

# The AEGRO *Brassica* case study at the EU level

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# Content

Crop *Brassicas*

The *Brassica* gene pool

Wide hybridization  
Brassicaceae phylogeny

Target species

Genetic reserves

## Basic literature for the case study

FitzJohn et al. 2007. Hybridisation within *Brassica* and allied genera: evaluation of potential for transgene escape. *Euphytica* 158: 209-230.

Snogerup et al. 1990. *Brassica* sect. *Brassica* (Brassicaceae). I. Taxonomy and variation.

*Willdenowia* 19: 271-365.

Warwick & Sauder. 2005. Phylogeny of tribe Brassiceae (Brassicaceae) based on chloroplast restriction site polymorphisms and nuclear ribosomal internal transcribed spacer and chloroplast *trnL* intron sequences. *Can. J. Bot.* 83: 467-483.

Warwick et al. 2009. *Guide to Wild Germplasm. Brassica and allied crops (tribe Brassiceae, Brassicaceae)* 3rd Ed. <http://www.brassica.info/info/publications/guide-wild-germplasm.php>

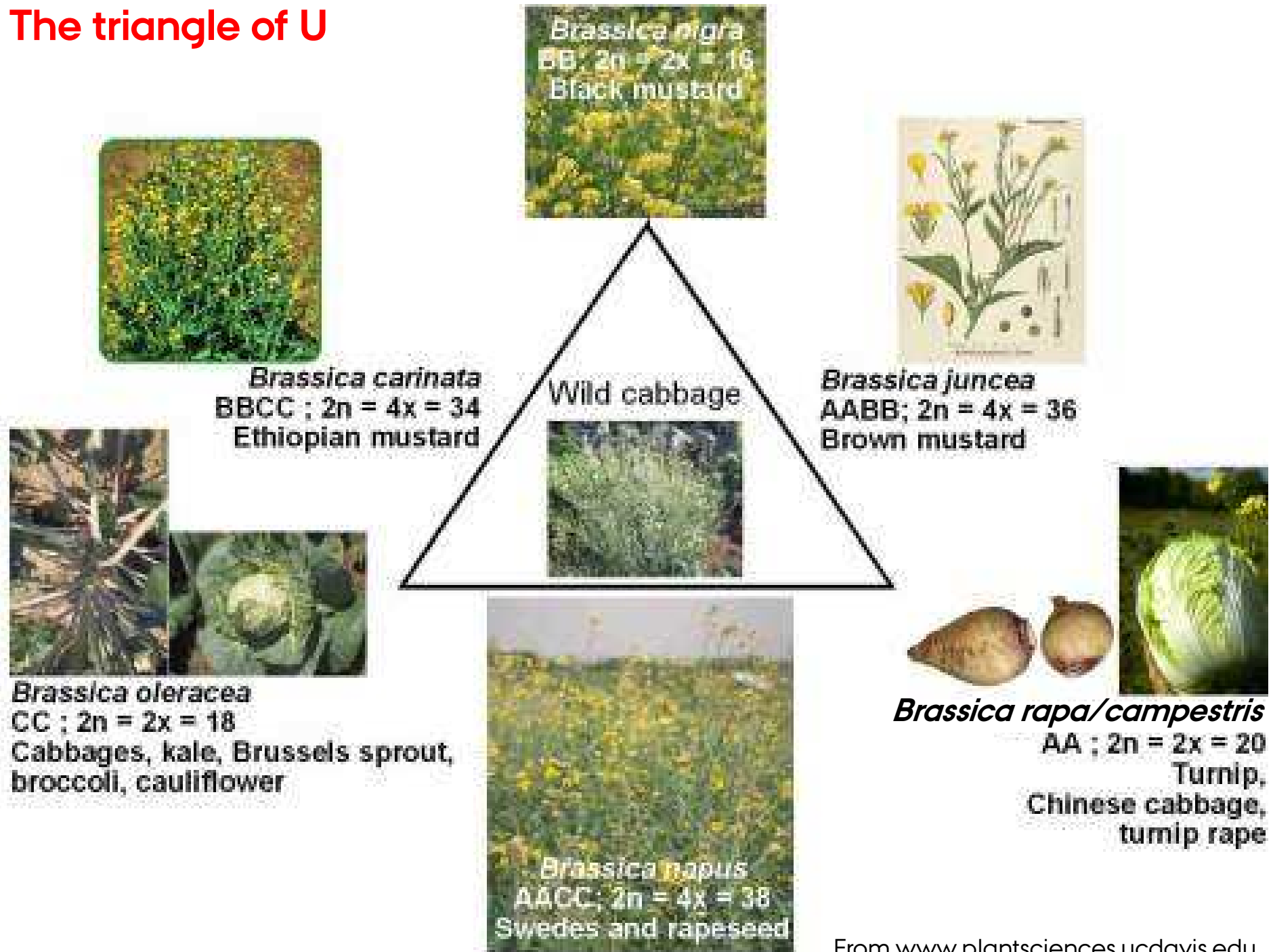
# Crop Brassicas

<i>B. juncea</i>	Indian Mustard, Brown and leaf mustards, Sarepta Mustard
<i>B. napus</i>	Rapeseed, Canola, Rutabaga, Swede Turnip, Nabicol
<i>B. oleracea</i>	Kale, Cabbage, Broccoli, Cauliflower, Kai-lan, Brussels sprouts
<i>B. rapa</i>	Chinese cabbage, Turnip, Rapini, Komatsuna
<i>B. nigra</i>	Black Mustard
<i>B. carinata</i>	Abyssinian Mustard or Abyssinian Cabbage

CWRIS: Euro+Med 14 *Brassicas* cultivated or wild collected (*cretica, hilarionis, incana, insularis, macrocarpa, montana, rupestris, tournefortii, villosa*)

