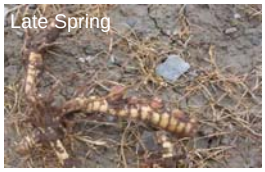
Miscanthus can provide a renewable source of

- Non-interruptible electricity
- Heat
- Liquid transport fuels
- Chemicals

Need integrated research

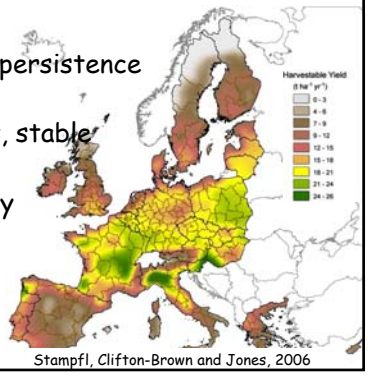
Yield components
Resource use efficiency
Carbon partitioning
Chemical composition
Processing/ Conversion
Biofuel characteristics
Sustainability & life cycle analyses

Miscanthus



Miscanthus Breeding objectives

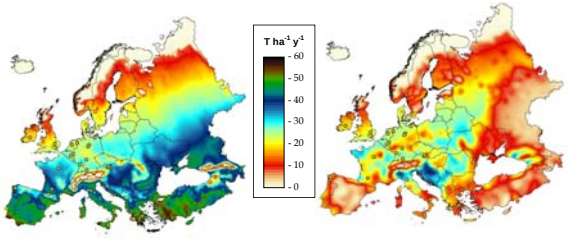
- High Yields, persistence and stability
- High Quality, stable composition
- Sustainability



Stampfl, Clifton-Brown and Jones, 2006

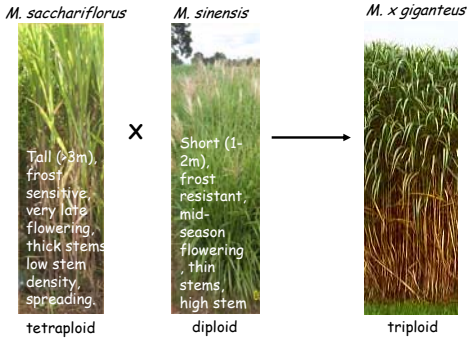
Potential (irrigated)

Rainfed



Clifton-Brown et al., Miscanmod

Miscanthus genetics



Breeding strategies

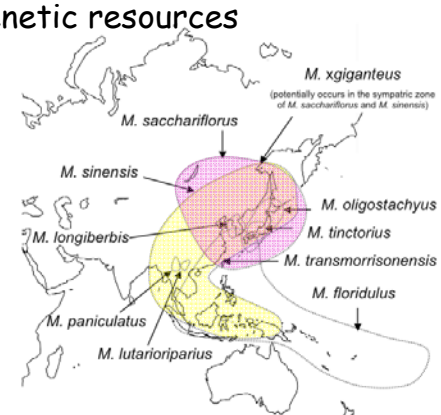
New *M. x giganteus* types
M. Sinensis hybrids
M. Sacchariflorus hybrids

Natural crosses
Embryo rescue
Genetic manipulation

Phenotyping of Germplasm

- Replicated field trials of single plants
- Characters under observation
  - Morphological
  - Physiological
  - Compositional

Genetic resources



after Hodkinson & Renvoize *et al.* 2001, and Clifton-Brown, Yu-Chung

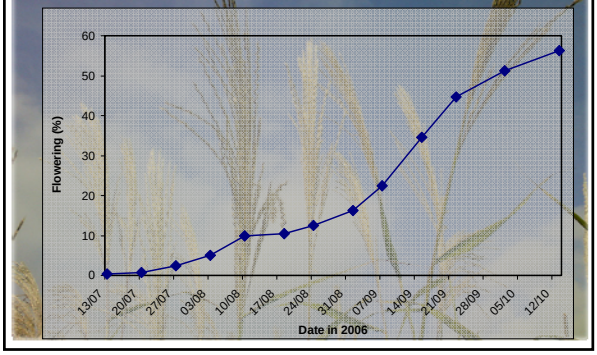
Flowering time

Why is it important?

Growing season → Yield quantity

Senescence → Yield quality

Weekly assessments of flowering time on 248 genotypes



Miscanthus flowering diversity (Elaine Jensen)

Tallest flower height 3.65m

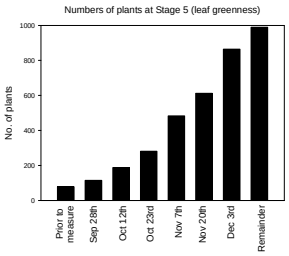
Shortest flower height 0.75m

4m
3m
2m
1m

Flowering 2007

JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER

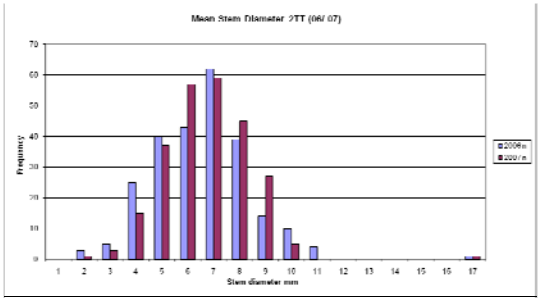
Decreasing leaf greenness among *Miscanthus* accessions (total No. of plants at or beyond 50% loss of greenness; Paul Robson).



