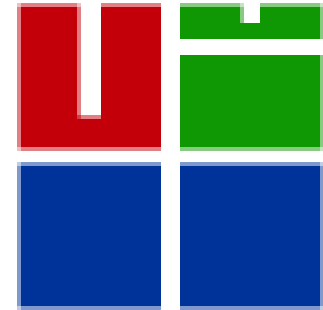


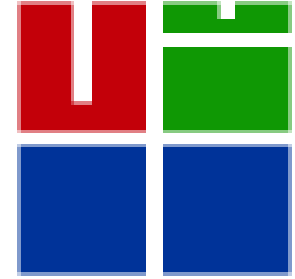
Miscanthus

Energy Solutions Conference May '06

Biomass

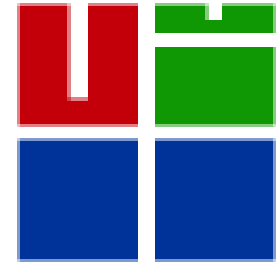


- Biomass energy is increasingly being accepted as a possible alternative to fossil fuels.
- In developed countries the potential role of biomass energy is enhanced by its consideration in the climate change debate.
- The biomass discussion is also driven by rural development and job creation, increasing energy self-sufficiency and improving competitiveness



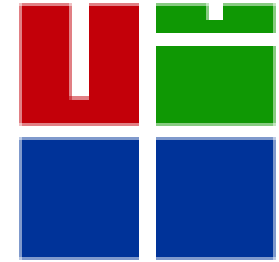
Why Biomass in Ireland

- ***Kyoto protocol implications***
renewable sources of energy are CO₂ neutral
- ***Increase energy self sufficiency***
Renewables are indigenous energy resources
- ***Regional development and job creation***
- ***Improved competitiveness***



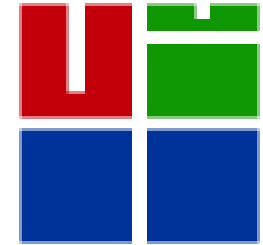
Miscanthus

- Origin - consists of 17 species. The genetic origin of miscanthus is in East-Asia, where it is found throughout a wide climatic range from tropical and subtropical and warm temperate parts of Southeast Asia to the Pacific Islands
- The genotype widely used in Europe for productivity trials, *Miscanthus* × *giganteus*, was introduced from Japan to Denmark in 1930.



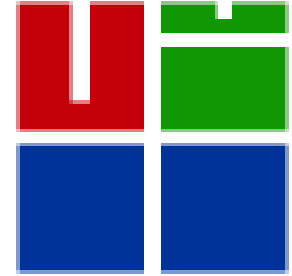
Ecological demands - soil

- Miscanthus can be grown on a wide range of soils.
- most important soil characteristic is the water retention. Sites with stagnant water are unsuitable.
- highest yields are produced on soils with a good water holding capacity.
- Establishment after planting better on sandy soils, due to lower competition by weeds, but long term yields are higher on heavy soils with improved water availability.



Ecological demand - temperature

- *M.×giganteus* begins growth from dormant winter rhizome when soil temperatures reaches 10–12°C .
- main problem with Miscanthus production in northern Europe is the poor over-wintering of the rhizomes in the first winter after planting when temperatures of -5 °C can kill the rhizome. Once established it can tolerate -10°C

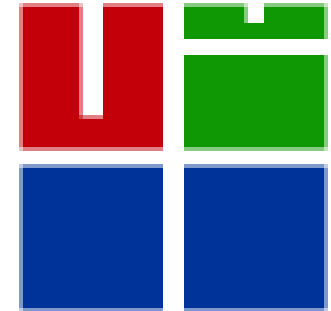


Biomass yields

- Miscanthus plantations need 3–5 years to become fully established and reach the maximum yield level
- Yields above 30 tDMha⁻¹ are reported for locations in southern Europe with high average temperatures but only with irrigation.
- In central and northern Europe (from Austria to Denmark) yields without irrigation are more typically 10–25 tDMha⁻¹

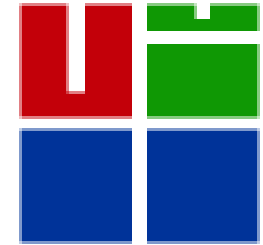
Reported yields of Miscanthus

Crop	Photo-synthetic pathway	Yield tDMha ⁻¹ a ⁻¹
Miscanthus	C ₄	5 - 44
Switchgrass	C ₄	5 - 23
Reed Canary	C ₃	7 - 13
Common Reed	C ₃	9 - 13