In E Asia *Brassicas* widely used as vegetables

# The triangle of U



## Worldwide production of

Cabbage and other Brassica  $70 \times 10^6$  Mt

Cauliflower and Broccoli  $18 \times 10^6$  Mt

Mustard seeds  $0.5 \times 10^6$  Mt

Rape seed  $58 \times 10^6$  Mt

FAO 2008

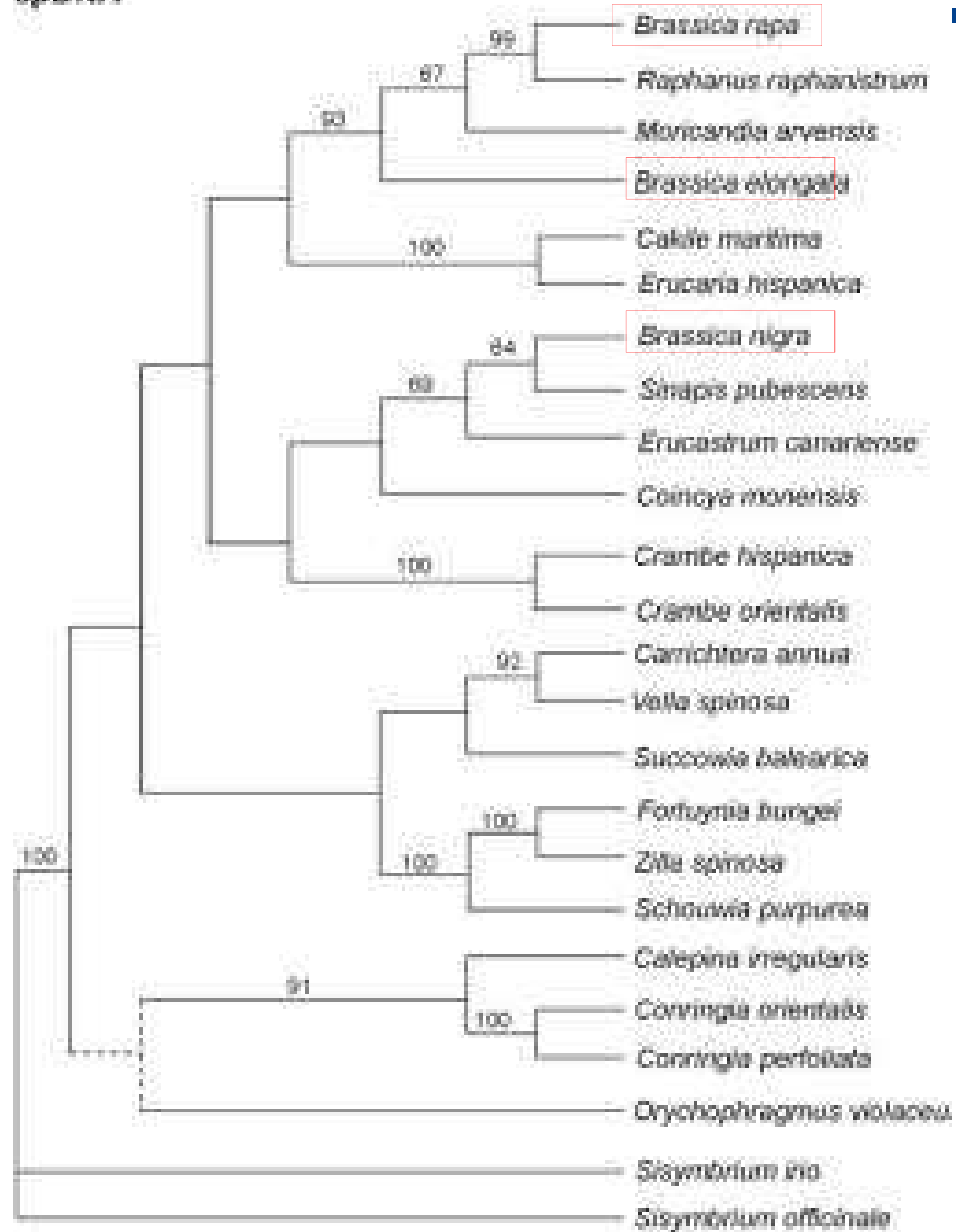
	<b>Interspecific hybrids</b>	<b>Intergeneric hybrids</b>
<i>B. carinata</i> (2n=34)	<i>fruticulosa, juncea, maurorum, napus, nigra, oleracea, rapa, tournefortii</i>	<i>Diplotaxis, Enarthrocarpus, Erucastrum, Ochryphragmus, Raphanus, Sinapis</i>
<i>B. juncea</i> (2n=38)	<i>carinata, gravinae, maurorum, napus, nigra, oleracea, oxyrrhina, rapa, tournefortii</i>	<i>Crambe, Diplotaxis, Enarthrocarpus, Eruca, Erucastrum, Moricandia, Ochryphragmus, Raphanus, Sinapidendron, Sinapis</i>
<i>B. napus</i> (2n=38)	<i>bourgeaui, carinata, cretica, gravinae, juncea, maurorum, montana, nigra, oleracea, rapa, tournefortii</i>	<i>Capsella, Diplotaxis, Enarthrocarpus, Eruca, Erucastrum, Hirschfeldia, Moricandia, Ochryphragmus, Physaria, Raphanus, Rapi-strum, Rorippa, Sinapis</i>
<i>B. nigra</i> (2n=16)	<i>barrelieri, carinata, fruticulosa, juncea, maurorum, napus, oleracea, oxyrrhina, rapa, spinescens, tournefortii</i>	<i>Coincya, Diplotaxis, Erucastrum, Hirschfeldia, Moricandia, Ochryphragmus, Raphanus, Sinapis</i>
<i>B. rapa</i> (2n=20)	<i>barrelieri, bourgeaui, carinata, cretica, fruticulosa, gravinae, incana, insularis, juncea, macrocarpa, maurorum, montana, napus, nigra, oleracea, oxyrrhina, spinescens, tournefortii</i>	<i>Capsella, Diplotaxis, Enarthrocarpus Eruca, Erucastrum, Hirschfeldia, Moricandia, Ochryphragmus, Raphanus, Sinapis</i>

