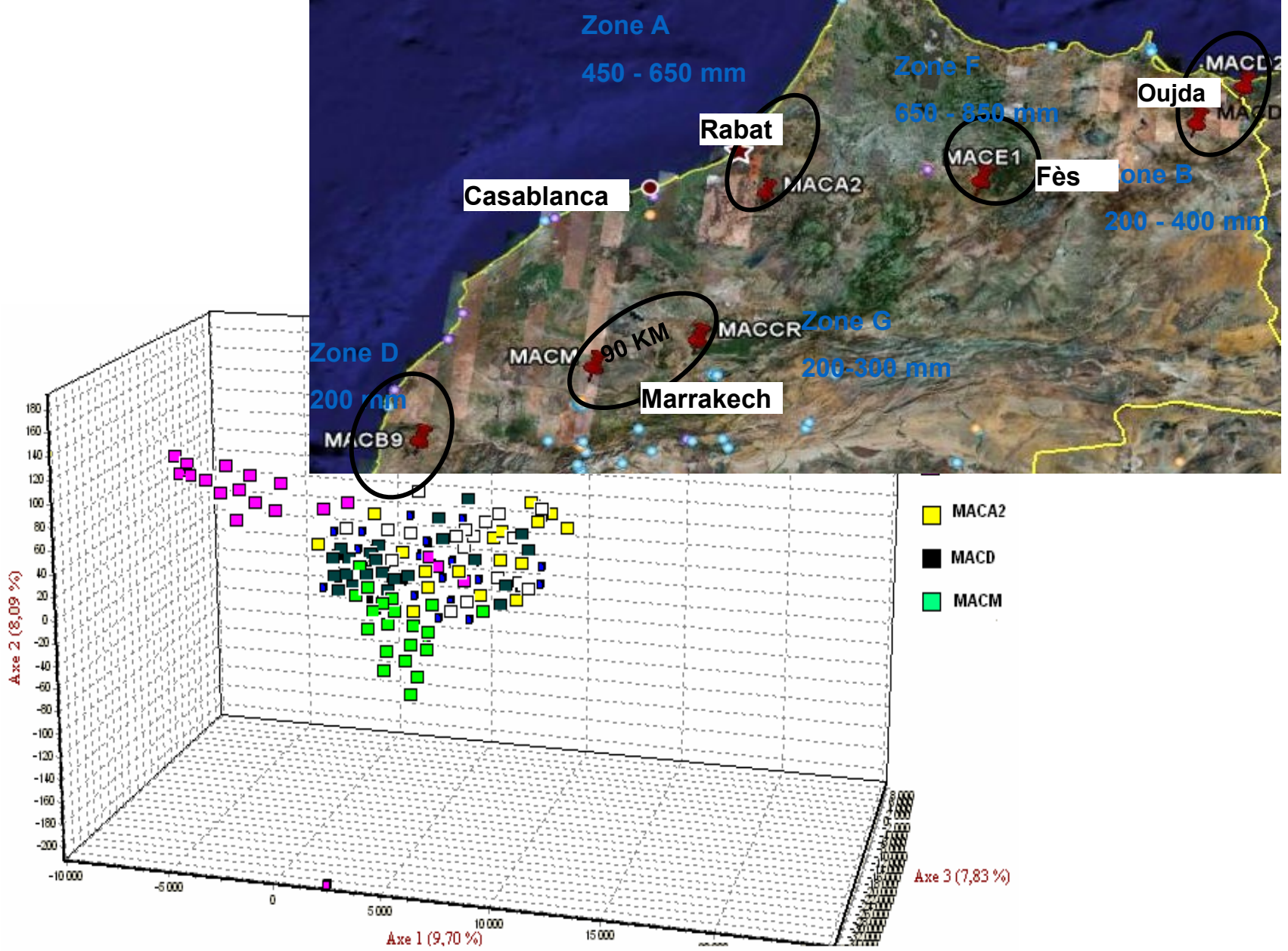
Patellifolia patellaris

Beta maritima

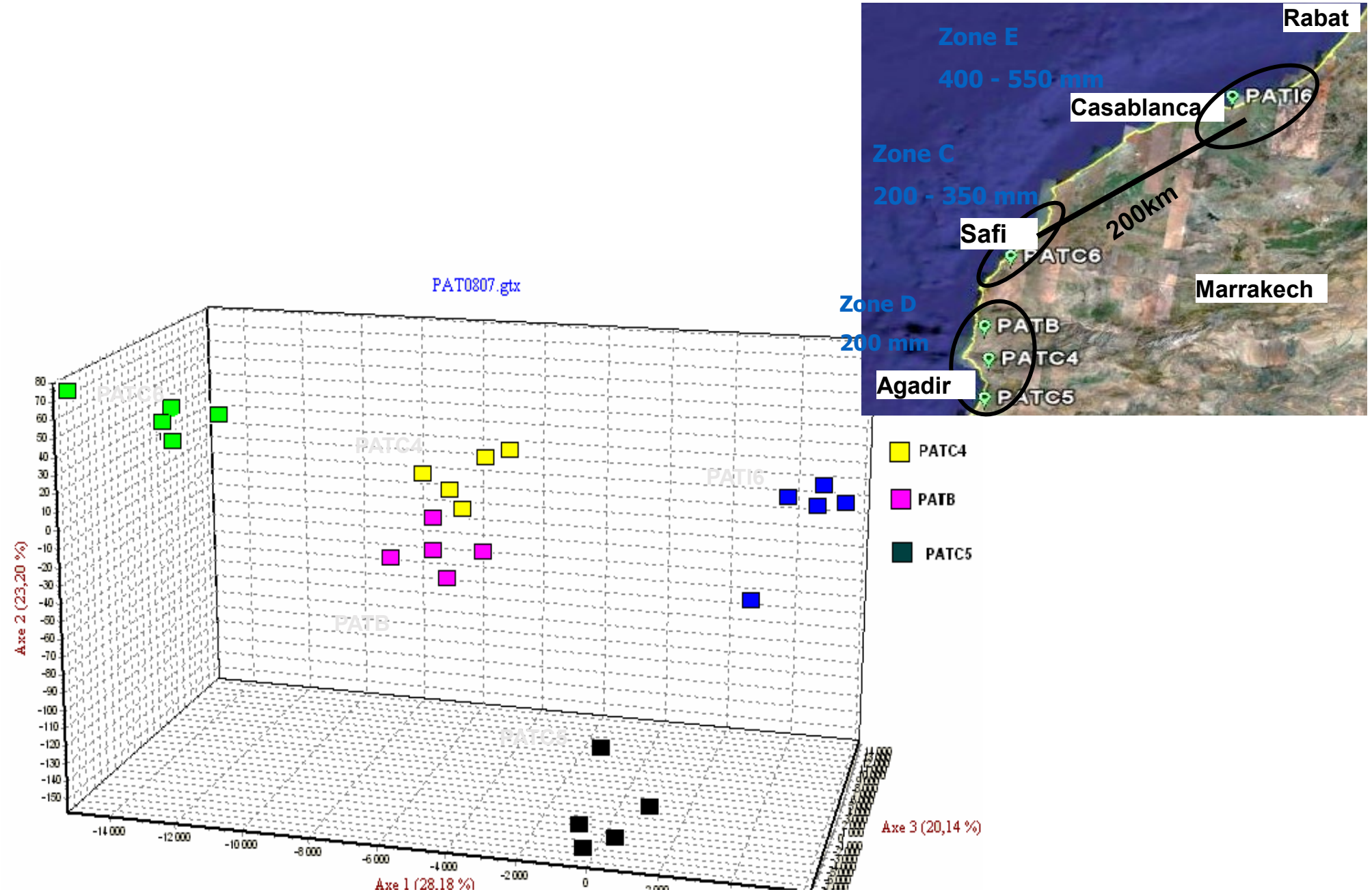
Beta macrocarpa



3 axes CFA explaining 17% of total diversity of collected *Beta maritima*



3 axes CFA explaining 25,6% of total diversity of collected *Beta macrocarpa*



3 axes CFA explaining 71,5% dof total diversity of collected *Patellifolia patellaris*

