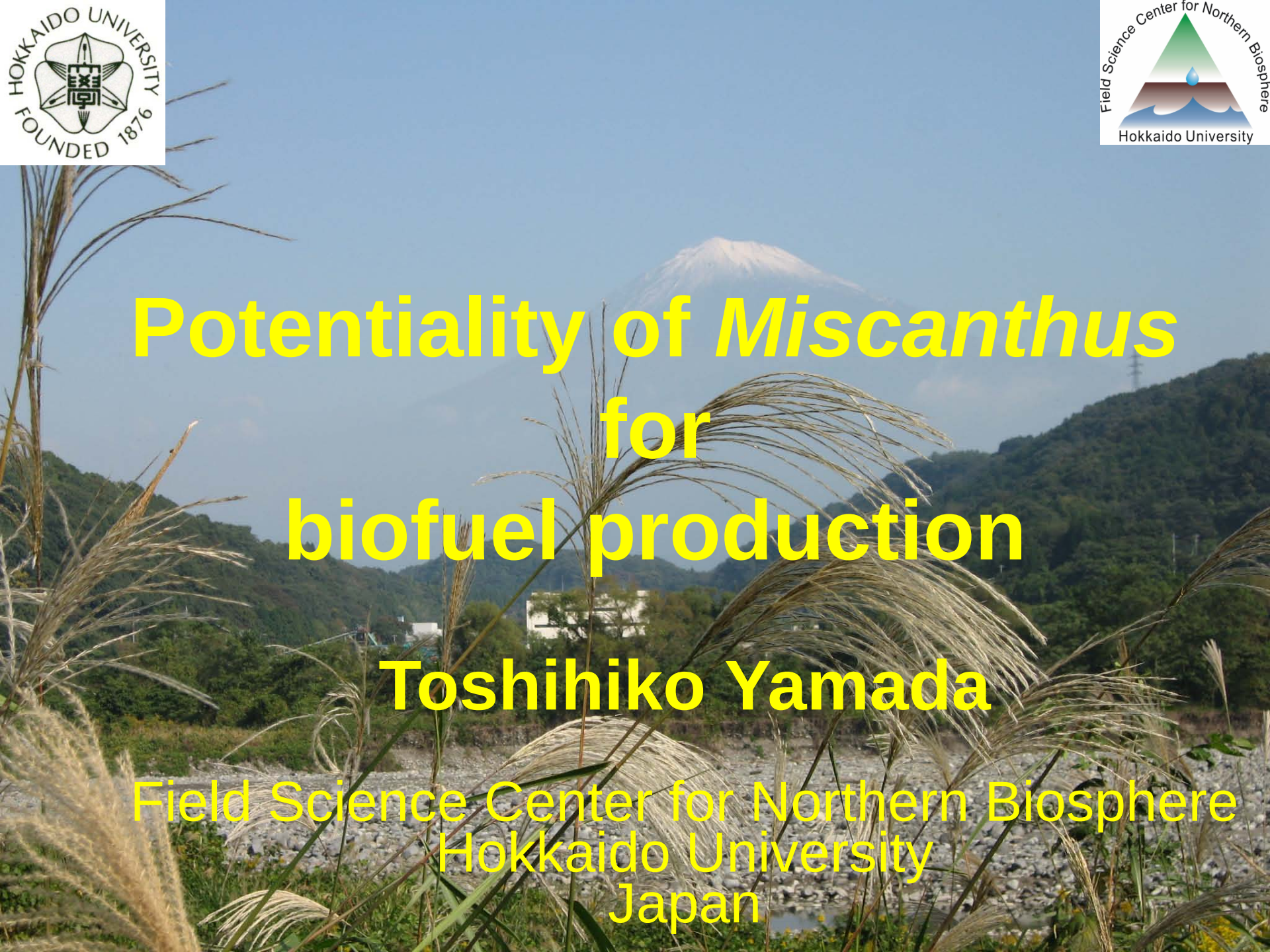


Potentiality of *Miscanthus* for biofuel production

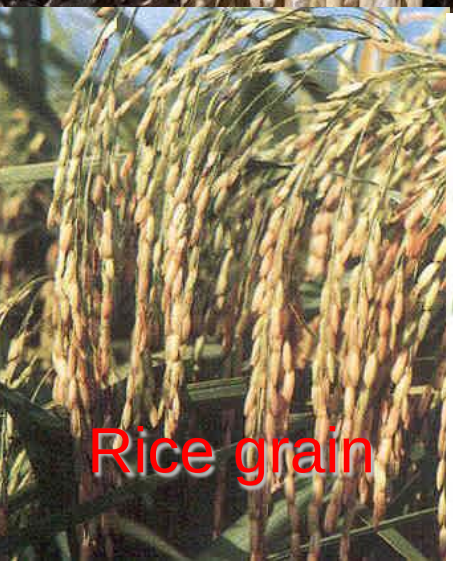
Toshihiko Yamada

Field Science Center for Northern Biosphere
Hokkaido University
Japan

Talks in today

- Cellulosic sources as 2nd generation of feedstocks to convert to biofuel
- East Asian native grass, *Miscanthus* as a potential cellulosic biomass crop
- Ecological studies on Japanese semi-natural *Miscanthus* pasture to establish a sustainable biomass production with the collaboration of Univ. Illinois