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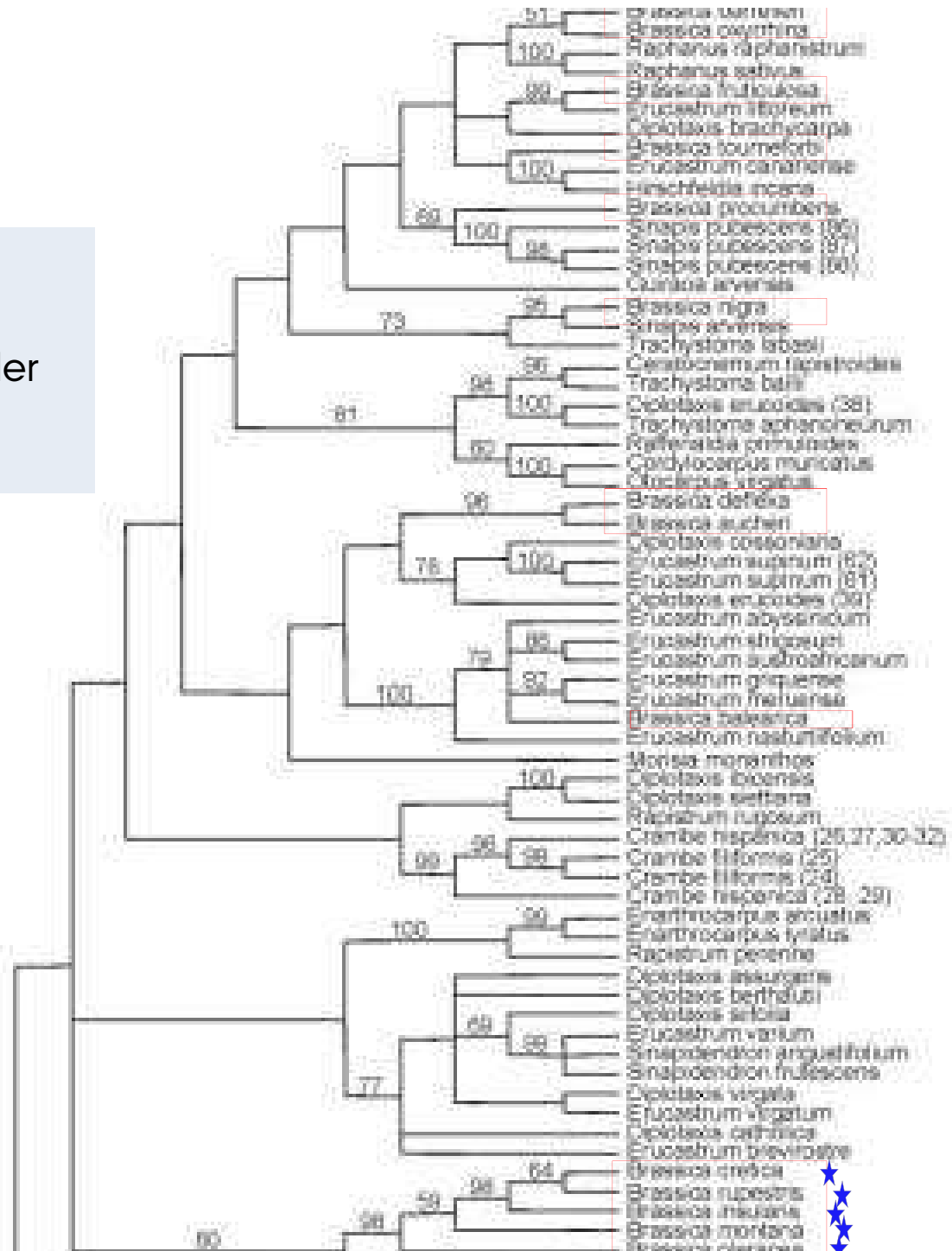
<i>B. oleracea</i> (2n=18)	<i>bourgeaui, carinata, cretica, incana, insularis, juncea, macrocarpa, maurorum, montana, napus, nigra, oxorrhina, rapa, rupestris, tournefortii, villosa</i>	<i>Coincya, Diplotaxis, Enarthrocarpus, Eruca, Erucastrum, Hirschfeldia, Moricandia, Ochryphragmus, Raphanus, Sinapis</i>
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Phylogenetic tree based on chloroplast DNA (Warwick and Sauder 2005)

