their genetic evaluation. Collection trips for *Beta* have been conducted since 2005, covering different climatic regions from Atlantic coast and inland areas. Nineteen populations from the collection were evaluated for genetic diversity. Eight *Beta maritima*, six *Beta macrocarpa* and five *Patellifolia patellaris* populations were analysed using 12 polymorphic microsatellites markers.

High genetic diversity was observed between and within populations of each studied group. Allelic richness was about (5.13) for *B. macrocarpa*, (5.07) for *B. maritima* and (1.6) for *Patellifolia*. Analysis of Functional Correspondence showed a low *B. macrocarpa* and *B. vulgaris* subsp. *maritima* population genetic structure. On the opposite, *Patellifolia* showed very highly structured populations. Gene flow was significant within *B. macrocarpa* despite the fact that it is a self-pollinated plant. It occurs probably by seed transfer and transportation. Gene flow within and between *B. vulgaris* subsp. *maritima* is the result of both seed and pollen migration. Gene flow was very low within *Patellifolia* group as it is a highly autogamous species.

The evaluated germplasm involves a high genetic diversity. The Moroccan collection is of great interest for introgression of genes of interest into cultivated beet.

Drought physiology of sugar beet compared with its wild relative Beta vulgaris *subsp.* maritima

(abstract provided by authors who were unable to attend the meeting)

E.S. Ober, D. Johnston

Insufficient soil moisture limits sugar beet (*Beta vulgaris* subsp. *vulgaris*) yields in the UK and other water-limited areas. It was hypothesized that the wild maritime relative *B. v.* subsp. *maritima*, which often thrives in saline and dry habitats, may have desirable drought tolerance traits that could be introgressed into elite sugar beet germplasm. To test this hypothesis, the performance of commercial sugar beet hybrids were compared with *maritima* accessions under well-watered and water-limited conditions. Various physiological and morphological features relating to drought tolerance were studied in sugar beet and *maritima* types from England, Greece and Corsica in both field and glasshouse experiments. In the field experiments, *maritima* types maintained greater turgor, net photosynthesis, stomatal conductance and transpiration rate than sugar beet, especially under water-limited conditions. However, *maritima* types had a lower total dry weight (TDW), water-use efficiency (WUE) and radiation use efficiency than sugar beet. This suggests that the whole plant net photosynthesis and/or the conversion of fixed CO_2 into dry matter was smaller in *maritima* types than in sugar beet. The percentage decrease in TDW and relative growth rate (RGR) due to water-limited conditions was similar in both *Beta* types, suggesting that sugar beet had similar tolerance to stress as *maritima*. In the glasshouse experiment, similar leaf water potentials, net photosynthesis, stomatal conductance and transpiration rate were obtained in both *Beta* types. As in the field experiment, *maritima* had a smaller TDW and WUE than sugar beet. However, the percentage decrease in TDW and RGR due to water-limited conditions was smaller in *maritima* than in sugar beet. This may have been due to the faster onset of water deficit in the glasshouse compared to the field experiments. It was concluded that the *maritima* accessions studied were not more drought tolerant than sugar beet. Further work has shown that sufficient diversity for drought tolerance exists within elite sugar beet germplasm to enable breeding progress. However, the *maritima* accessions did show greater osmotic adjustment than the hybrids, which deserves further investigation.

Biogeographical determinants of population structure in Beta nana

C.M. Richards, A.L. Fenwick, B.C. Hellier, L. Panella, L. Frese

Beta nana is a rare alpine species endemic to Greece. It is a crop wild relative of cultivated beet (*Beta vulgaris* subsp. *vulgaris*) and is an important genetic resource for breeding cold

tolerance and other traits. A plant exploration conducted in 2005 found 26 occurrences of this wild beet on six mountain locations that span 3 phytogeographical zones in Greece, from Mount Olympos in the north to Mount Taygetos in the south. In addition to seed collections, leaf materials from ca. 30 individual plants were collected at each mountain location. These samples were used to estimate the patterns of genetic diversity and differentiation using co-dominant simple sequence repeat (SSR) loci. Specifically these genotypic data were used to estimate the hierarchical genetic structure across these discrete alpine habitats in Greece and to estimate ongoing and historic demographic and gene flow patterns linking these sites. Importantly these patterns of genetic differentiation were compared to environmental niche models for the species.

Integration of spatial and genetic data was used to assess the impact of various climate models on this specialized species' range and assist in identifying regions of critical conservation priority.

Preliminary work looking at tissue from plants arising from collected seed at Mt Olympos, Mt Giona, Mt Vardousia and Mt Parnassos showed similar results to Nagamine and Ford-Lloyd (1989)[6] who had found five unique and invariant allozyme alleles compared to other species. A high overall inbreeding associated to locus information was detected with SSR markers from populations at nine specific sites comprising 180 individuals. Population specific variation with SSRs also showed huge inbreeding with some populations showing no variation. Genotypic data has shown that if loci are polymorphic, almost all of the diversity is among the different mountain tops.

Discussion

A. Tan pointed out that the development of protocols for germination of *Beta nana* would be useful.

B. Ford-Lloyd remarked that it would be useful to better understand the ecology of this species also in order to be able to guess the effects of climate change. Currently it is not easy to grow this species outside of its natural habitat.

***Project discussion: Genetic diversity and gene flow in* Beta nana**

(led by L. Panella and P. Ralli)

P. Ralli presented a proposal for a research study for *in situ* conservation of *Beta nana* on Mount Olympus, to be carried out in collaboration with the Services responsible for protection of the Olympus National Park. It is important to know that Mount Olympus is a National Park and also belongs to the Natura 2000 protected area network. The location is also close to the genebank, which is an advantage. The threat from human activities or from grazing is more limited here than in other areas where *Beta nana* was detected. However, climatic and environmental changes can be a more immediate threat, since this species is adapted to conditions of low atmosphere pressure and oxygen concentration, low temperature and high relative humidity. The purpose of the project would be the detection of appropriate areas for *in situ* conservation of *Beta nana* and monitoring of *Beta nana* populations that were located in previous expeditions (Dale 1980, 1981; Frese et al. 2009)[7], as well as surveying additional areas.

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[6] Nagamine T, Ford-Lloyd BV. 1989. New genetic markers in a wild species of beet (*Beta nana* Boiss. et Heldr.): prospects for utilization. Plant Breeding 102:344–347 (doi: 10.1111/j.1439-0523.1989.tb01268.x).

[7] Dale MFB. 1980. Report on 1980. Survey on *B. nana* in Greece. Copy available at the Greek Genebank, Thessaloniki.