Starch Conversion Processes



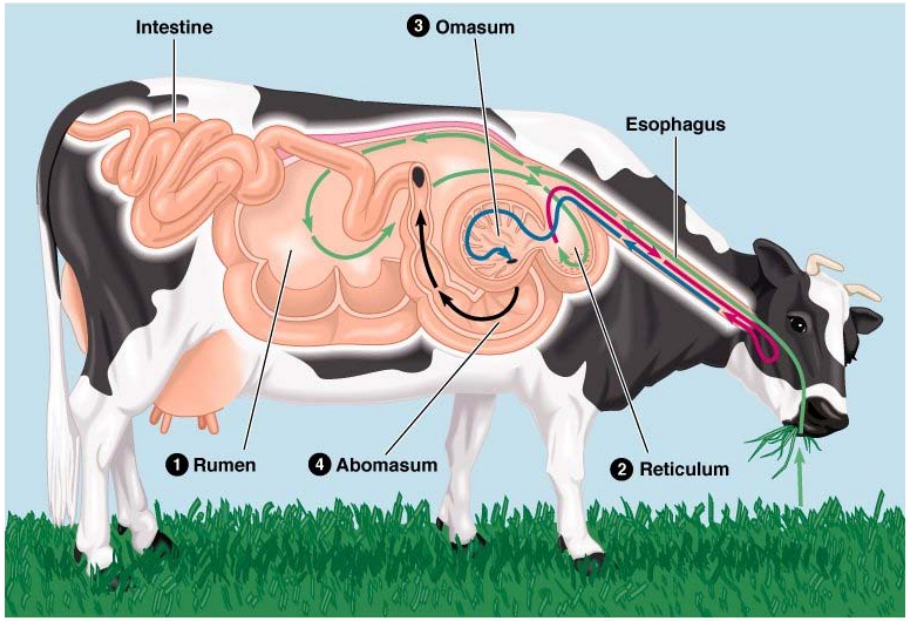
- Human food
- Animal feed
- Biofuel

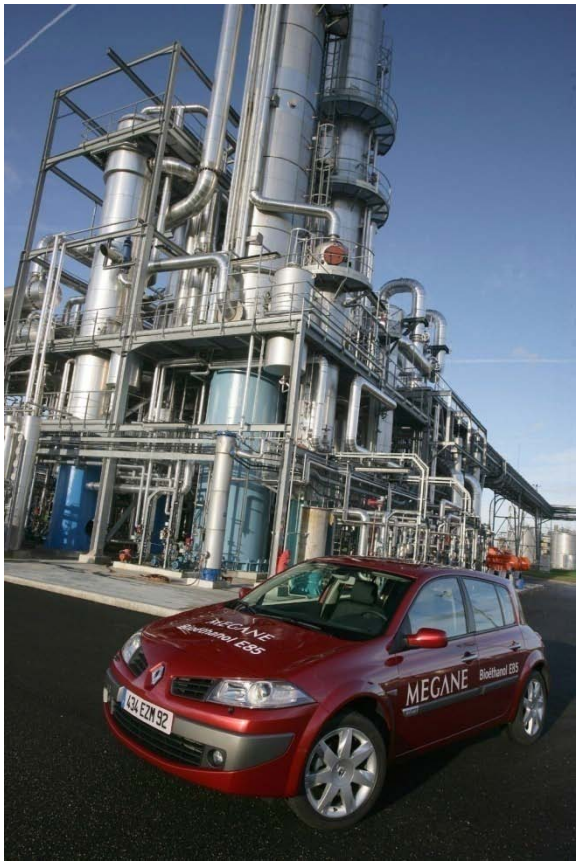
Energy Balance and Greenhouse Gas (GHG) Emission

Feedstock	**Energy balance** (Biofuel output to Petrolium requirement)	**GHG emission** Ethanol/Gasoline
Corn grains	1.3	1.93/2.44 (22%)
Sugarcane	8	1.07/2.44 (56%)
Cellulosic biomass	2 (potential 36)	0.22/2.44 (91%)

(from DOE)

