

Commercial Scale Giant Miscanthus

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Repreve Renewables**

Southern Bioproducts and Renewable
Energy Conference
May 11, 2011

www.REPREVERenewables.com
www.FreedomGiantMiscanthus.com

Giant Miscanthus 101

Miscanthus x giganteus Perennial Energy Grass, Yielding 20+ dry Tons/Acre



Giant Miscanthus



- The best crop in the SE for growth of cellulosic material
- Many benefits:
 - Environmental
 - High Yield & Profit Potential
 - USDA Incentives & Cost Sharing (BCAP)
 - Low Inputs & Production Costs
 - Care-free Growth

Giant Miscanthus:

- **Up to 25 tons/acre/yr**, dependent upon:
 - Variety
 - Culture practices
 - Geographical location
 - Soil Class
- Height up to 15 ft
- Dormant harvest: nutrients & moisture senesce back to roots
 - **10-15% Moisture Content at harvest**
 - **Sequesters Carbon**
 - **Returns minerals back to roots**

Attributes & Benefits

- Efficient fertilizer use, lower needs than row crops
- Highly drought tolerant
- No known pests
- Dense growth crowds out weeds
- Nutrients returned to soil each year
- CO₂ neutral or negative energy source: Carbon credits
- **~ 12% Moisture Content at Harvest**
- **Up to 25 tons per acre yield**

Growth Stage

Herbaceous: dies back to ground at end of the season (not woody)
Deciduous: goes dormant at end of growing season
Perennial: grows back yearly

Rhizomes
Divided for propagation

Freedom
Climate Positive Energy

Harvest
After leaves die off and fall, woody stalks are left for harvest. Fallen leaves return carbon, nitrogen to soil.

Miscanthus is not switchgrass.



Freedom

Giant Miscanthus

- Developed by Dr. Brian Baldwin at MSU, through 12 years of biomass crop study and selection for superior traits.
- The only variety MEANT FOR the Southeast.
- Freedom is the only University-released, named, certified strain of giant miscanthus.



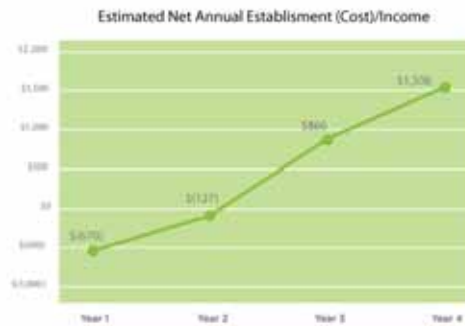
“We see a lot of potential in Freedom giant miscanthus --it’s the most promising of the hundreds of miscanthus cultivars we’ve evaluated over the years, and it’s light years ahead of any of the other grasses.”



--Dr. Brian Baldwin, MSU



Grower Economics



Rhizomes: 0.24 per rhizome
\$1,250 per acre to establish
Full Yield Revenue: \$1,200/acre per year

Planting

Giant Miscanthus Growth

- New growth from rhizomes
- Plant is sterile
 - Triploid = seed sterile
- Multiplication is by plant division
- 5,000 rhizomes per acre



Proper Rhizome storage



Planting

- Working on custom, precision planter
- Can use existing equipment: tobacco planters
- We have a protocol to ensure greater emergence, viable plants





1st Year Plot, August & October



Same plot, 2nd year



Same plot, October 2010



Same plot, Harvest, Jan 2011



Regrowth, 6 weeks ago



Regrowth, 4 weeks ago





**6th Year Plot.
Growing at MSU.
No fertilizer.**



Harvesting:



Harvesting

- In-field baling – varies by equipment
 - Up to 4'x4'x8'
 - 650 to 1,400 lbs per bale
- Modified existing equipment and specialized equipment under development



Transportation Efficiencies



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Freedom Material Characteristics

Moisture Content

At Harvest ~ 12%

BTU Values:

As Harvested ~ 7,250/lb

Dry Basis ~ 8,200/lb

Wood as harvested: ~
4,600/lb

Ash Content:

~ 1-3%

Chlorine: < 80 ppm



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Analysis: 1.5 years old Yielded 8.15 tons



Repreve Renewables
6211 GA Hwy #8
Soperton GA 30487

Date Received: Mar 7, 2011
Date Tested: Mar 10, 2011

Att: Craig Patterson

Sample Log No: 11C0800
Sample Designation: FOMSPH 0211

- Planted July, 2009, harvested Jan 2011
- Ash: <2%
- MC: 11%
- BTU: 7,269 at harvest
- Chlorine: <80ppm

