Cellulose, hemicelluloses, lignin, and ash content in various green energy crops for second generation biofuels production

Bruno Godin, François Ghysel, Thomas Schmit, Richard Agneessens, Sébastien Gofflot, Stéphane Lamaudière (*), Georges Sinnaeve, Jean-Pierre Destain, Patrick A. Gerin (*), Didier Stilmant and Jérôme Delcarte

Gembloux Agricultural Research Center, Farming Systems, and
(*) Université catholique de Louvain, Unit of Bioengineering

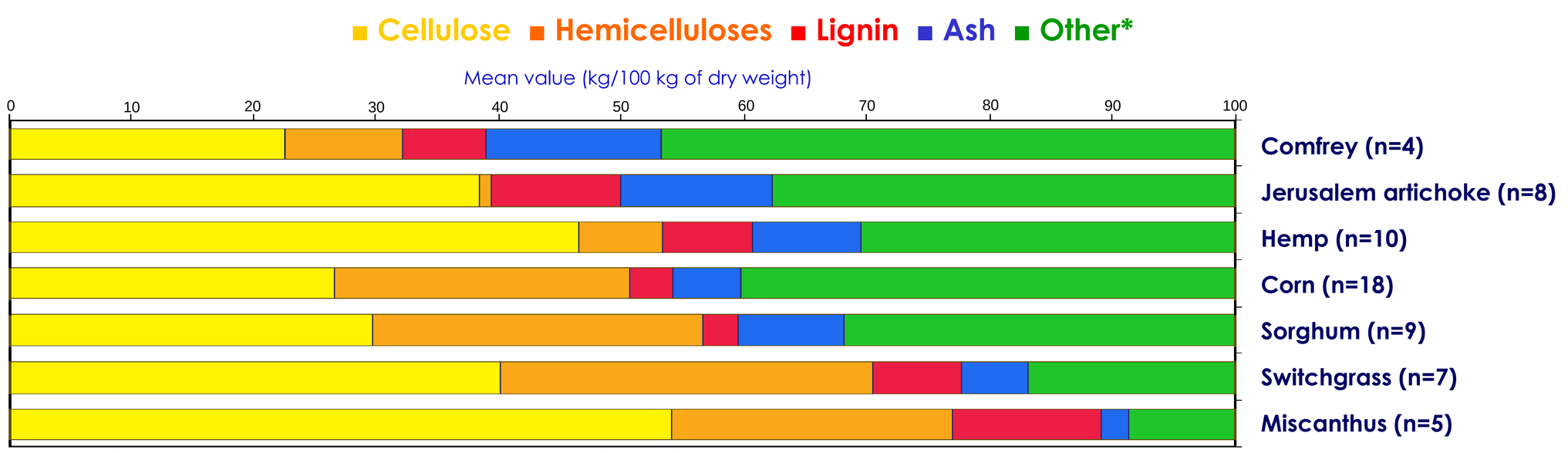
Rue de Serpont, 100 - 6800 Libramont Belgique, +32 61 23 10 10, +32 61 23 10 28, b.godin@cra.wallonie.be, f.ghysel@cra.wallonie.be

Introduction

● Many different green energy crops are available for the production of renewable energy vectors such as second generation biofuels. The energy recovery potential of these lignocellulosic crops depends on the crop husbandry, the type of biofuel produced and their content of main components such as cellulose, hemicelluloses, lignin and ash. In the case of second generation bioethanol from green energy crops, the amount of cellulose and hemicelluloses has to be high but the amount of lignin and ash has to be low.

Biomass characterization

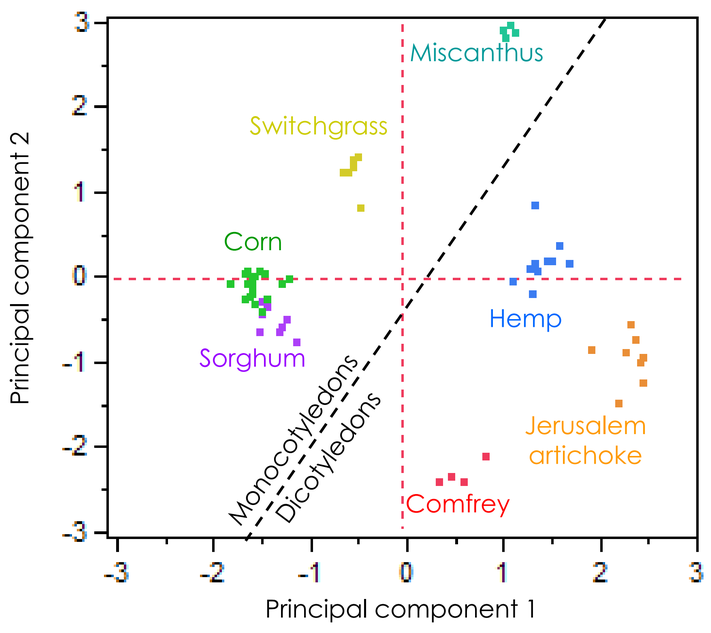
● The cellulose, hemicelluloses, lignin and ash content was quantified using the Van Soest method on various green crops energy : miscanthus, switchgrass, jerusalem artichoke (aerial part), comfrey, sorghum, corn and hemp. These crops were harvested at a mature stage in 2007 and 2008 in Libramont (Belgium).