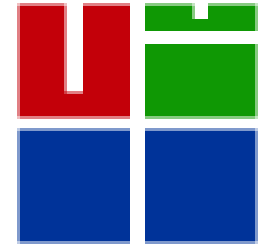
Biomass characteristics

Moisture content	16 - 62 %
Heating value (MJ/kg)	17.1 – 9.2
Ash (% of dry mater)	1.6 – 4.0
Ash Fusion temperature	1020 °C



Establishment & propagation

- The need to propagate miscanthus vegetatively results in high establishment costs ~ €1000/a
- *Miscanthus* is a sterile hybrid which does not form fertile seeds. Propagation is by micropropagation or by rhizome cutting.
- Ploughing is recommended before planting & planting should be undertaken when the frost period ($< -3^{\circ}\text{C}$) is finished.
- The optimal planting density is 1 to 2 plants m^{-2}



Harvest

- Miscanthus is harvested in early spring because the stems dry during winter and part of the ash, Cl and K contents are leached by precipitation, which substantially improves combustion quality. A delayed harvest is preferred because of the improved biomass quality, but it also results in yield losses of about 25%

Miscanthus Rhizome



Miscanthus rhizome + cane



Sowing Miscanthus







Input demand.

- Miscanthus does not respond to N fertilization so N fertilization is necessary only on soils with low N contents.
- The overall nutrient requirements are about 2–5kg N, 0.3 –1.1kg P and 0.8–1.0 kg Ca per t of dry matter and for K 0.8–1.2 kg

Weed and diseases

- Weed control in the year of planting is an important measure to ensure establishment of the poorly competing miscanthus plants. Various herbicides suitable for use in maize or other cereals can be used.
- To date, there are no reports of plant diseases significantly limiting the productivity of miscanthus.