	METHOD	UNITS	MOISTURE & Ash FREE	MOISTURE FREE	AS RECEIVED
Moisture Total	ASTM D2172	wt. %			11.03
Ash	ASTM D2174	wt. %		1.74	1.55
Volatile Matter	ASTM D2176	wt. %		79.68	70.90
Fixed Carbon By Difference	ASTM D2176	wt. %		18.58	16.53
Sulfur	ASTM D4238	wt. %		0.143	0.127
Heating Value	ASTM D1585	BTU/lb	8215	8171	7269
Carbon	ASTM D2172	wt. %		49.02	43.01
Hydrogen	ASTM D2172	wt. %		5.93	5.28
Nitrogen	ASTM D2172	wt. %		< 0.01	< 0.01
Oxygen	ASTM D2176	wt. %		+ 43.16	+ 36.42

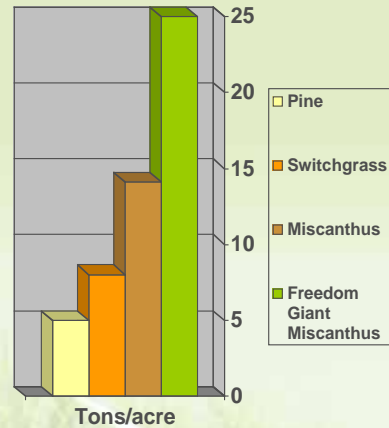


Yield Comparisons

Biomass Yields for SE

3-5X the yield of timber
& switchgrass

Almost double the yield
of other giant
miscanthus

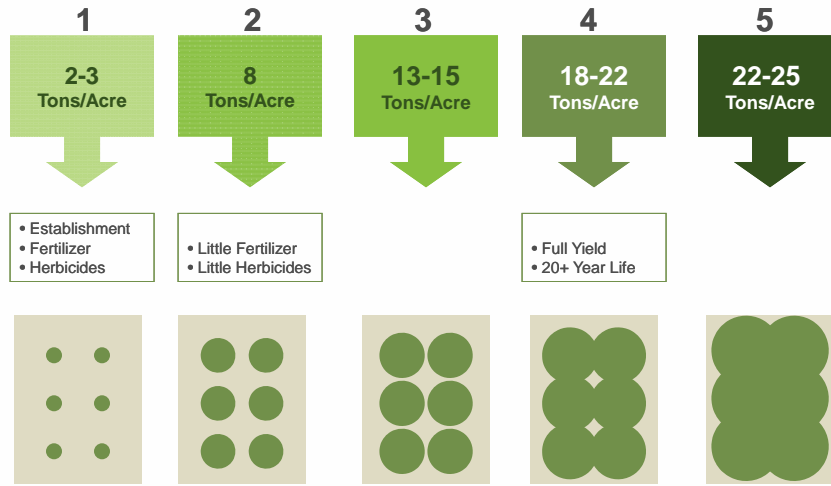


1 Acre of Freedom

28 tons total over first three years
20-25 tons/yr each year thereafter
288 tons after 16-years of harvest
18+ tons/year cumulative yield
10-15% Moisture Content



Yield Model: Year 1-5



Stem Crown Size at Ground



Our Work at Bringing Miscanthus to Market

Going Forward: Knowledge

Goals:

- Affordable Establishment
- Optimized Growth
- Efficient Harvesting

Going Forward: Availability

- 2011: 800+ acres of Foundation planted
- Protocols in place for harvest, storage & planting of rhizomes
- 2012: We can plant up to 80,000 acres from rhizomes

Going Forward: Research

- On-farm Research
 - Input studies on fertilizers, moisture, herbicides
 - Nematode studies
 - Protocols for various soil types and resulting feedstock characteristics
 - Rhizome harvesting protocols and equipment
 - Planting protocols and equipment
 - Testing: analysis as fuel source: BTU, moisture, ash, mineral composition

Going Forward: Research

- Continued work with MSU:
 - Developing a chemical-tolerant giant miscanthus
 - Pathology research



Going Forward: Research

- USDA ARS: reducing leaching
- Appalachian State Univ: biochar on miscanthus
- Chicken house litter from miscanthus/switchgrass
- Demonstration/Research plots

Char Research at App State

Biochar and microbial inoculum (*Bradyrhizobium*) increased average *Miscanthus* dry biomass in a pilot greenhouse study

Treatment	Above ground dry biomass (g)	Below ground dry biomass (g)	Total dry biomass (g)	# of new rhizome branches
Soil	0.623	2.252	2.875	0.25
Soil + Biochar	0.877 (40 % increase)	2.586 (15 % increase)	3.463 (20 % increase)	1.15
Soil + Biochar + inoculum	1.123 (80 % increase)	3.289 (46 % increase)	4.412 (53 % increase)	1.19



Field of Freedom Giant Miscanthus



Thank you for your time.

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