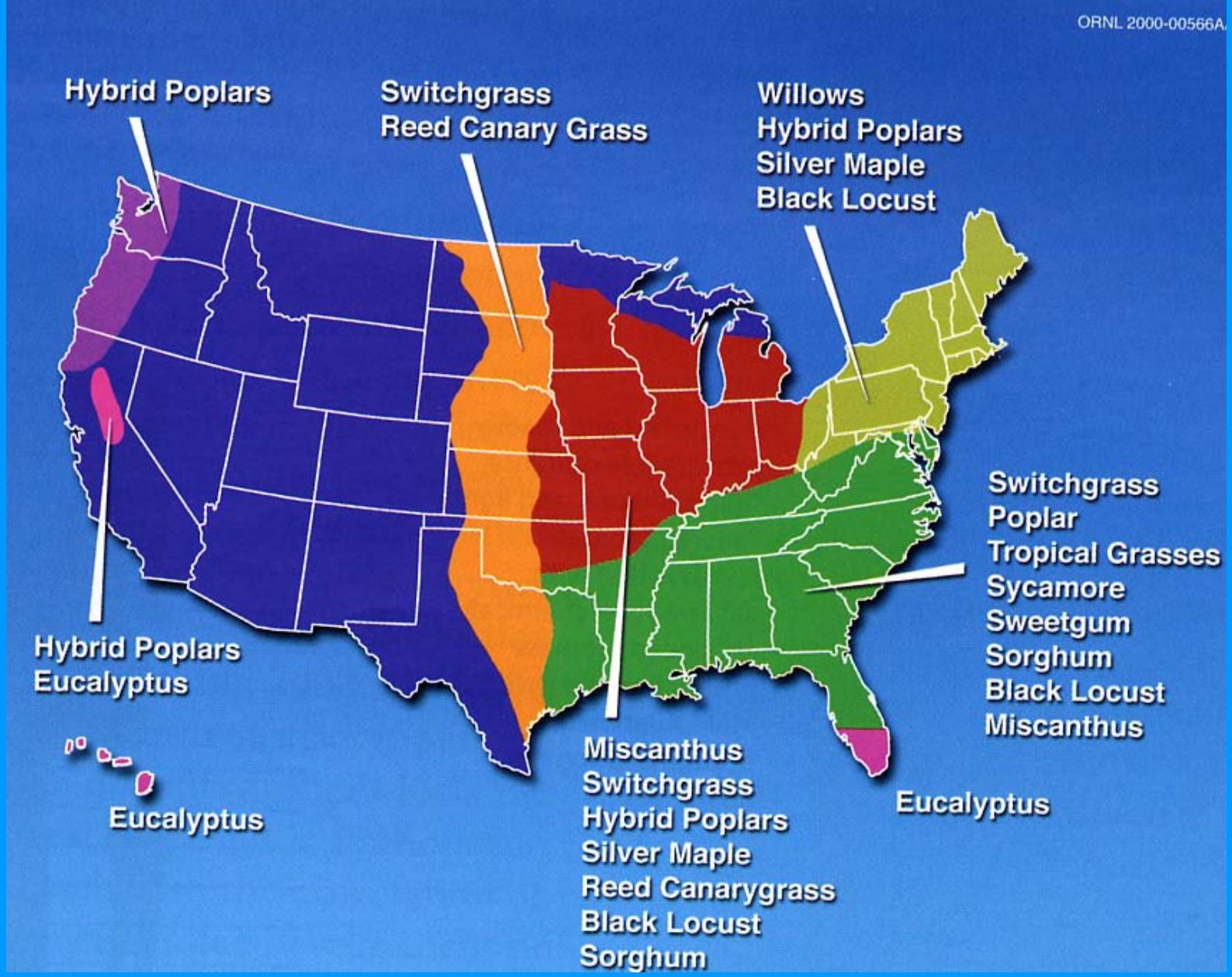
Biomass Conversion from Grasses (Livestock products & Biofuel)





