BIOETHA2: Contribution to the development of the 2nd generation bioethanol production chain

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Introduction

EUROPE 2020 : 10% renewable biofuels

DRAWBACKS OF FIRST GENERATION BIOFUELS

- Require the plant parts with the highest value (starch, oil)
- Leave most of the biomass poorly valorised
- Hence, can induce food / fuel competition
- Crops usually require high levels of fertilisation

Development of second generation biofuels

BIOETHA2

WP1 Foresight
Are biofuels pertinent ?

WP2 Cropping references
What is the most suitable crop ?

WP3 Hydrolysis and fermentation processes
What are the available monosaccharides ?

Workpackage 1: Foresight

Foresight is defined as a convergence of trends underlying recent developments in the fields of "policy analysis", "strategic planning" and "future studies". It's different from a prediction by taking into account future events to explore possible futures. Prediction considers one future, Foresight considers several futures !
Our aim is answer to the question: "What are the economical, environmental, ethical and social benefits/drawbacks of developing second generation biofuels chains ?"
BioEtha 2 is a transversal and multi-disciplinary project, which covers all the steps of the biomass valorisation chain, from phytotechny to biotechnology. This is of particular importance in the framework of foresight where the results of phyto-technical and industrial approaches should be taken into consideration.

Workpackage 2: Cropping references

The growth of height species of interest for bioethanol production are studied. These species are switchgrass, sorghum, corn, miscanthus, tall fescue, Jerusalem artichoke, hemp and comfrey. Large scale fields have been implemented in Gembloux to investigate the effect of crop techniques such as fertilisation and weed control. Other field assays aim to finding the optimal harvesting time. Indeed, the highest dry matter content doesn't necessarily coincide with the highest yeast-fermentable sugar content.

Alternative weed control: harrow comb (upper left) and clover cover (lower left)
Precision seeder for Switchgrass (upper right)
Maize, Sorghum, Hemp (lower right)

Workpackage 3: Hydrolysis and fermentation processes

Fibers analyzer (left) and fermentation vessel (right)

The plant grown in the WP2 will be submitted to analysis to determine the amount of cell wall components (cellulose, hemicelluloses and lignin), starch and soluble sugars. Extended studies will be dedicated to hemicelluloses composition: using soft chemical hydrolysis and HPLC analysis, sugar monomers will be identified and quantified. The "sugar monomer fingerprint" of each plant will allow us to establish the potential amount of bioethanol that can be produced from them. Crossing data from WP3 and WP2 (cropping references), our aim is the estimation of the amount of bioethanol that can be produced, per hectare, for each of these crops in optimal conditions in Walloon region. To ascertain our prediction model, enzymatic hydrolysis and fermentation (using Saccharomyces cerevisiae) experiments will be performed on plants grown by WP2 group. The aim is to confirm theoretical yields used in the prediction model by real experimental data.

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