

Short Rotation Eucalypt Plantations in Brazil: an Overview

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*Oak Ridge – Tennessee - USA
November 2012*



Short Rotation Eucalypt Plantations in Brazil: an Overview

The introduction of eucalypts in Brazil

- 1904
- Edmundo Navarro de Andrade
- Railroad company in Sao Paulo
- Firewood and sleepers



Short Rotation Eucalypt Plantations in Brazil: an Overview

The expansion of the use of eucalypts in Brazil

- Charcoal for pig iron and steel industries
- Pulp and paper
- Particle and fiber boards
- Treated wood
- Sawnwood
- Wood chips
- Pellets and briquettes
- Biofuels



Short Rotation Eucalypt Plantations in Brazil: an Overview

Spacings and rotation ages

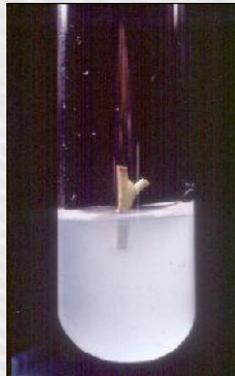
- Traditional spacings 3 m x 3 m, 3 m x 2 m, 3 m x 1.5 m
- Traditional rotation ages 7, 6, 5 years
- In the 70's pilot areas with closely spaced plantations
- Seeds based seedlings
- Closely spaced plantations did not work properly
- Closely spaced plantations were abandoned



Short Rotation Eucalypt Plantations in Brazil: an Overview

Vegetative propagation of eucalypts in Brazil

In 1975, researchers of Aracruz introduced in Brazil the vegetative propagation of eucalypts starting the clonal silviculture of this genus in the country



Short Rotation Eucalypt Plantations in Brazil: an Overview

Clonal eucalypt seedlings



Short Rotation Eucalypt Plantations in Brazil: an Overview

Clonal eucalypt seedlings



Short Rotation Eucalypt Plantations in Brazil: an Overview

Planting operations



Short Rotation Eucalypt Plantations in Brazil: an Overview

Low carbon silviculture 6 m x 1.5 m spacing



Short Rotation Eucalypt Plantations in Brazil: an Overview

Low carbon silviculture 6 m x 1.5 m spacing



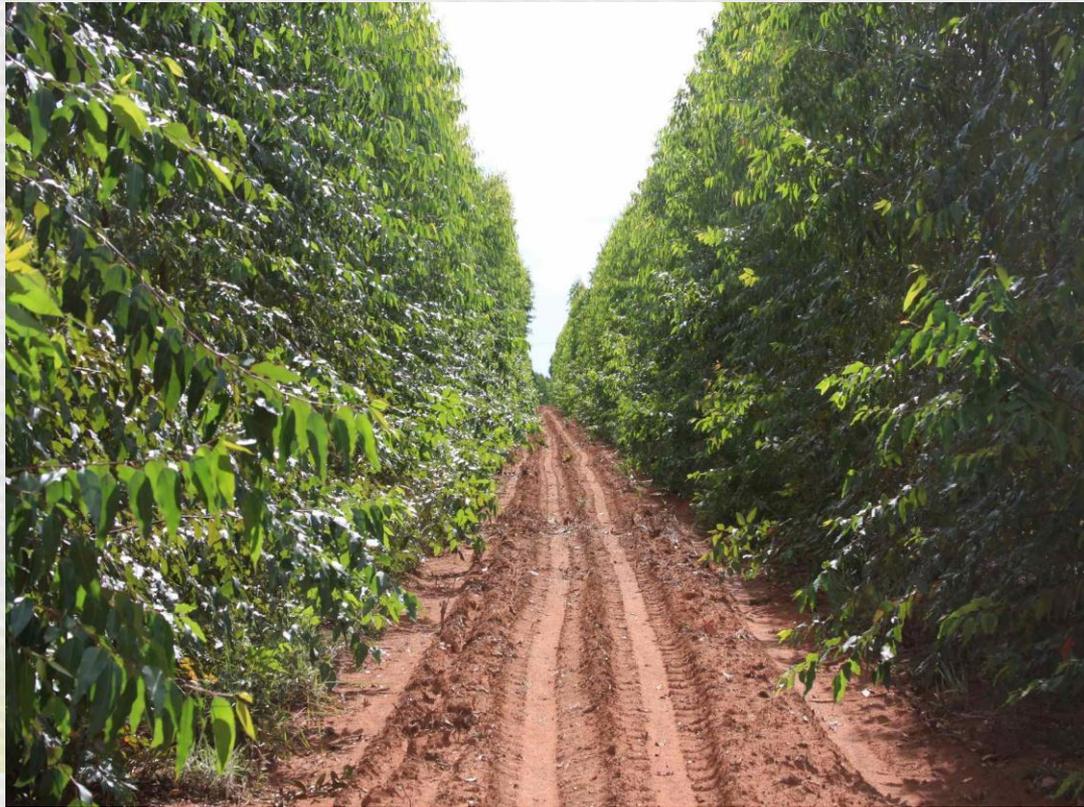
Short Rotation Eucalypt Plantations in Brazil: an Overview