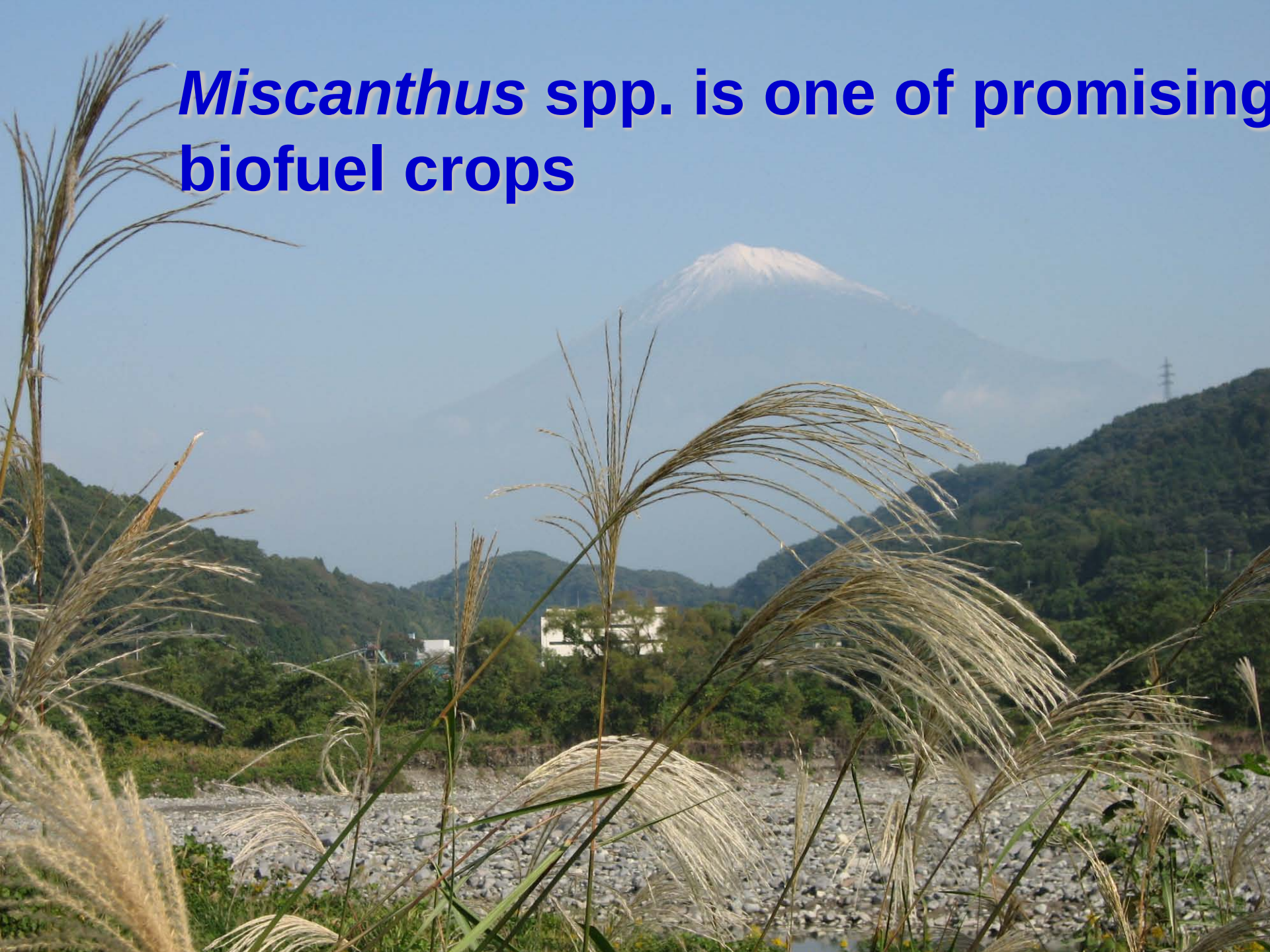
Advantage of perennial grasses for biomass production

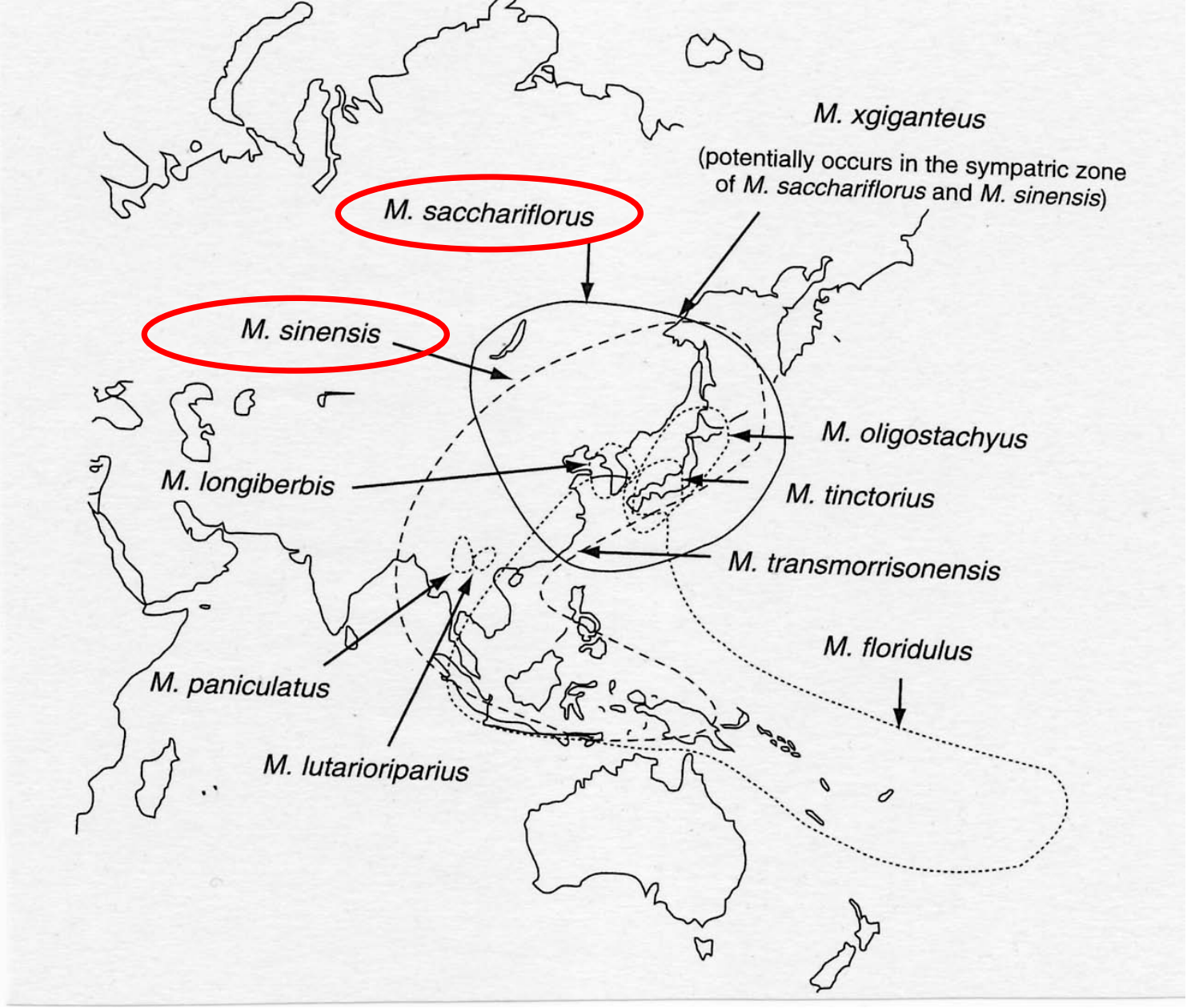
- ✓A low demand for nutrient inputs
- ✓Higher yields on relatively poor quality land
- ✓Longer persistency
- ✓Increase in soil carbon content
- ✓Effect on stability and cover value for wildlife



