# Innovative breeding research project underpins the value of genetic reserves

***Lothar Frese[1] and Gina Capistrano-Gossmann[2]***

*[1]Julius Kühn-Institut, Federal Research Centre for Cultivated Plants (JKI), Institute for Breeding Research on Agricultural Crops, Quedlinburg, Germany*

*[2]Plant Breeding Institute, Christian-Albrechts-Universität zu Kiel, Kiel, Germany*

"Crop wild relative populations of *Beta vulgaris* allow direct mapping of agronomically important genes" is the title of a paper recently published in Nature Communications (Capistrano-Gossmann et al. 2017). The researchers used two CWR populations of *Beta vulgaris* subsp. *maritima* for fine mapping and rapid identification of a Rhizomania resistance gene. The resistance trait was detected in a genebank accession collected at the coast of the Kalundborg Fjord in Denmark (Lewellen et al. 1987; Scholten et al. 1996, 1999) where the species exists since 1952 at least (Lewellen et al. 1987). The trait was introgressed into the sugar beet and lines with improved resistance to Rhizomania, a disease caused by the Beet Necrotic Yellow Vein Virus (BNYVV), were released by the USDA/ARS in the 1990s (Lewellen et al. 1995).

The Kalundborg Fjord population proved to be a random mating population in Hardy-Weinberg-Equilibrium which allowed the researchers the application of an innovative concept. Instead of creating an artificial sugar beet mapping population, seeds of individual wild beet plants in the large population spread along the sea shore of the Kalundborg Fjord were harvested. This material was used to identify the resistance gene *Rz2* with a modified version of mapping-by-sequencing. The results of this approach were confirmed in a second CWR population located in Brighton, France, greatly underpinning the importance of *in situ* conservation of crop wild relatives. These populations harbour further traits with great value for sugar beet breeding programmes.

The genetic reserve conservation technique has been developed to systematically implement the *in situ* conservation strategy in practice (Maxted et al. 1997) and was further elaborated and tested using CWR of cultivated beets (Kell et al. 2012). In the context of the AEGRO project, suitable locations for the establishment of genetic reserves for targeted crop wild relative taxa across Europe have been proposed in 2011. Inter alia, the Kalundborg Fjord area has been recommended as a site suited to maintain genetic variation of the economically important Rhizomania resistance trait. The findings of Capistrano-Gossmann and co-authors reinforce the recommendation. The population is distributed within the NATURA 2000 site N166, covering the area between the outer coastal areas of Røsnæs and the recommended genetic reserve site at Gisseløre, Houget (http://www.agrobiodiversidad.og/aegro/). Since decades, the area harbours a stable population with economically important traits and evident scientific value. Even the legal framework would allow the integration of a genetic reserve as a discrete component into the protected area management plan as was argued by Kristiansen and Frese in 2011. What else is needed to establish a genetic reserve?

## References

Capistrano-Gossmann G. et al. 2017. Crop wild relative populations of Beta vulgaris allow direct mapping of agronomically important genes. Nature Communications 8:15708 (DOI: 10.1038/ncomms15708).

Kell S, Maxted N, Frese L, Iriondo JM. 2012. *In situ* conservation of crop wild relatives: a strategy for identifying priority genetic reserves sites. In: Maxted N, Dulloo ME, Ford-Lloyd BV, Frese L, Iriondo JM, Pinheiro de Carvalho MÂA (eds). Agrobiodiversity Conservation: Securing the Diversity of Crop Wild Relatives and Landraces. Wallingford, CAB International. pp.7–19.

Kristiansen K, Frese L. 2011. The legal framework and action plans relevant to the establishment of a genetic reserve in Denmark (AEGRO documents, Annex 9, available online: http://aegro.jki.bund.de/aegro/uploads/tx_neofileshare/2012-05-03_13-39-48_A09_Legal_Framework_Denmark_Establishment_Genetic_Reserves.pdf)

Lewellen RT, Skoyen IO, Erichsen AW. 1987. Breeding sugarbeet for resistance to rhizomania: evaluation of host–plant reactions and selections for and inheritance of resistance. In: Proceedings of the 50th Winter Congress of the IIRB, 1987. International Institute for Beet Research, Brussels, pp.139–156.

Lewellen RT. 1995. Registration of C859 germplasm of sugar beet resistant to Rhizomania. Crop Science 35:289–290.

Maxted N, Hawkes JG, Ford-Lloyd BV, Williams JT. 1997. Chapter 22. A practical model for *in situ* genetic conservation. In: Maxted N, Ford-Lloyd BV, Hawkes JG (eds.). Plant genetic conservation: the *in situ* approach. London, Kluwer Academic Publishers. pp.339–364.

Scholten O, Jansen RC, Keizer L, De Bock T, Lange W. 1996. Major genes for resistance to beet necrotic yellow vein virus (BNYVV) in *Beta vulgaris*. Euphytica 91:331–339.

Scholten O, De Bock T, Klein-Lankhorst RM, Lange W. 1999. Inheritance of resistance to beet necrotic yellow vein virus in *Beta vulgaris* conferred by a second gene for resistance. Theoretical and Applied Genetics 99:740–746.