Low carbon silviculture 6 m x 1.5 m spacing



Short Rotation Eucalypt Plantations in Brazil: an Overview

Low carbon silviculture 6 m x 1.5 m spacing



Short Rotation Eucalypt Plantations in Brazil: an Overview

Tending and protection



A: *Emabris mollis* - larva
B: *Emabris mollis* - adulto
C: *Psyllax commensalis* - ovifera
D: *Psyllax commensalis* portando larva de *Emabris mollis*
E: Foto para criação de *Psyllax commensalis*
F: Detalho do peso (água = *Emabris mollis*)



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Harvesting and transportation



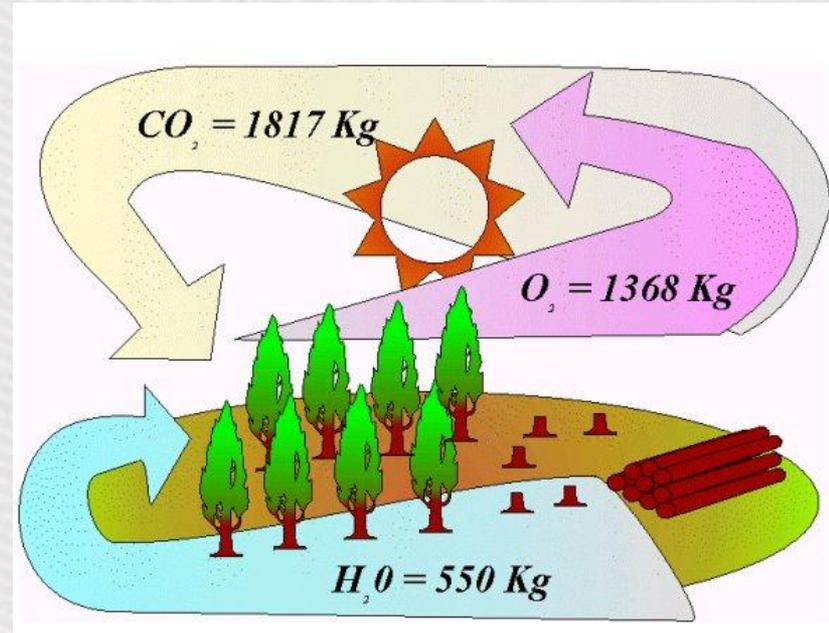
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Social aspects