6 week old cane crop



1st year crop



2nd year crop summer 2005

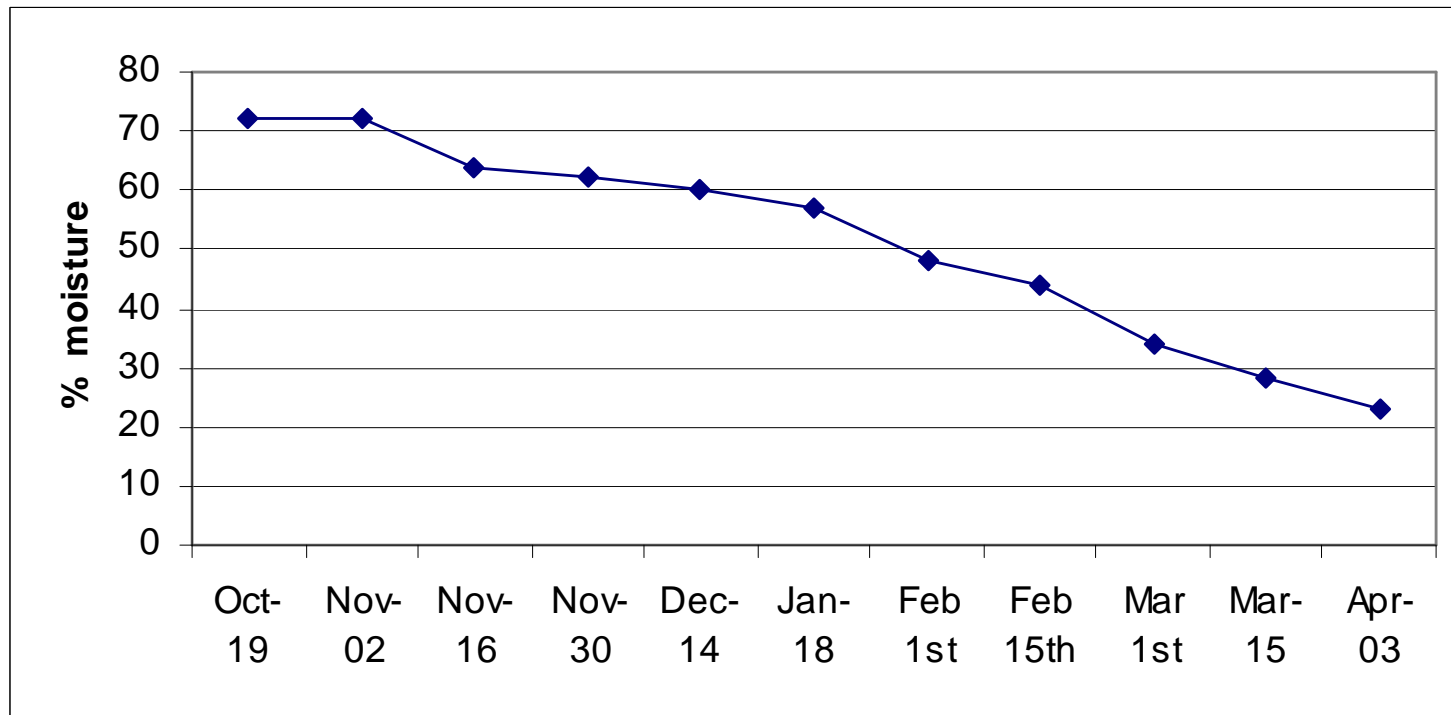


Harvest frequency and time

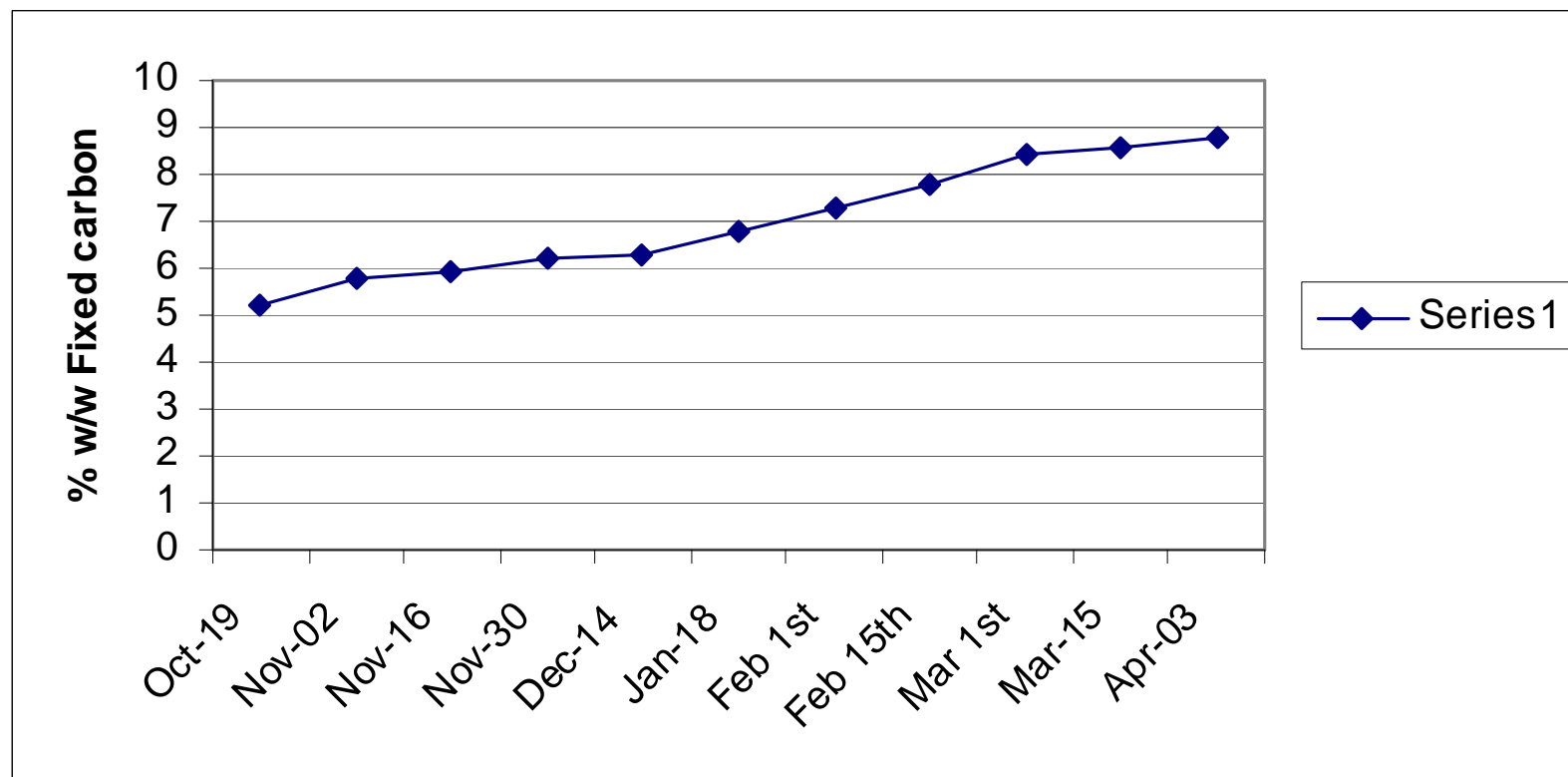
- . Miscanthus can be harvested only once a year
- The later the harvest can be performed, the more the combustion quality improves - moisture content and the mineral contents decrease but biomass also yield falls
- a late harvest at a water content lower than 30% is recommended because the costs for harvesting and drying of the biomass are increasing with the water content.

