OPTIMISC: Developing miscanthus value chains for marginal site conditions

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Introduction

Despite large genetic variability of miscanthus in natural habitats, the production of miscanthus in Europe is currently dominated by a single clone, *M.* × *giganteus*. Cultivation of *M.* × *giganteus* is limited by low winter temperatures in the North and East Europe and by drought in the southern regions. Expanding the gene pool beyond *M.* × *giganteus* and using genotypes better adapted to particular environmental conditions could extend the climatic and edaphic ranges in which this crop can be grown.

Genetic variability of miscanthus in nature and its high resource-use efficiency provide opportunities for developing miscanthus genotypes suitable for cultivation on marginal land characterized by drought or salinization. However, for miscanthus production under such conditions safe and low-cost establishment and harvesting technologies are needed. Due to high variability in quality parameters of the biomass of different miscanthus genotypes, it also has a good potential for higher-value uses such as building materials, bioplastics, animal husbandry and chemical applications.

Objective

The main **objective of OPTIMISC** ("Optimizing Miscanthus Biomass Production") project is to optimize miscanthus bioenergy and bioproduct chains by

- trialling elite germplasm types over a range of sites across Europe, Russia and China,
- identifying miscanthus genotypes tolerant to the four key abiotic stresses and analysing the key traits that currently limit the potential of miscanthus,
- identifying high-value bioproducts,
- modelling the combined results to provide recommendations to policy makers, growers and industry.

Overwiev of the progress

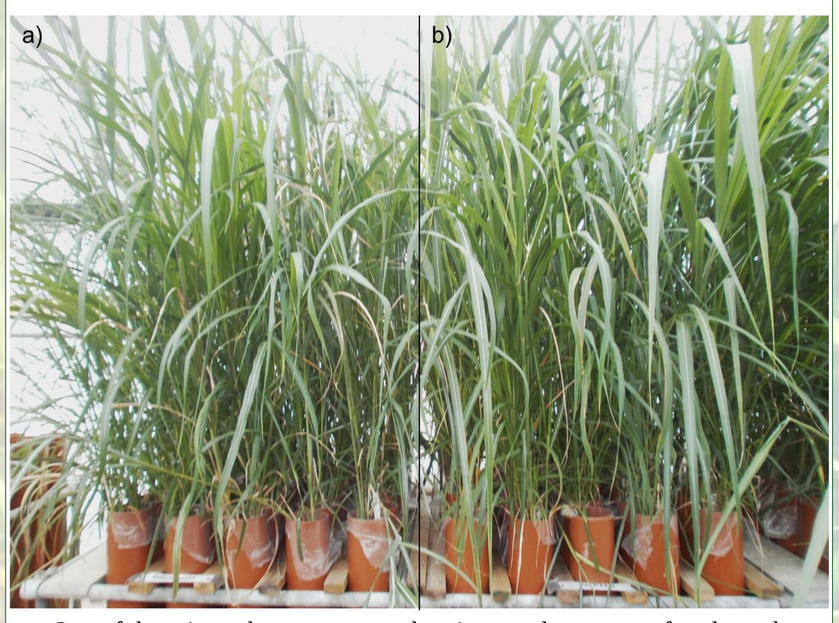
1. Trialling elite *Miscanthus* germlasm at agro-plot scale across 7 sites in Europe, Russia and China and at large scale in the UK, Germany and Ukraine.

- High variability in growth, ripening time and biomass yield among the miscanthus genotypes was found.
- The best performing high yielding genotypes at each location and the genotypes performing well at all locations were identified.
- The data will be used for modelling miscanthus yields and predicting the areas where novel germplasm can be grown.
- OPTIMISC recommendations on the establishment and maintenance of the large-scale miscanthus plantations were issued.

OPTIMSIC agro-plot field trial in Germany. October 2014. The differences between the genotypes in height and senescence are visible.

2. Selection of genotypes tolerant to 4 key abiotic stresses: drought, salinity, cold and frost.

- The protocols for the efficient screening of a high number of miscanthus genotypes for tolerance to abiotic stresses were developed and implemented.
- About 100 miscanthus genotypes were evaluated for their tolerance to the abiotic stresses.

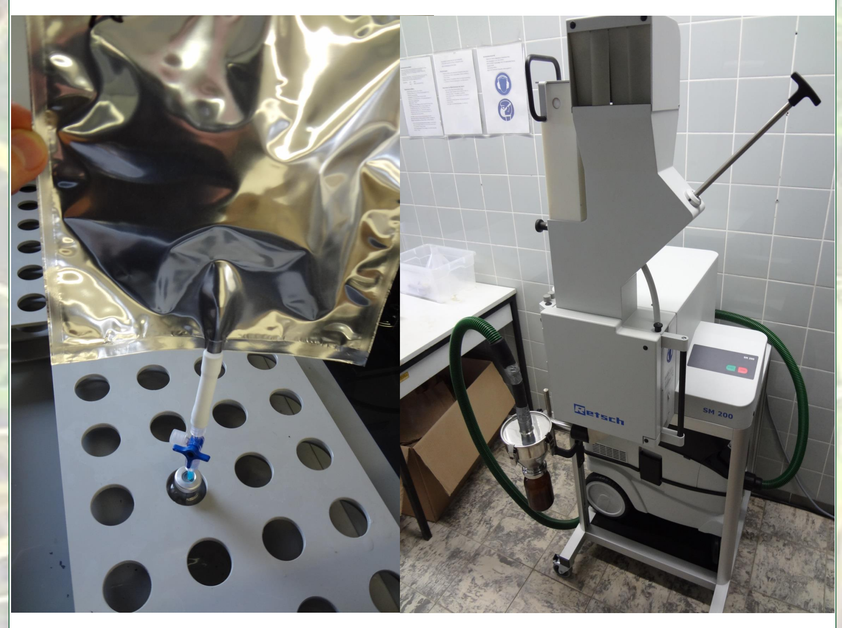


One of the miscanthus genotypes showing good recovery after drougth stress: a) drought-treated plants, b) control plants.

- Large genetic variability in stress tolerance and different mechanisms of stress tolerance in miscanthus were found.
- The most tolerant and the best yielding genotypes will be recommended for use in breeding programmes to develop stress-tolerant miscanthus varieties for marginal land.

3. Miscanthus biomass quality assessment for added value uses and novel bioproducts.

- Biochemical analysis of the lignocellulosic fraction of a large part of OPTIMISC germplasm has been completed.
- Genotypes with highly contrasting cell wall profiles were identified.
- The findings will support recommendations for the choice of genotypes suited for ethanol and biochemical production.
- Miscanthus genotypes optimized for other applications, such as biogas production, are selected.



Biogas laboratory established at the University of Hohenheim, Germany.

4. Identification of the best value chains and "genotype×biomass application×location" combinations.

- The following 6 miscanthus *value chains* are assessed in OPTIMISC:
  - ■ Combustion (CHP) – pelleting chain
  - ■ Combustion (CHP) – chopping chain
  - ■ Ethanol
  - ■ Biogas (methane)
  - ■ Particle boards
  - ■ Chlorophyll production
- Based on the results of OPTIMISC experiments and field trials, Life Cycle Assessment (LCA) and cost assessment will be performed for optimised miscanthus biomass production, processing and use chains. Decision support tool will be provided with regard to cost reduction and environmental performance of specific value chains and for the selection and cultivation of miscanthus genotypes for different industrial uses.

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