Short Rotation Eucalypt Plantations in Brazil: an Overview

Environmental aspects

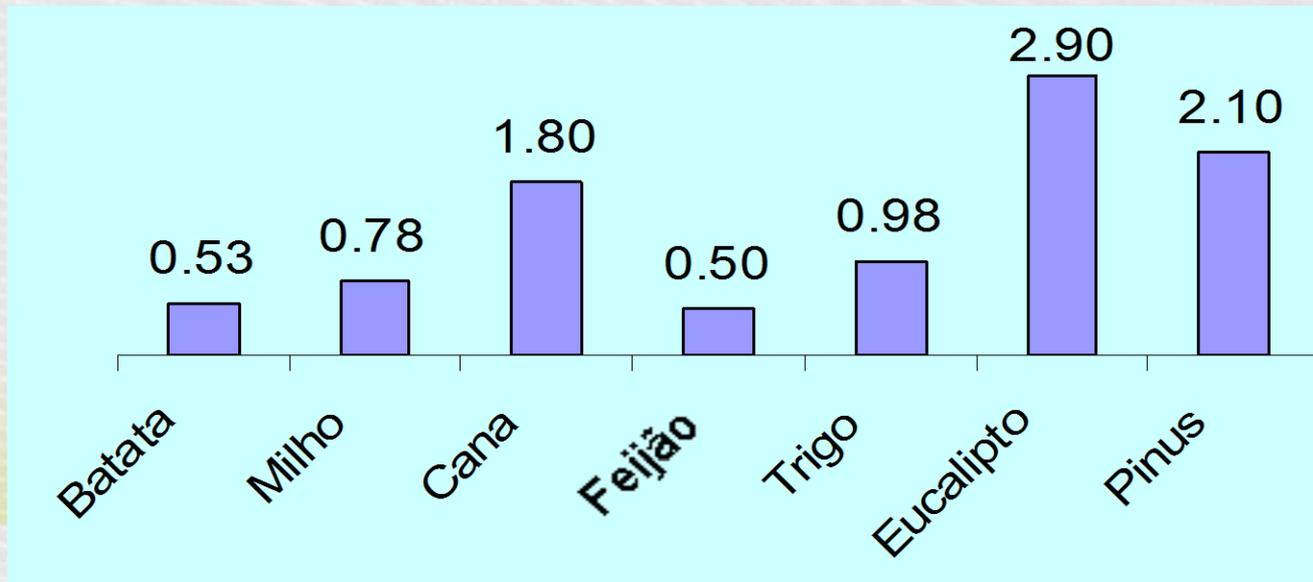


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Environmental aspects

Residues Left in the Area after Harvesting (ton per hectare)

Crown	Bark	Roots	Mulching	Total
9	8	20	13	50



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The importance of the choice of the correct clone



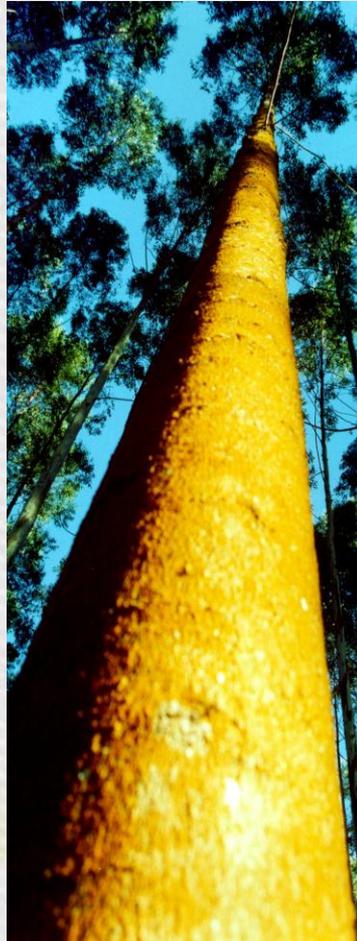
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Eucalyptus dunnii in Santa Catarina, Brazil, 30 years



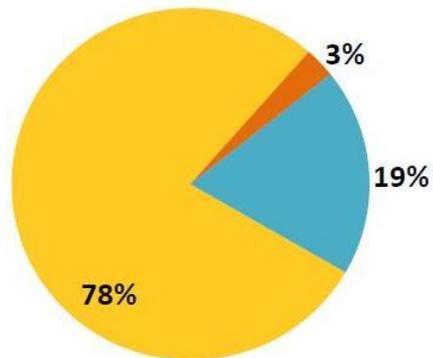
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Eucalyptus urograndis in Sao Paulo, Brazil, 8 years