Delayed harvest

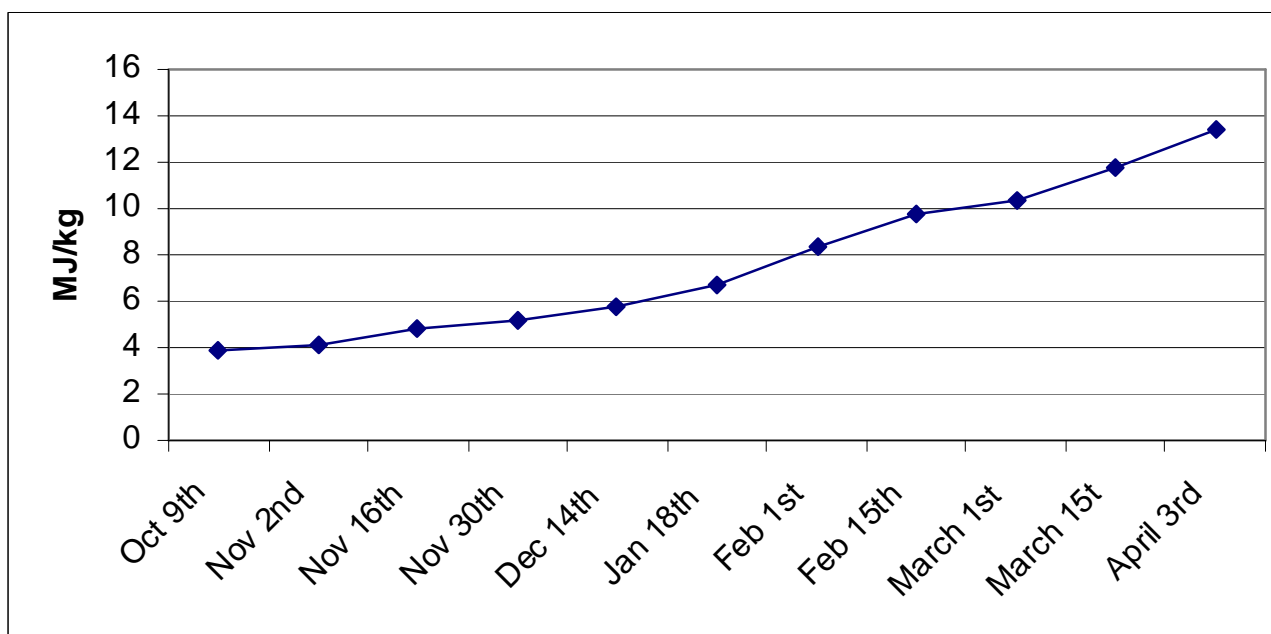
- Biomass characteristics of miscanthus are mainly a function of location - biomass ash is correlated with silt and clay content of the soil .
- most important management tool to improve biomass quality in miscanthus is delayed harvest. Following **senescence** in autumn and shoot death after frost, Cl, K and ash components are leached from the shoots by precipitation .



Fixed carbon



Calorific value





Harvest April 2006













Miscanthus pellets