21 crosses: 208 genotypes

4 crosses: 75 genotypes

B. v. subsp. *maritima*

X

X

283 Hybrides

B. macrocarpa

Caractéristiques Agro-morphological characteristics of 19 WP genotypes and 19 CP involved in interspecific hybridization of local beet germplasm *vulgaris* L.).

	Genentic parental material		
	B. macrocarpa (WP)	B. vulgaris subsp. maritima (WP)	B. vulgaris subsp. vulgaris (CP)
Vernalization	Spontaneous	Spontaneous	-4°C to 4°C for 85 to 100 d
Flowering	88.5	125.9	180 to 240
Flowering period	15.5	22.56	48
Early maturity	181.5	207.7	240 to 261
ASW / plant g	0.65	4.18	133
Biomasse	Low	Low	Important
Cycle Type	Annual	Annual	Bisannual

BISANNUAL CYCLE OF SUGAR BEET

Vernalization

daylight

Sowing → Germination → Flowering → Maturity

year I

year II

Wild genotypes

B. vulgaris subsp. maritima

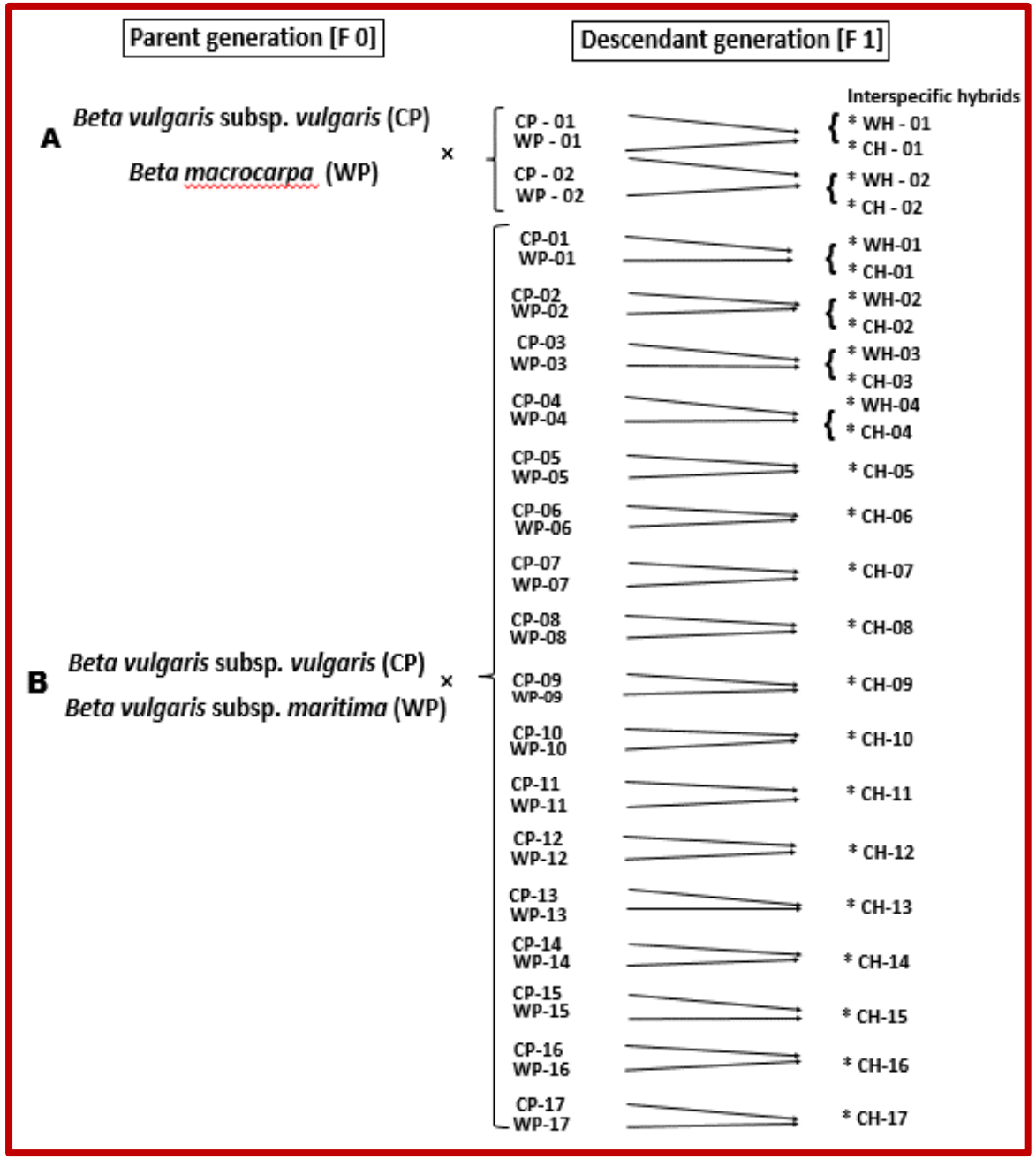
B. macrocarpa

Cultivated sugar beet

B. vulgaris subsp. vulgaris

Flowering synchronization

65 -77 days diffrence in sowing dates



Interspecific hybrides ; wild beets x sugarbeet (INRA-Rabat)

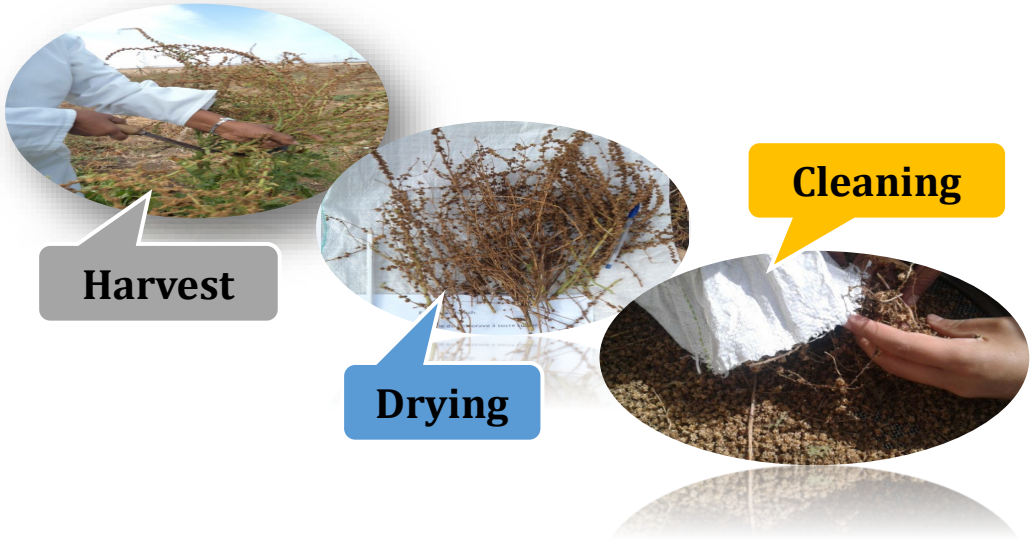
B. v. subsp. vulgaris x B. v. subsp. maritima

	Hybride on cultivated parent (CH)	Hybride on wild parent (WH)
Flowering (%)	83,17	100

