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PRESSEMITTEILUNG

Innovation in the European Bioeconomy: 15 million euro project optimizes value chains for miscanthus and hemp

EU project with 22 partners from science, agriculture, and industry / new varieties, cultivation on unused areas, biomass value chains, life cycle assessment, and knowledge transfer

There are three essential conditions for further developing the bioeconomy as a sustainable alternative to fossil oil: sustainable products with strong market potential, a reliable and affordable supply of sustainably produced biomass, and a better link between biomass producers and the processing industry. Other important factors include avoiding competition with food production and maintaining biodiversity.

The BBI demonstration project “GRowing Advanced industrial Crops on marginal lands for biorEfineries” (GRACE) under the coordination of the University of Hohenheim in Stuttgart pursues these aims as a unique consortium made up of universities, agricultural companies and industry. This will be achieved by knowledge exchange between these groups, together with new crop varieties and cultivation experiments on areas that have been polluted by heavy metals, for example, or are unattractive for food production due to lower yields.

The EU and the industrial association Bio-based Industries Consortium (BIC) are supporting the project with € 12.3 million through their private-public partnership (PPP) Bio-based Industries Joint Undertaking (BBI JU). The private project partners are contributing the remaining € 2.7 million.

Developing the bioeconomy as an alternative to fossil fuel dependency is vital in order to ensure sustainable growth whilst combatting climate change. A number of key barriers exist in the bioeconomy. Firstly, there is a lack of farmer confidence in the industry end markets for biomass. Meanwhile industry do not have access to sufficient biomass of a suitable quality to develop their production chains at scale. An additional barrier is needed to ensure that cultivation of crops for producing materials does not compete with requirements for food production by using prime agricultural land.

This is the starting point of the European project “GRowing Advanced industrial Crops on marginal lands for biorEfineries” (GRACE) under the coordination of the University of Hohenheim.

22 project partners from science, agriculture, and industry have set themselves the goals of promoting cooperation between biomass producers and processing companies in Europe, creating seamless value chains, and making biomass production more attractive with new types of crops, innovative cultivation methods, and by using marginal or contaminated land.

Miscanthus and hemp: testing new varieties

The project partners will focus on two crops; miscanthus and hemp. In particular, the perennial crop Miscanthus is high yielding and requires little agricultural input. Until recently the crop was planted via cloned rhizomes, which resulted in high planting costs and limited the potential for expansion. This project will capitalize on new seed-based varieties developed by the universities of Wageningen (NL) and Aberystwyth (GB) to decrease establishment costs. The project will test seven new varieties from each university with the help of industrial partners Terravesta (GB) and the seed company Vandinter Semo (NL). The objective is to commercialize new varieties with improved quality, that are cold and drought tolerant, require lower establishment costs and have comparable yields to the commercially standard variety, Miscanthus x giganteus.

Biomass production for industry – potential for using marginal land

The miscanthus varieties are being tested at 21 locations in Europe while 4 experiments are looking at hemp production. The cultivation experiments are being led by scientists from the partners at the universities of Hohenheim (D), Aberystwyth (GB), and Wageningen (NL), the National Institute for Agricultural Research (INRA) in Paris (F), the Università Cattolica del Sacre Cuore in Piacenza (I), and the University of Zagreb, Faculty of Agriculture (HR).

One of the aspects being investigated is the effect of miscanthus cultivation on biodiversity. For example, we need to ensure that any switch to seed-based varieties does not result in the crops spreading from their planted areas and becoming invasive.

The partners are also growing miscanthus on land polluted by heavy metals, including land that was previously used by heavy industry. Partners will investigate the effect of heavy metals on the plants, the extent to which they are taken up by the plants, and the ways in which contaminated biomass can be used and further processed without posing a health risk.

The companies Terravesta (GB), Miscanthus Group (NL), Gießereitechnik Kühn (D), and Novabiom (F) contribute their experience in miscanthus production and processing, with additional input from Miscanthus F.A.R.M (A).

Hemp cultivation is being taken on by the Italian companies Ecohemp and the Consorzio di Bonifica di Piacenza. Part of their work will be to investigate strip-farming the two crops; adjacent plantings of hemp and miscanthus will allow the benefits of both crops to be realized. In low-yielding locations such as the Apennines, hemp is a particularly profitable option with its high yields of straw and seeds, while miscanthus as a permanent crop lowers the risk of erosion and stabilizes the soil.

Improving value chains

A key goal of the project is to construct value chains for biomass between project partners in

order to maximize the use of every part of the crop. The partners will demonstrate a series of examples from construction and insulation materials, platform chemicals for producing plastics, bio-fuel, composite materials, medical/cosmetic applications, and bioherbicides as a replacement for glyphosate.

Application example 1: Construction materials

The companies CMF Greentech (I) and Mycoplast (I), for example, produce building panels for furniture and house construction from chipped miscanthus and hemp. Both are also working on replacing adhesives made from fossil-based polyurethane with other materials; Mycoplast uses the tissue from a mycelium fungus for this while CMF Greentech uses a binding agent based on hemp oil to produce the panels.

