Energy crops and biogas – pathways to success?

Biocascading – Towards efficient biomass chains

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Outline

- Introduction
- Agronomic criteria for suitable crops
  - At crop level
  - At farm level
  - At regional and institutional level
- Strategies
- Biocascading
- Examples

Introduction

A simple production equation:

$$Y = LIGHT\ (INT) \times LUE \times HI$$

Agronomic aspects at the crop level

An energy crop should have / be:

* High potential and actual yields
    - High LUE (C4)
    - High HI
* Adequate yield security and stability
    - Resistant / tolerant to abiotic and biotic stress
* High and stable quality
    - High energy content
    - Low content of contaminants
    - Predictable in composition

An energy crop should have:

Minimum requirements for agronomic inputs

* Low nutrient content in harvestable product
* Drought tolerance

Maximum efficiency of input use

* High WUE and NUE
* Maximum resistance against pests, diseases and weeds
* Minimum use of energy during cultivation, harvest and on-farm processing

Environment-friendly crop husbandry

Maximum contribution to CO_2 sequestration

Agronomic aspects at the farm level

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* Possibility to fit the energy crop into:
    - Current production system (rotation)
    - Farming system (labour / machinery)
    - Land use system (water and waste management)
* Contribution to biodiversity
    - Crops and associated species
* Potential acreage of the crop
* Farmer-friendly transport, transport, storage, processing and use
* Low production costs
    - Seeds, harvest, storage, etc.

Agronomic aspects at the regional and institutional level

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* Adequate potential acreage around centralised processing plants
* Potential of economic feasibility
* Time for gradual development to:
    - biocascading or multi-input/multi-output systems
    - economies of scale
    - high added value
* Multiple use

* Technological; infrastructure for processing and use
* Logistic infrastructure
* Positive institutional and social environment
* Market acceptation
* Adequate knowledge
* Availability of inputs
* Advanced breeding and seed production systems
* Political support for
    - primary producers
    - processors
    - users

Strategies

1. Bulk production by growing one crop for one type of raw material)

Does not work (low prices, low efficiency)

Strategies

2. Bulk production by growing most efficient crops in areas with large-scale, extensive agriculture and cheap land and creating diversity at the end of the chain (C5 / C6 economy)

Might work in a biobased economy (sugar beet)

Strategies

3. Biocascading of multi-use crops
yielding several products of different value.
One crop for various uses through different sequential steps of
i) direct separation / extraction, followed by conversion and derivation,
ii) indirect extraction or conversion (e.g. through fermentation processes)
iii) residue conversion (e.g. through incineration)

Strategies

4. High value speciality crops

e.g. Artemisia annua - artemisinine

Small markets

Biocascading:

* Whole crop utilisation
* Processing flexibility
* Economic flexibility
* Even material of different origin (multi-input; waste management) fed into multi-output processing unit
* No special breeding and production for one purpose

Examples:

1. Modified sugarbeet:

   lysine, sucrose, ethanol, feed, fertilizer

2. Grass:

   protein, cellulose, energy

3. Hemp:

   medicinal compounds, oil, long fibre,

   short fibre, residue

Needs:

Complicated techologies

Flexible systems

Markets

Advantages

One can select crops with high resource use efficiencies

No agronomic problems at farm level

Flexible fit in regional system

Contribution to waste management will result in better societal acceptance

Thank you!

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