Geographic distribution of potential cellulosic biomass crops in USA **(from DOE)**


Switchgrass


Miscanthus spp. is one of promising biofuel crops



Geographical distribution of the *Miscanthus* spp.

(Clifton-Brown et al. 2008)

Old Japanese farmer’s house

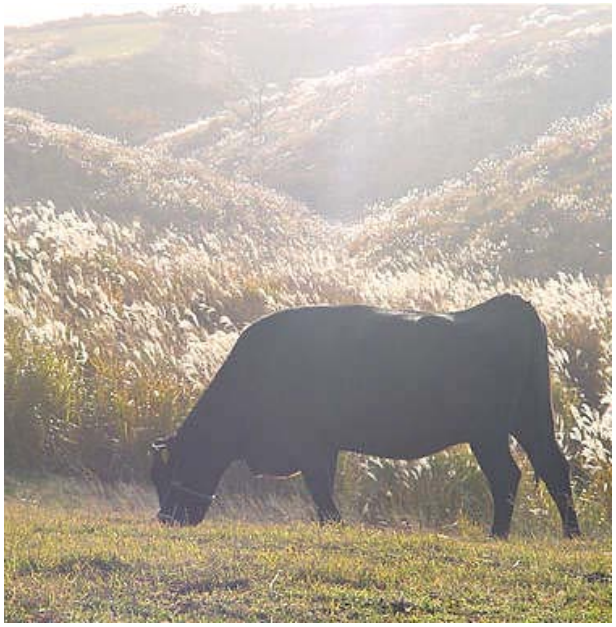





Aso area in Kyushu, Japan

Burning

Cutting for forage



Grazing

Biotic pressures involved maintenance of semi-natural *Miscanthus* grassland

Biomass utilization using *Miscanthus* in Aso

NPO Kyushu Biomass Forum

Gasification from *Miscanthus* biomass is utilized to supply electricity and heat.

Miscantus x giganteus (Giant Miscanthus)

Triploid natural hybrid: *M. sinensis x M. sacchariflorus*

Introduction to Denmark in 1935 from Japan

“Susuki” 2n=38

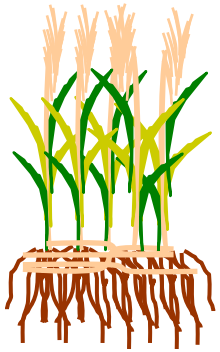
Miscanthus sinensis

Compact roots

×

“Ogi” 2n=4x=76

Miscanthus sacchariflorus



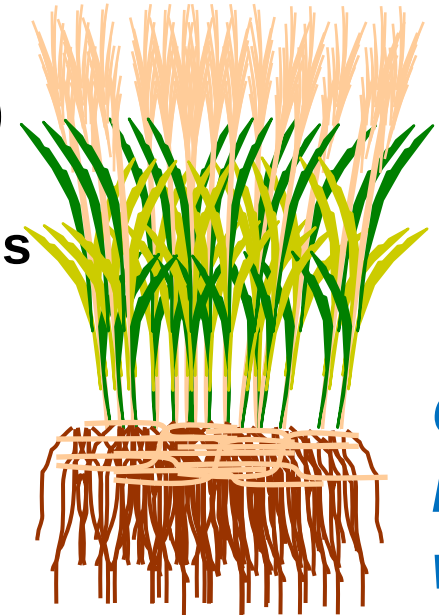
Rhizomes

Natural hybrid

Triploid (3n=57)

M, x giganteus

Giants Miscanthus



High biomass production

（30-45 t/ha/yr)

More than 50t/ha/yr in Illinois

Hybrid vigor

High density

Collection of new natural hybrids and artificial crosses will be important.