cpDNA



Phylogenetic tree based on ITS sequences (Warwick and Sauder 2005)



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## Characters identified i *Brassica CWR*

### CHEMICAL TRAITS

Fatty Acids

Glucosinolates

Phenolics

Floral Pigments

Allelopathy

Flavonoids

Peroxidases

Tocopherols

Nectar Production

Mucilage

Cyanide

C3-C4 Photosynthesis

Cytoplasmic Male Sterility

## Characters identified i *Brassica* CWR

### **ABIOTIC RESISTANCE**

Salt Tolerance

Cold Tolerance

Drought Tolerance

Heavy Metal Tolerance

Heavy Metal Hyperaccumulation

Aquatic Habitats

Mycorrhiza

### **HERBICIDE RESISTANCE**

## Characters identified i *Brassica* CWR

### BIOTIC RESISTANCE

White rust

Black spot

Blackleg

Downy mildew

Clubroot

Sclerotinia stem rot

Turnip mosaic virus

Wilt disease

Black rot

Peppery leaf spot

Defensin genes

Flea beetles

Lepidopterous pests-moths

Aphids

Cabbage white fly

Cabbage root fly

Cabbage seed pod weevil

Mustard sawfly

Beet cyst nematode

Root-knot nematode

## European *Brassica* species with restricted distribution areas

*B. cretica* Lam ssp. *cretica* and *laconica* Gustafsson & Snogerup

*B. incana* Ten.

*B. insularis* Moris

*B. montana* Pourr.

