Master projects on macroalgae genetics

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There is an enormous potential for value creation based on kelp production along the Norwegian coast and a strong interest in developing cultivars with improved traits. Worldwide, the total production of cultivated macroalgae in 2018 was 32.4 million tons (fresh weight), worth 1.3 billion USD (FAO 2020). The production is increasing steadily, in 2000 it was only 10.6 million tons. Most of the production occurs in Asia, but Olafsen et al. (2012) suggested that a production level of 20 million tons should be possible in Norway by 2050. Globally, cultivation of kelp and other macroalgae is expected to become an increasingly important source of human food, and the production is recognized as being environmentally sustainable (Duarte et al. 2009, 2017). The biomass production is large, in spite of no fertilizers or pesticides being used. In addition, cultivated macroalgae can contribute significantly to carbon sequestration and absorb polluting nutrients released from fish aquaculture. Kelp has a large range of potential uses: human food, animal feed (either directly, as a feed ingredient, or as a resource for yeast production), biochemicals (such as alginate), pharmaceuticals, agricultural fertilizer, and bioenergy. A potential problem with extensive use of kelp for food and feed, however, is the high content of certain minerals, e.g. iodine (I) and arsenic (As) (Banach et al. 2020).

The role and success of selective breeding in both agri- and aquaculture shows that selective breeding is likely to be of high importance for future cultivation and utilization of kelp worldwide, boosting economic and environmental sustainability of marine aquaculture, and creating markets for the aquaculture, processing and breeding industries. Selective breeding of kelp is a new field of research outside Asia, and we have recently published a review paper on the topic (Goecke et al., 2020).

This master project is associated with a project funded from the Norwegian Research Council (Grensesprengende havbruksideer, HAVBRUK) – Breed4Kelp2Feed (8 mill. NOK, 2018-2022), which is a collaboration between BIOVIT, Sintef Ocean AS, Scottish Association of Marine Sciences, and Seaweed Energy Solutions (SES). You will take part in a short-term selection experiment based on mixed hybridization and phenotypic selection of large individuals (to demonstrate the potential of selective breeding also in kelp, and to obtain genetic information) (Fig. 1). In the selection experiment we will genotype (genotyping by sequencing (GBS)) 159 parents as well as 800 individuals of both F1 and F2. The F1 individuals have already been phenotyped for yield-related traits (fresh weight, stipe length, blade length and blade width). Forty of the longest individuals and 40 random individuals were selected as parents for F2 and a control population (C), respectively. In 2021 you will take part in phenotyping and genotyping 800 F2 individuals, phenotyping of around 200 C individuals and in the estimation of genetic variance, heritability, genetic correlations between traits and genetic response.

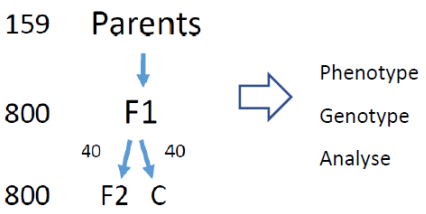

Fig. 1. The selection experiment in Breed4Kelp2Feed