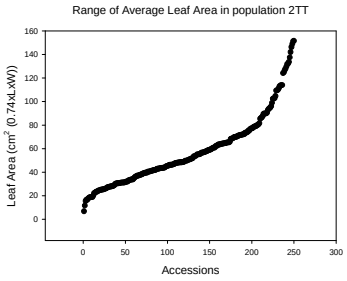
Stem yield (Kerrie Farrar)

Stem number
Stem length
Stem thickness

Stem diameter (Kerrie Farrar)



Variation in leaf area among *Miscanthus* accessions (Paul Robson)



Develop genetic tools: QTL Mapping

Cross progeny with diverse range of phenotypes

↓

Combine phenotypic & genetic analysis to identify QTL

With molecular markers translate from models

Fuel specification & matching:

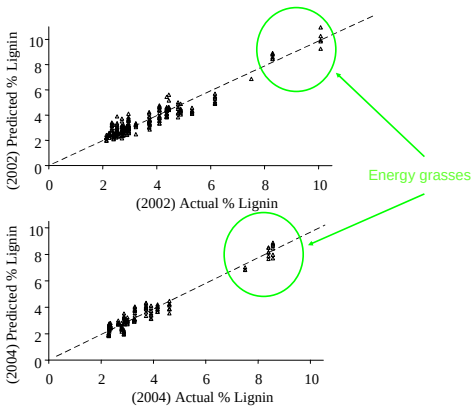
SUPERGEN

- Establish relationship between biomass quality, conversion efficiency and end product quality characteristics
- Develop high throughput screening methods
- Evaluate grasses of defined chemical composition for energy (bio-oil, alcohols, methane, hydrogen)

Collaborations with RRes, Universities of Aston, Leeds & Glamorgan, Porter Alliance

FT-IR Experimental Procedure

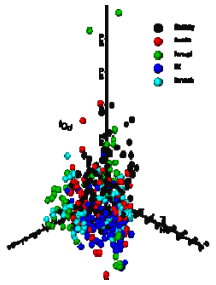
1. Sample preparation – powdered and whole leaf disc, alcohol extracted.
2. FT-IR method – ATR & Transmission.
3. Data correction & deconvolution.



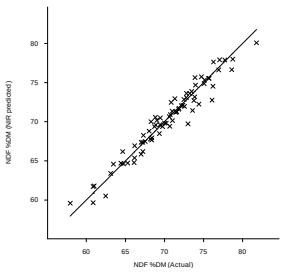
Sites of EMI Project

Country	Observed Yield in 1999	Modelled Yield Irrigated	Modelled Yield Rainfed A
Sweden	22	22.3	22.3
Denmark	17	21.4	21.4
England	18	24.0	24.0
Germany	26	25.2	25.2
Portugal	38	47.3	14.5

NIRS Calibrations for lignin, NDF and ADF



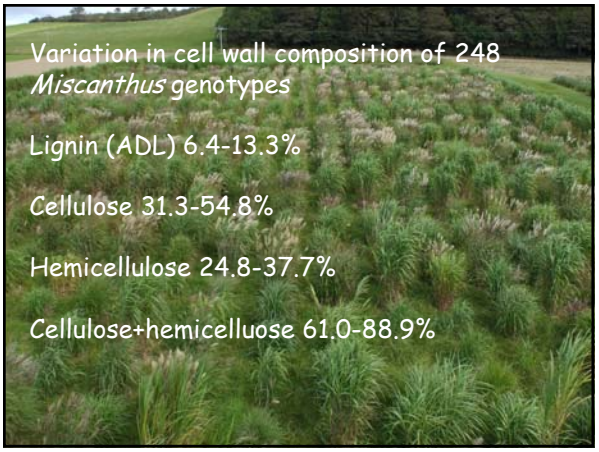
3D PCA plot of sample spectra



NIRS calibration for NDF

Lignin, cellulose & hemicellulose contents on EMI

Genotype	No.	Lignin Autumn	Lignin Spring	Cellulose Autumn	Cellulose Spring	Hemi-cellulose Autumn	Hemi-cellulose Spring
Gig	1						
Gig	2						
Gig	3						
Gig	4						
Sac	5						
Sin H	6						
Sin H	7						
Sin H	8						
Sin H	9						
Sin H	10						
Sin	11						
Sin	12						
Sin	13						
Sin	14						
Sin	15						



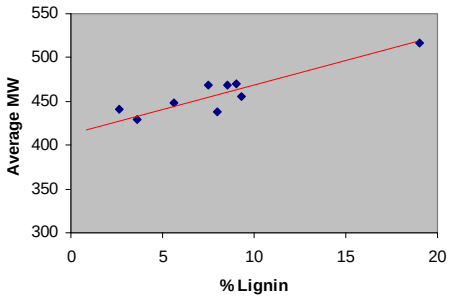
Cell wall composition of selected genotypes at two harvest times

Genotype	Harvest 1 (peak DM yield)			Harvest 2 (commercial)		
	Lignin	Cellulose	Hemicellulose	Lignin	Cellulose	Hemicellulose
M.x giganteus	12.02	46.76	23.46	12.58	52.13	25.76
M.x sacchariflorus	12.10	45.28	25.73	12.42	50.31	28.11
M.sinensis (hybrid)	9.27	40.33	31.44	9.70	45.36	32.99
M.sinensis (wild)	9.69	40.53	32.28	10.32	45.52	33.83
M. sinensis (wild)	9.23	44.31	31.10	9.34	52.20	30.56

Using Py-GC-MS significant differences were observed between genotypes in the total amounts of *P*-Hydroxyphenyl and Syringyl derived compounds present. In all genotypes the *P*-Hydroxyphenyl derived compounds were the most abundant lignin sub-unit

Ed Hodgson, Daniel Nowakowski, Ian Shield, Tony Bridgwater

Influence of lignin (ADL) on average molecular weight of pyrolysis oil



Romani Fahmi & Tony Bridgwater, Aston University

Conversion at scale