*B. balearica* Pers. - Mallorca

*B. bourgeaui* (Webb. ex H. Christ) Kuntze - Canary Islands

*B. cadmea* Heldr. ex O.E. Schulz - Greece

*B. gravinae* Ten. - Italy, N Africa

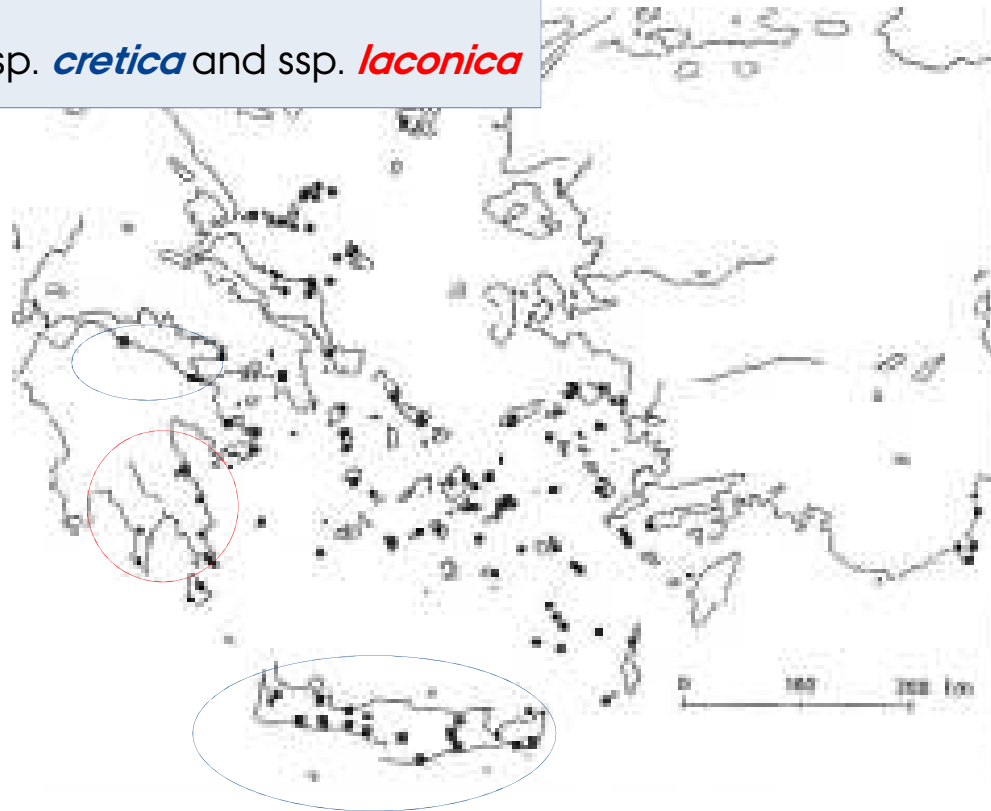
*B. hilarionis* Post - Cyprus

*B. nivalis* Boiss. & Heldr. - Bulgaria-Greece

*B. procumbens* (Poir.) O.E. Schulz - Corsica, Giglio isl. Italy, N Africa

*B. tyrrhena* Giotta, Piccitto & Arragoni - Sardinia

*B. cretica* ssp. *cretica* and ssp. *laconica*



Self-incompatible perennial. Limestone cliffs, gorges and nongrazed ravines. 0-700 m



***Brassica incana***

Perennial, 80-150 cm (3 m). Below limestone cliffs, rocky slopes with macchia, disturbed vegetation along roads. 0-900m. Coastal areas S and C Italy. Coastal areas Croatia and Corfu





Self incompatible, branched perennial up to 150 cm. Open limestone cliffs, rarely porphyry or basaltic rock. Corse, Sardinia and the Tunisian coast. 0-500 m; Corse up to 1200 m



80-150 cm perennial. Limestone cliffs, rocks, macchia and disturbed areas. Mostly coastal (Alpi Apuanae, Italy 1000 m). Risk extinction/introgression from garden grown *Brassica*.

## Genetic reserves

The target species (*B. montana*, *B. incana*, *B. insularis*, *B. cretica* ssp *cretica* and *B. cretica* ssp. *laconica*) have:

- > relative large genetic differences among populations
- > populations are isolated by distance.

Thus several populations of each species have to be included in genetic reserves

# Locations suggested as genetic reserves



*B. cretica*  
ssp.  
*cretica*

*B. cretica*  
ssp.  
*laconica*

Ellenikon, Lakonia, Peloponnisos  
Charakas (Zarakas), Lakonia, Peloponnisos  
Valanidia (Velanidia), Lakonia, Peloponnisos

## Locations suggested as genetic reserves



*B.*  
*incana*

Sorrento peninsula, Italy  
Curzola and islets, Croatia  
Korfu, Othoni, Greece

## Locations suggested as genetic reserves

<i>B. insularis</i>	Monti Rossi-Teghime, Corsica Alpa Mariuccia, Corsica Inzecca, Corsica Capo Caccia, Sardinia Isole de Cavoli, Sardinia Isola Rossa, Sardinia
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## Locations suggested as genetic reserves

<i>B. montana</i>	Gerona coast, NE Spain Mount Faron-Le Croupatier, Toulon, France Gorges de la Bevera, Menton, France Capo di Noli, Italy Alpi Apuanae, Italy
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Thank you for your attention