B. v. subsp. vulgaris x B. macrocarpa

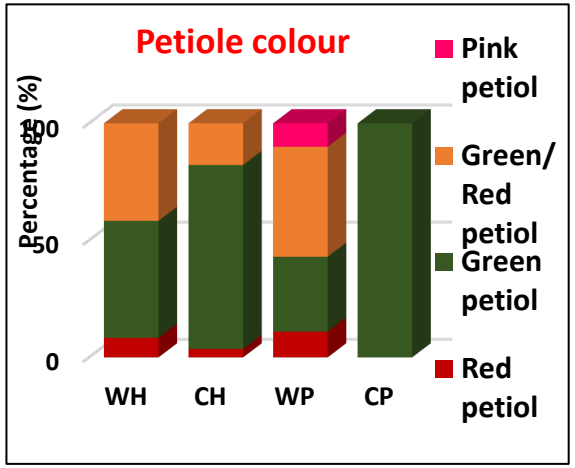
	Hybride on cultivated parent (CH)	Hybride on wild parent (WH)
Flowering (%)	50	100

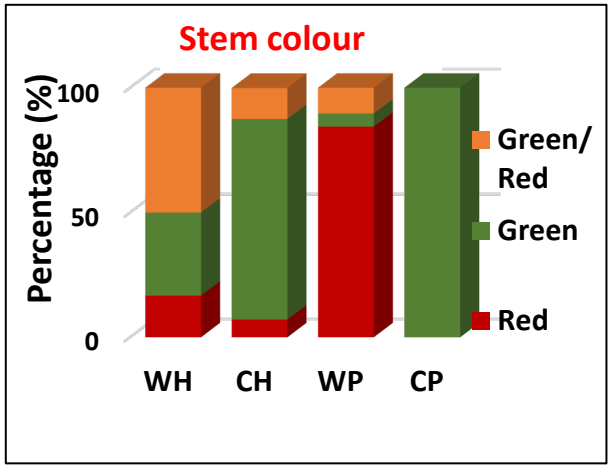
Yield components

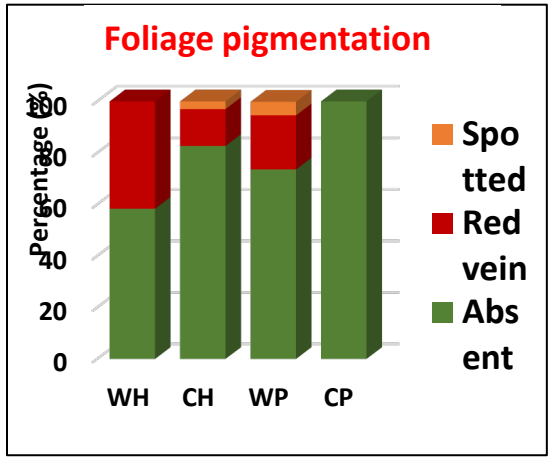


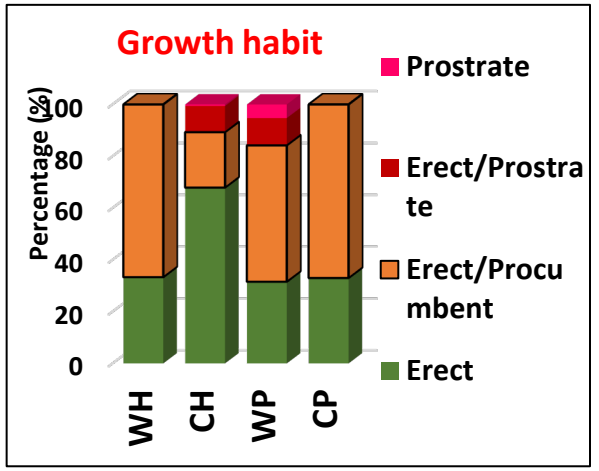
Hybrids phenotypique characterization

WH: Hybrid collected on wild stem / **CH**: Hybrid collected on cultivated stem
Crosses between Sugar beet × B. maritima, in comparision with "**WP** = Wild Parent" and cultivated "**CP** = Cultivated Parent".









Why this study?