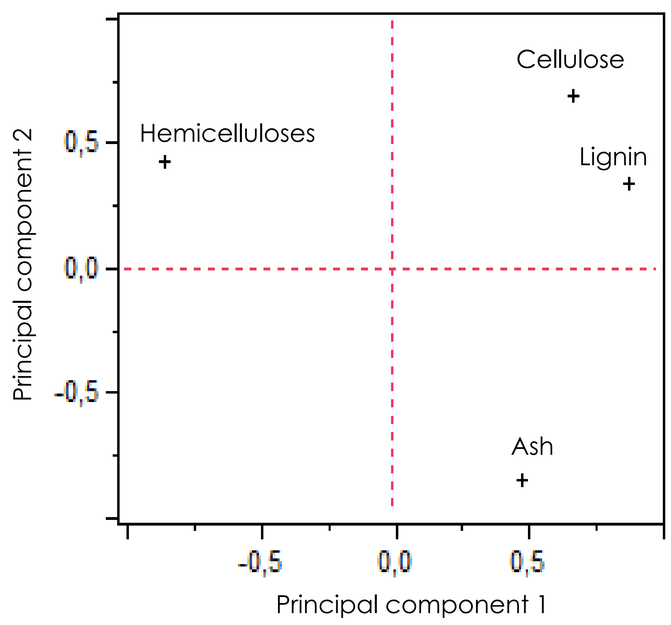


* Other is composed of soluble polysccharides (such as pectins, starch and fructans), soluble sugars, organic acids, proteins and lipids

● The green energy crops with the best potential are mainly monocotyledons ➔ switchgrass, miscanthus, corn, sorghum and hemp because, on one hand, these crops are composed of higher amounts of cellulose and hemicelluloses and, on the other hand, the amounts of lignin and ash are lower in these crops.
● The profile of miscanthus has characteristics of both dicotyledons (cellulose and lignin content) and monocotyledons (hemicelluloses and ash content).

● Based on these results, a principal component analysis and a paired correlation of the measured parameters have been performed





Correlation (R)	
Cellulose – Hemicelluloses	- 0,28 *
Cellulose – Lignin	0,76 ***
Cellulose – Ash	- 0,23
Hemicelluloses – Lignin	- 0,56 ***
Hemicelluloses – Ash	- 0,71 ***
Lignin – Ash	0,14

● Each green energy crop formed a differentiated group excepted corn and sorghum.
● The closer the phylogenetic link between species, the closer the principal component scores
  ➔ corn and sorghum = one group
  ➔ dicotyledonous and monocotyledonous species have opposed principal component scores
● The correlation table and the principal component loadings plot shows the significant negative correlation between cellulose-hemicelluloses, hemicelluloses-lignin and hemicelluloses-ash, and the significant positive correlation between cellulose and lignin.

Conclusion

● The best potential green energy crops to produce second generation bioethanol are mainly monocotyledons : switchgrass, sorghum, corn, miscanthus and hemp.
● Miscanthus combines monocotyledonous and dicotyledonous characteristics.
● Based on these first results and considering other technical characteristics (fertilisation and weed control), large scale field tests will be implemented in the BIOETHA2 (Gembloux) and the INTERREG IV - ENERBIOM (Libramont, Bitburg and Nancy) projects using the most promising crops to produce biofuels (especially second generation bioethanol).

Acknowledgment

The authors are grateful to D. Mahin (Farming systems, CRA-W, Belgium) for his technical support.

Programme cofinancé par l'Union européenne
Fonds européen de développement régional
EU-gefördertes Programm
Europäischer Fonds für regionale Entwicklung

CRA-W Gembloux

Walloon Agricultural Research Center

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