Production of lightweight concrete by incorporating milled Miscanthus results in Miscanthus dust as a byproduct. In another industrial application, Miscanthus Group (NL) uses this dust in paper production in order to maximize use of the biomass. The miscanthus for this element of the project will be grown on land at Schiphol airport in Amsterdam, thus taking advantage of land that is currently unused.

Another company, Gießereitechnik Kühn (D) will also develop methods to remove pith from plant stems. The pith has excellent insulating properties and can be processed into insulation material.

Application example 2: Platform chemicals and fuels

Developments in the bioeconomy now offer alternatives to fossil materials for fuels and plastic production. For example, University of Hohenheim scientists were already able to successfully convert sugars from chicory roots into the platform chemical HMF. Among other things, this chemical is used to produce plastic bottles. Together with the company AVA Biochem, the goal is to develop this process for sugars from miscanthus straw, which is to be extracted in a chemical process using enzymes. To close the loop, the byproducts from the HMF production can be used to produce biogas. The fermentation residues can then go back to the field as fertilizer.

Project partners such as the University of Hohenheim and the company AVA Biochem extract phenol, another important intermediate in plastic production, from the polymer lignin, which is a byproduct of processing the biomass e.g. into HMF.

Other project partners are also looking at sugar from miscanthus straw; the Italian company Novamont will evaluate it to produce a chemical intermediate for making a range of products including bio-plastics. Dicarboxylic acid is another interesting chemical for Novamont and the company will be attempting to produce it from hemp oil.

The Croatian oil company INA Plc. is currently developing a Bio-refinery project. The plant will process non-edible biomass to produce 55 kt yr-1 of 2G bioethanol. INA´s main task in the consortium is the demonstration of miscanthus cultivation on marginal land located in Sisak region. As a result of the war in the 90´s, mines were left in in the targeted area. This type of land, which is now cleared from mines, falls into a special category of marginal land also due to social abandonment. The project implementation could be a significant driver to bring people and agricultural production back to the area.

Additional application examples: Composite materials, bioherbicides, and medications

Hemp and miscanthus can also be used for composite materials; Addiplast (F) plans to use both hemp and miscanthus fibers to strengthen plastics. Thanks to lower costs, these could then be used not only in the automobile industry but also in production of cheaper mass production plastics such as stadium seats. Meanwhile bioplastic producer Novamont (I) is interested in testing hemp and miscanthus fibers to produce bio-based composite materials. To maximize use of the plant, the seeds and chaff of hemp are also used; Novamont (I) will be attempting to use hempseed oil to produce monocarboxylic acid, which can be an environmentally sustainable alternative to herbicide glyphosate, whilst Indena (I) is working on extracting medically useable cannabinoid in pure quality from the chaff of hemp seeds. Besides medical applications, it can also be used in cosmetic products.

Detailed life cycle assessment for all value chains

Scientists at the universities of Hohenheim and Aberystwyth are evaluating all value chains using a detailed life cycle assessment to address key questions; how does each value chain compare to the conventional chain? Is it really more ecologically sustainable than the fossil-fuel based alternative?

To analyze this, the scientists look at factors such as the contribution to the greenhouse effect, the amount of fossil energy saved, acidification of the terrestrial ecosystems and damage to aquatic environment. Despite their enthusiasm for the possibilities of bioeconomy, the partners also want to test whether there could be negative effects for people and the environment and which intensity of biomass cultivation is safe and sensible.

The partners are also examining the economic and social consequences of expanding the bioeconomy. Positive outcomes could include local regeneration, such as in Croatia where areas have been underpopulated since the war in the 90´s. However, it is important to minimize the risks of negative outcomes, such as if intensive cultivation of biomass crops was to prevent local food production.

Expertise for and feedback from industry

As the project develops there will be opportunities for interested companies to participate via an industry panel, which will allow companies to share common experiences and discuss broadening the scope of potential end-uses for biomass. It will also accelerate the implementation of research findings into agricultural and industrial practice.

Assisted by the University of Hohenheim and the technology cluster for green chemicals SPRING (Sustainable Processes and Resources for Innovation and National Growth) from Italy, interested industry representatives from the industry panel will have the opportunity to meet up at conferences, receive project updates via newsletters, and be provided with hemp and Miscanthus biomass to enable them to conduct their own tests.

Background: “GRowing Advanced industrial Crops on marginal lands for biorEfineries” (GRACE)

The project “GRowing Advanced industrial Crops on marginal lands for biorEfineries” (GRACE) started on 1 June 2017 and runs until 31 May 2022. The project is being funded with € 12.3 million from the public-private research partnership “Bio-based Industries Joint Undertaking (BBI JU)” between the European Union and the Bio-based Industries Consortium (BIC), a consortium of large companies working in the bioeconomy. The remaining € 2.7 million are contributed by the private project partners.

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