

Miscanthus biomass options for contaminated and marginal land: quality, quantity and soil interactions



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FACCE SURPLUS
SUSTAINABLE AND RESILIENT AGRICULTURE
FOR FOOD AND NON-FOOD SYSTEMS

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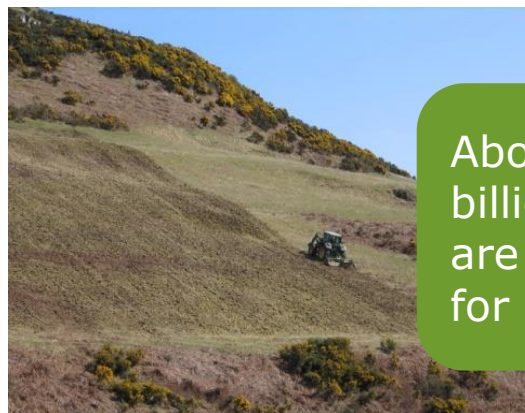
Why MISCOMAR?



About 10% of arable lands across Europe seems to be marginal



Renewability of biomass makes it an attractive source of energy



About 100 million to 1 billion ha of marginal lands are theoretically available for production worldwide



Some energy crop species demonstrate potential for heavy metal removal

FOOD OR FUEL?

Nearly a billion people will go hungry tonight, yet this year the U.S. will turn nearly 5 billion bushels of corn into ethanol. That's enough food to feed 412 million people for an entire year.

8 BUSHELS OF CORN = **21.6** GALLONS OF ETHANOL FUEL OR ENOUGH FOOD TO FEED A PERSON FOR A WHOLE YEAR



Use of land for biomass production should not compete with its use for food production

DOING THE MATH:
5 billion bushels / 8 bushels of corn enough calories to feed a person for a year = sufficient calories to support 625 million people, plus one-third to account for calorie losses (EOD) = 412 million

SOURCES:
450 pounds of corn supplies enough calories for one person for a year. <http://www.energyefficiency.com/news/2007/06/food-fuel-and-biofuels-are-not-the-same>
About 5 billion bushels of U.S. corn production is slated for ethanol production. <http://www.usda.gov/oc/comm/ethanol/ethanol.html>

8 bushels of corn feeds a person for a year
= 21.6 gallons of ethanol per bushel

One bushel of corn produces 2.7 gallons of ethanol
(Purdue Extension, "How Fuel Ethanol is Made From Corn," http://www.asterion.purdue.edu/actmedia/10/10_1023.pdf)



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OBJECTIVE: develop techniques for biomass production on marginal land in Europe

MISCOMAR GOALS:

- **investigate the field performance** of novel, stress tolerant *Miscanthus* hybrids in comparison to the standard genotype *M. x giganteus* on economically marginal and heavy metal contaminated soils,
- **quantify the impacts** of *Miscanthus* production on soil parameters,
- **identify utilisation options** for biomass and study the impact of varying environmental conditions on potential *Miscanthus* end uses,
- **develop concepts** for the integration of *Miscanthus* into existing landscapes, crop rotations and farming systems.



METHODS AND MATERIALS

Plant:

Miscanthus promising near-to-market seed-based hybrids from IBERS' breeding program;
control - the commercial standard *M. x giganteus*,



photo from Terravesta Ltd., www.terravesta.com

Planting:

novel agronomic techniques repeating approaches taken at the existing Lincolnshire trial



Three locations (in the three different climates):

1. heavy metal contaminated soils - Katowice, Southern Poland (dry continental),
2. low grade shallow, stony soils - Aberystwyth (temperate)
3. high clay content, waterlogged soils - Unterer Lindenhof, Southern Germany (wet continental)



HM contaminated arable land - POLAND



control - optimal arable land - UK



METHODS AND MATERIALS

Measurements:

- **plant production potential** (quantity and quality), crop and yield development,
- **soil analyses:** bulk density, pH, electrical conductivity, organic matter, organic carbon, total concentration (*aqua regia* extraction) of Pb, Cd, Zn, N, P, K, Ca, Mg, Fe, S and bioavailable fraction (CaCl₂ extraction) of Pb, Cd and Zn,
- **plant analyses** (autumn and winter harvest): content of macronutrients and contaminants (Pb, Cd, Zn),
- **combustion and anaerobic digestion quality:** ash content, mineral content (N, P, K, Mg, Ca), content of critical elements (Cl, Si), ash melting behaviour, substrate-specific biogas and methane yield (including methane content of the biogas), fibre content (hemicellulose, cellulose and lignin), protein content ,
- **plant physiological parameters** (for Katowice trial): photosynthesis rate, transpiration rate, stomatal conductance, chlorophyll, flavonoids and anthocyanins content, leaf index area (LAI),



TARGET GROUP(S) / WHO WILL BENEFIT?

- **farmers:** MISCOMAR will show how to improve and diversify their income by involving biomass production on non-profitable land to their crop rotation,
- **marginal land owners/managers:** MISCOMAR will introduce alternative management options for contaminated land and help avoiding introduction of harmful substances into the food-chain,
- **policy makers:** MISCOMAR will help them drive an agenda of reduced health risks, environmental resilience and economic recovery in rural and polluted areas.



EXPECTED RESULTS

biomass quantity and quality estimates (including chemical composition) for a core set of *Miscanthus* hybrids and a control grown in diverse conditions

determined production potential and biomass quality of novel *Miscanthus* hybrids for anaerobic digestion and combustion

concepts for integration of *Miscanthus* in existing crop rotations and landscapes with maximized environmental and economic benefits

provision of policy-relevant data on the balance between food/fuel production, with a particular focus on the scope for optimisation of land-use in contaminated and marginal areas

The project results will offer alternatives for land less suitable or unsuitable for food production, with reduced risk for heavy metal introduction into the food-chain



RESEARCH GAPS / POTENTIAL FOR FURTHER RESEARCH

- How the seed-based *Miscanthus* hybrids will perform when cultivated on marginal land in different climate conditions (soil improvement, landscape interaction, crop rotation)?
- Can novel *Miscanthus* hybrids be used for phytoremediation?
- How the produced biomass could be converted into energy by combustion and anaerobic digestion taking into account environmental aspects?



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Thank you for your attention

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