Why Use *Miscanthus*

- ✓ C4 photosynthesis
- ✓ High photosynthesis level at low temperature
- ✓ High energy ratio (output/input) 22-50
- ✓ Perenniality

Disadvantage of *M. x giganteus*

- ✓ High establishment costs of sterile triploid
- ✓ Narrow genetic background
- ✓ Less winter hardiness, especially first winter at established year

from HP in University of Illinois

Biomass production and potential ethanol production in US (Heaton et al. 2008)

Feedstock	Harvestable biomass (t/ha)	Ethanol (L/ha)	Million hectares needed for 1,300 million KL of ethanol	Harvested US cropland (%) in 2006
Corn Grain	10.2	298	31.0	24.4
Corn stover	7.4	196	47.2	37.2
Corn total	17.6	493	18.7	14.8
Low-input high diversity	3.8	100	92.1	72.5
Switchgrass	10.4	275	33.7	26.5
Miscanthus	**29.6**	**782**	**11.8**	**9.3**

Miscanthus sinensis collection in Japan

M. sacchariflorus collection

Collection at active volcano (Showa-Shinzan)
R.J. Stwart, Univ. Illinois

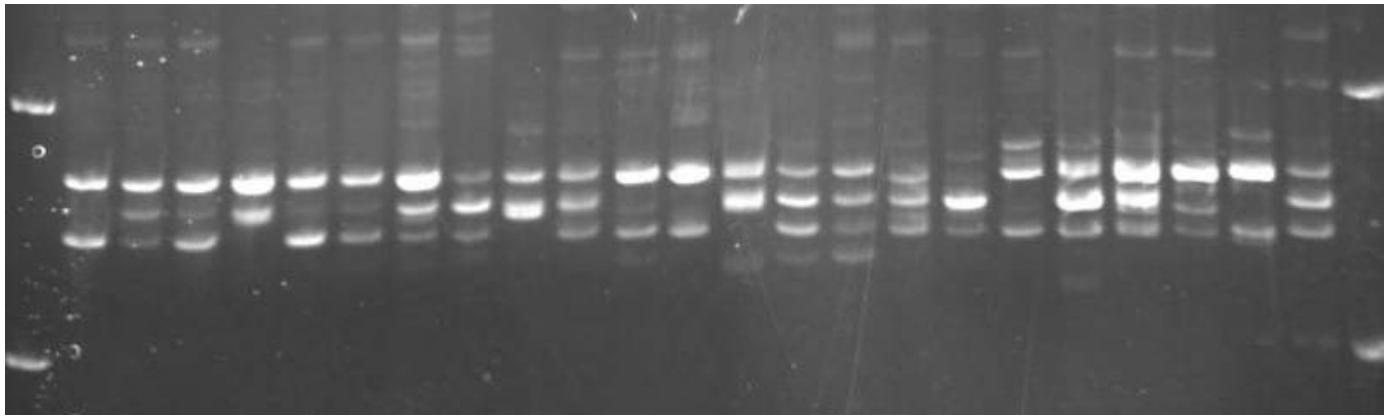

M. sinensis var. *condensatus*
in south island ‘Hachijou’ in Japan

Evaluation of collected accessions

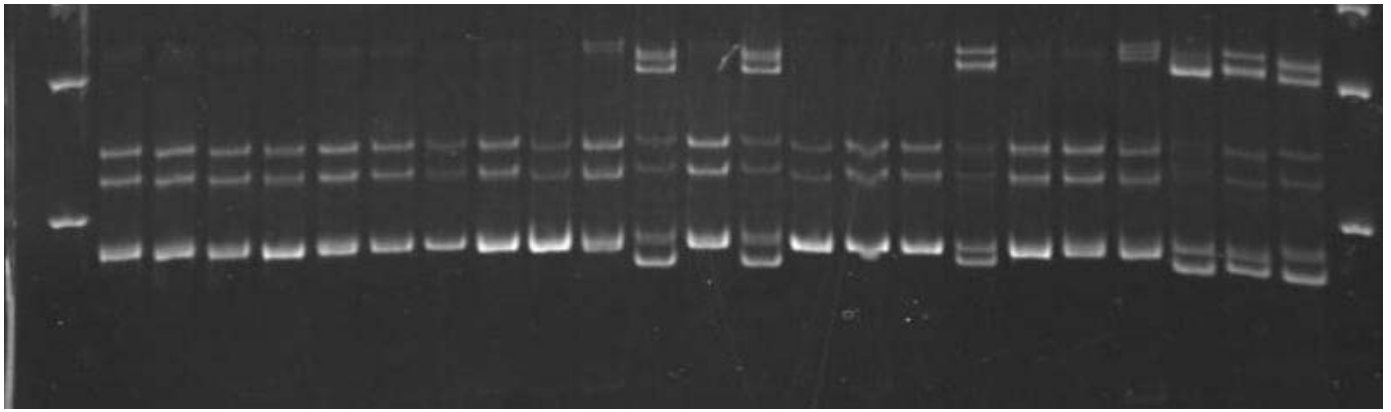
Hokkaido Univ.
18th Oct, 2008

M. sinensis *M. sacchariflous*

置戸 上川 札幌 京極 樽前 苫東 岩手 新潟 群馬 長野 那須 東京 山梨 大阪 鳥取 徳島 高知 宮崎 種子島 中国 長沼 人吉 都城

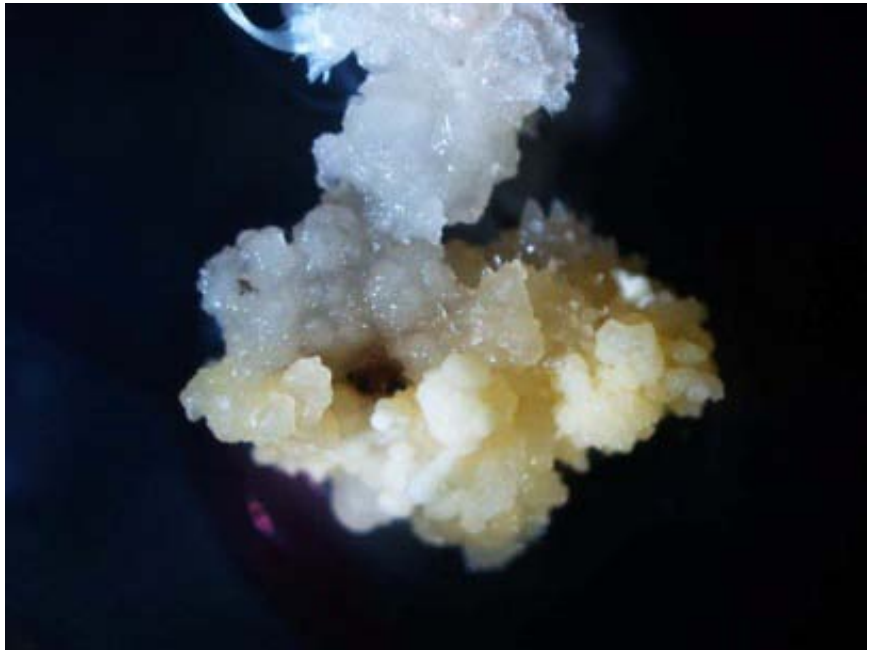


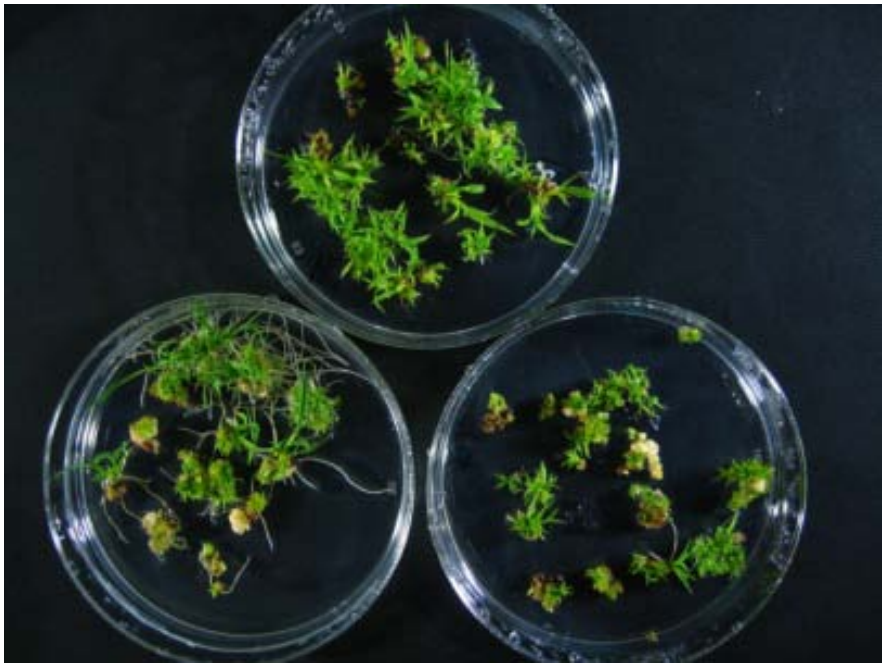
Primer 1



Primer 2

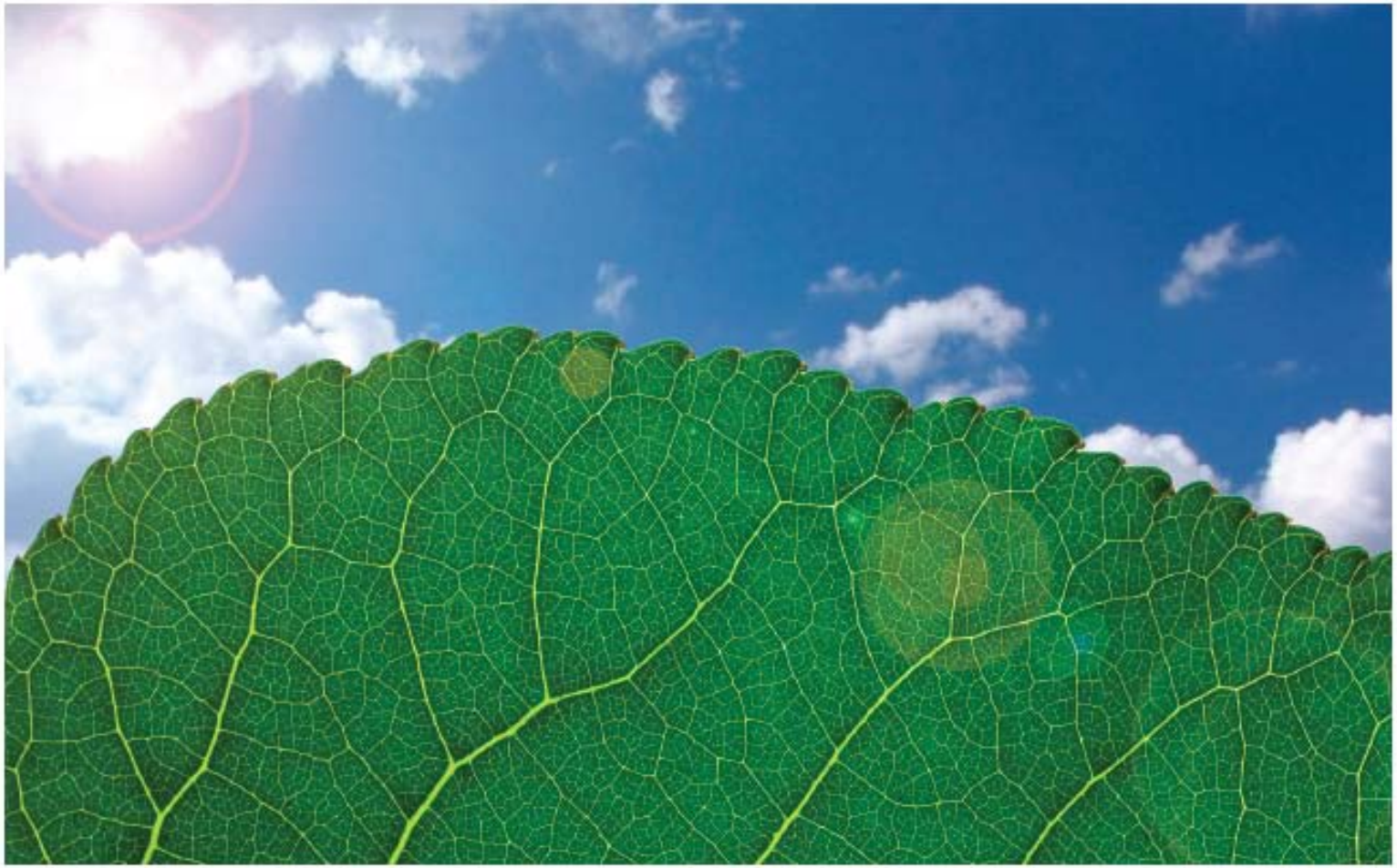
Genetic polymorphism in *Miscanthus* accessions using SSR markers





Molecular Breeding of *Miscanthus*

Energy Biosciences Institute



University of California, Berkeley

Lawrence Berkeley National Laboratory

University of Illinois at Urbana-Champaign

Collaboration between Univ. of Illinois and Hokkaido Univ. by EBI fund

Germplasm collection, nutrient cycling, cold hardiness, photosynthetic capacity, and flowering phenology of *Miscanthus sacchariflorus*, *Miscanthus sinensis*, and their natural hybrids in native stands ranging from central to northern Japan

Objectives:

- ✓Evaluating the nutrient cycle (C, N, P, K) in *M. sinensis* grassland
- ✓Evaluating the N, P, K requirement for the biomass production in *M. sinensis* grassland
- ✓Evaluating the global warming potential in *M. sinensis* grassland

Field Experiment sites in EBI project

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