Plants for the Future
European Technology Platform

PLANT BREEDING FOR A MORE CIRCULAR BIOECONOMY

POTATO

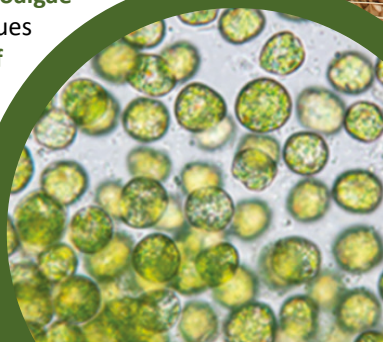
Potatoes are a staple food crop with significant potential in the bioeconomy, particularly through their starch content. **KMC**, a Danish cooperative owned by potato growers, is actively engaged in developing new potato varieties using both traditional breeding and advanced gene-editing techniques, such as CRISPR-Cas. These efforts focus on **enhancing disease resistance**, notably against late blight, and **tailoring starch properties to meet specific industrial needs**. By improving these traits, KMC aims to **produce potatoes that are more resilient and versatile**, supporting applications ranging from **plant-based food ingredients to biodegradable materials**. These initiatives align with their goal to reduce the use of plant protection products by 50% by 2030 and contribute to a more sustainable and circular bioeconomy.

CASSAVA

Cassava is a vital food crop in many tropical regions and holds promise as an industrial starch source. The **NextGen Cassava project** employs genomic selection and data-driven breeding to expedite the development of cassava varieties with enhanced traits, including **disease resistance, higher starch content, and improved processing quality**. These advancements not only bolster food security but also position cassava as a more reliable feedstock for industrial starch applications within the bioeconomy.

MICROALGAE

Microalgae are versatile organisms with immense potential in the bioeconomy, serving as sources for biofuels, bioplastics, animal feed, and high-value compounds. The Horizon Europe-funded **GeneBEcon project** is pioneering the application of gene editing techniques to **optimise microalgae strains for industrial use**. By employing New Genomic Techniques (NGTs), GeneBEcon aims to **enhance the production of valuable compounds** like mycosporine-like amino acids, which have applications in cosmetics and pharmaceuticals. Additionally, the project focuses on **improving resource efficiency by repurposing residual biomass as animal feed**, thereby reducing waste and CO_2 emissions.



MISCANTHUS

Miscanthus is a high-yielding perennial grass recognised for its potential as a sustainable biomass crop. European institutions, including **Wageningen University & Research** (Netherlands), **Aberystwyth University** (UK), and the **University of Hohenheim** (Germany), are leading breeding programs aimed at **enhancing traits like biomass yield, stress tolerance, and adaptability to marginal lands**. These efforts strive to produce Miscanthus varieties suitable for various applications, including **biofuels** (e.g., bioethanol and biogas), **bioplastics, biocomposites, and bio-based chemicals**. With **strong potential for cultivation on marginal land**, Miscanthus offers a low-input alternative that **avoids competition with food crops**.

SORGHUM

Sorghum is a versatile crop valued for its **flexibility in food, feed, and fuel production**. **Iowa State University** is developing new photoperiod-sensitive sorghum lines that grow taller and produce up to **three times more biomass** than the leftover plant material from corn harvests, while also needing less nitrogen fertiliser. These hybrids delay flowering to **maximise biomass accumulation** before the first frost, making them ideal for cooler climates. While sorghum in general is used for food and livestock feed, these new varieties are tailored for bioenergy: **their sugars and starches can be turned into ethanol**, and **their fibrous stems into biogas**. Through targeted breeding, sorghum is being adapted to better support the bioeconomy as a high-yield, low-input, and multipurpose crop.

BARLEY

Barley is a widely cultivated cereal crop, traditionally valued for its grain. The EU-funded **BEST-CROP project** is leveraging advanced phenotyping, gene editing, and genetic tools to breed barley varieties that not only yield high-quality grain with **enhanced protein content,** but also produce **more and better-quality straw**. By adjusting cellulose and lignin composition, this **straw is being tailored for use in bio-based products** such as **alternative feed and construction panels**. These efforts aim to add value to each harvest and supporting more circular resource utilisation.

Breeding plants for a circular bioeconomy

Plant biomass is the core of the bioeconomy, providing not only food and feed, but also raw materials for bio-based products, fuels, and chemicals. As demand grows for sustainable alternatives to fossil resources, there is increasing interest in plant varieties that can serve multiple purposes — supporting circular and diversified value chains.

Plant breeding plays a key role in making plants more “multipurpose.” By enhancing traits such as biomass yield, sugar or starch content, and fibre quality, breeders can tailor varieties to better serve both food and non-food uses. In parallel, efforts to improve stress tolerance and resource use efficiency help ensure that these plants remain resilient and productive under changing environmental conditions.

So far, investments in research and innovation have mostly focused on how to better valorise the side streams or waste from food, feed or drink processing. The potential of breeding to improve the quality and processability of plants to optimise that biomass for wider and higer value uses, is mostly untapped. Through targeted breeding, multipurpose crops can offer greater flexibility to farmers and industry alike — enabling the development of integrated value chains, reducing waste, and contributing to a more circular and sustainable bioeconomy.

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