



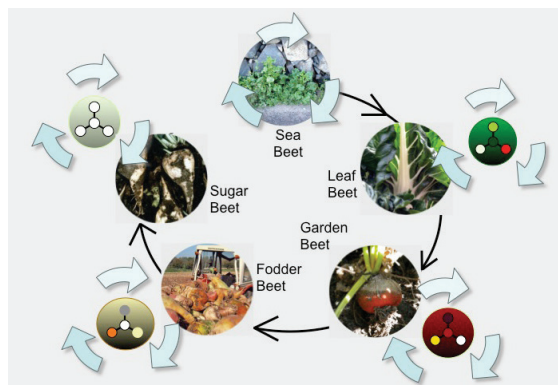
# The sugar beet crop genepool

Sugar beet is one of the most important cash crops of European origin grown world-wide. Sugar beet and the closely related cultivar groups Leaf, Garden, and Fodder beet derive from *Beta vulgaris* subsp. *maritima*, called the sea beet. The sugar beet was developed from fodder beet around 1800.

Since the beginning of large scaled sugar production, the crop has to be protected against a wide range of pests and diseases. Breeders realised the significance of crop wild relatives as a genetic resource already in the 1920s. Since then wild beets and landraces are increasingly used as donors of resistance genes and for broadening the genetic base of the sugar beet crop in general. Engaged breeding researchers and plant breeders started collecting germplasm already in the 1930s.

The genepool (GP-1, GP-2, GP-3; figure below) consists of two genera (*Beta*, *Patellifolia*) and twelve species. The names of endangered species/subspecies are printed in red letters. The genetic diversity of wild beet species is difficult to maintain off the natural distribution area. The conservation of wild species in their natural habitat (*in situ*) is therefore of utmost importance as it secures the genetic diversity required to replenish the sugar beet breeding pool. The maintenance of leaf, garden and fodder beet breeding programmes is of similar importance for the same reason.

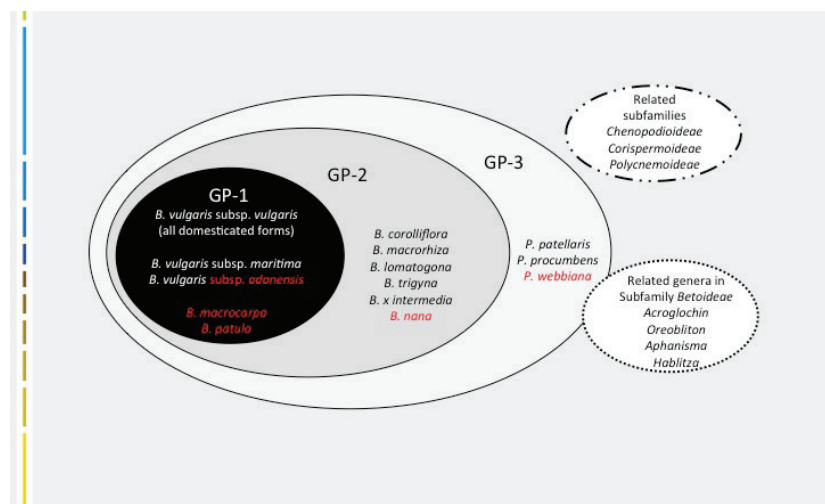
The distribution area of wild species ranges from the southern part of Norway southwards along the Atlantic coast including the UK, Ireland, the Azores and the Capverdian Islands. From west to east the area extends from the Azores to the eastern Caucasus Mountains and western Iran. Species such as *Beta vulgaris* subsp. *maritima* or *B. macrocarpa* are adapted to high soil salinity. Species of *Beta* section *Corollinae* mainly occur in Turkey and adjacent regions above 800 m altitude where they survive hot and dry summers and snowy and cold winters. *Patellifolia* species are mainly distributed in southern Spain, in Morocco, and the Canary Islands. Adaptations of the species to a wide range of habitats generated high variation in genes plant breeders use to improve yield as well as the tolerance and resistance to abiotic and biotic plant stresses.



*Beta nana* is a mountainous species of the snow patch vegetation endemic to Greece. It is a perennial, frost resistant species.



Flowering *B. macrocarpa*. Site of *B. lomatogona* the Talysch Mountain in Azerbaijan (group photo below).





Left: A site of *P. procumbens* on La Gomera. Right: Seeds of *Patellifolia patellaris*.

Variation for trait	Taxon																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Salinity tolerance																		
Frost tolerance																		
Curly Top resistance																		
Yellowing viruses (BYV) resistance																		
Beet mild yellowing virus (BMV) resistance																		
Beet mosaic virus (BMV) resistance																		
Beet necrotic yellow vein virus (BNYVV) resistance																		
Yellow wilt resistance																		
<i>Peronospora farinosa</i> resistance																		
<i>Erysiphe betae</i> resistance																		
<i>Rhizoctonia solani</i> resistance																		
<i>Cercospora beticola</i> resistance																		
<i>Polymyxa betae</i> resistance																		
Black leg disease resistance																		
<i>Erwinia sp.</i> resistance																		
<i>Heterodera schachtii</i> resistance																		
<i>Heterodera trifolii</i> resistance																		
<i>Meloidogyne hapla</i> resistance																		
<i>Meloidogyne incognita</i> resistance																		
<i>Meloidogyne javanica</i> resistance																		
<i>Meloidogyne arenaria</i> resistance																		
<i>Myzus persicae</i> resistance																		
<i>Pegomya sp.</i> resistance																		

Above: Valuable traits of *Beta* and *Patellifolia* species are listed.

- 1- *Beta vulgaris* (B. v.) subsp. *vulgaris*
- 2- B. v. subsp. *vulgaris* Leaf Beet group
- 3- B. v. subsp. *vulgaris* Garden Beet group
- 4- B. v. subsp. *vulgaris* Fodder Beet group
- 5- B. v. subsp. *vulgaris* Sugar Beet group
- 6- B. v. subsp. *maritima*
- 7- B. v. subsp. *adanensis*
- 8- *Beta macrocarpa*
- 9- *B. patula*
- 10- *B. corolliflora*
- 11- *B. macrorhiza*
- 12- *B. lomatogona*
- 13- *B. intermedia*
- 14- *B. trigyna*
- 15- *B. nana*
- 16- *Patellifolia procumbens*
- 17- *P. webbiana*
- 18- *P. patellaris*



Resistance to the Rizomania disease caused by Beet Necrotic Yellow Vein Virus (BNYVV) was detected in a sea beet population at the Kalundborg Fjord in Denmark (pictures above).

Beet samples at NIAB innovation farm. The samples demonstrate the domestication process. Sea beet samples are shown as well as representatives of the cultivar group Leaf, Garden, Fodder and Sugar Beet.

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Sources used

Biancardi, E., Campbell, L.G., Skaracis, G. N., Biaggi, M. de (eds.) (2005) *Genetic and Breeding of Sugar Beet*. Science Publishers, Inc. Enfield (NH), USA, Plymouth, UK.

Frese, L. (2010) Conservation and Access to Sugarbeet Germplasm. *Sugar Tech* 12, 3-4, pp 207-219.



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