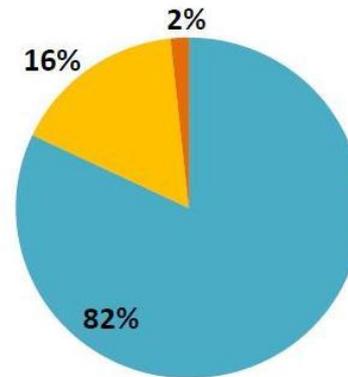


Energy Matrix in Brazil and in the World

Global Energy Matrix



Brazilian Energy Matrix



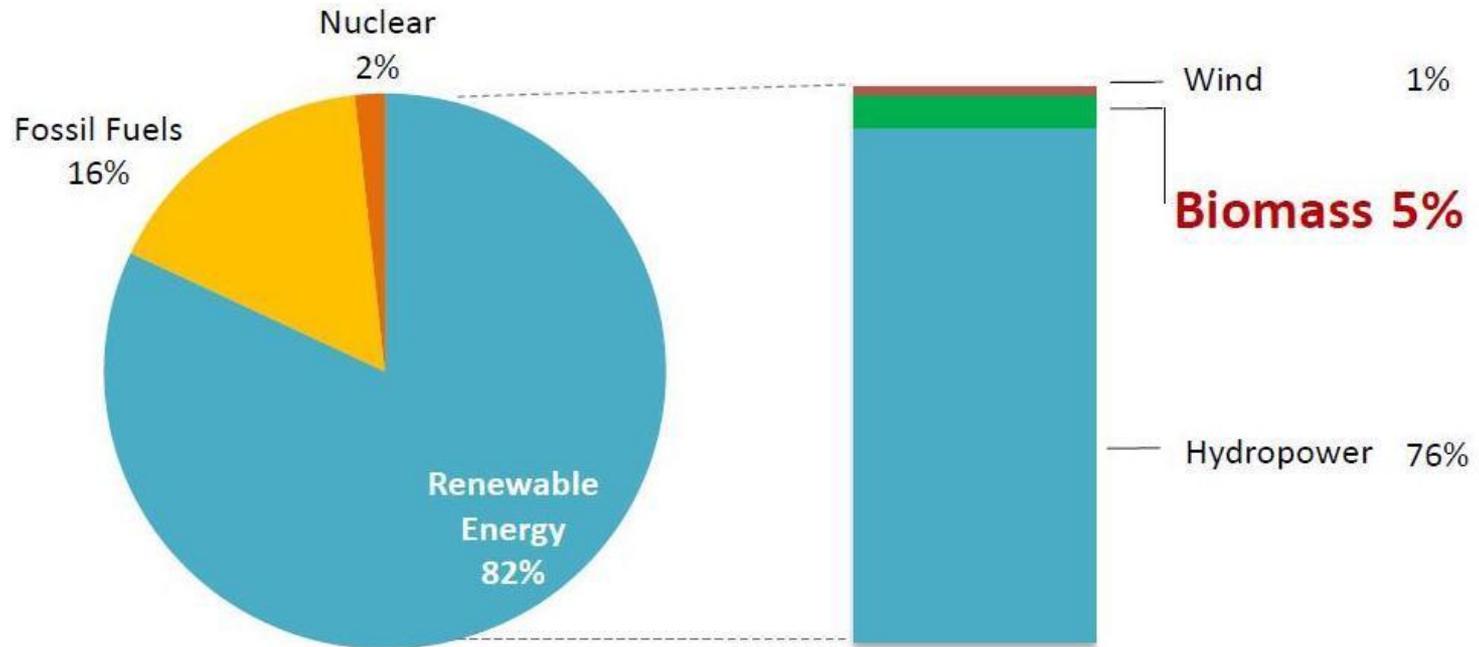
■ Fossil fuels ■ Nuclear ■ Renewable

Source: RENEWABLES GLOBAL STATUS REPORT

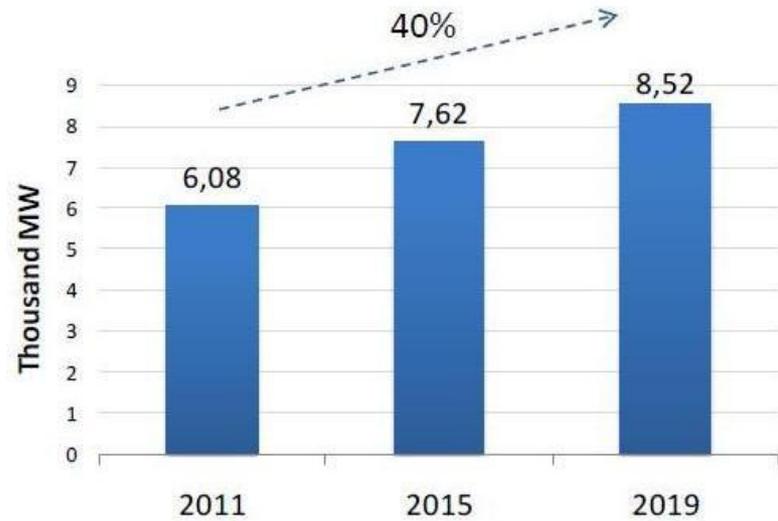
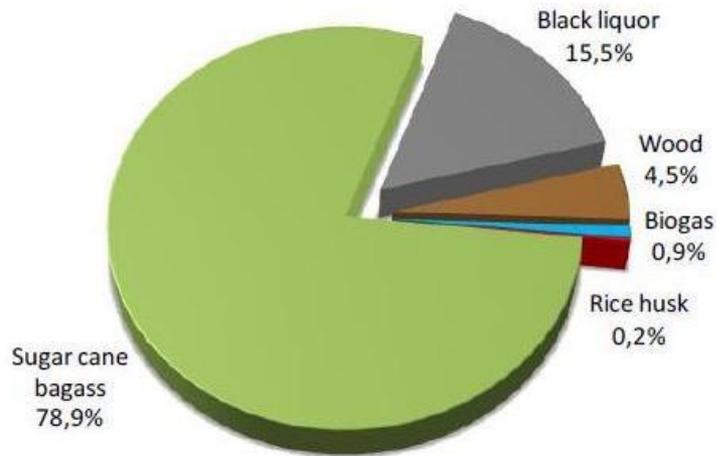


Energy Matrix in Brazil

Renewable Energy Share of Brazil Final Energy Consumption, 2011



Energy Matrix in Brazil



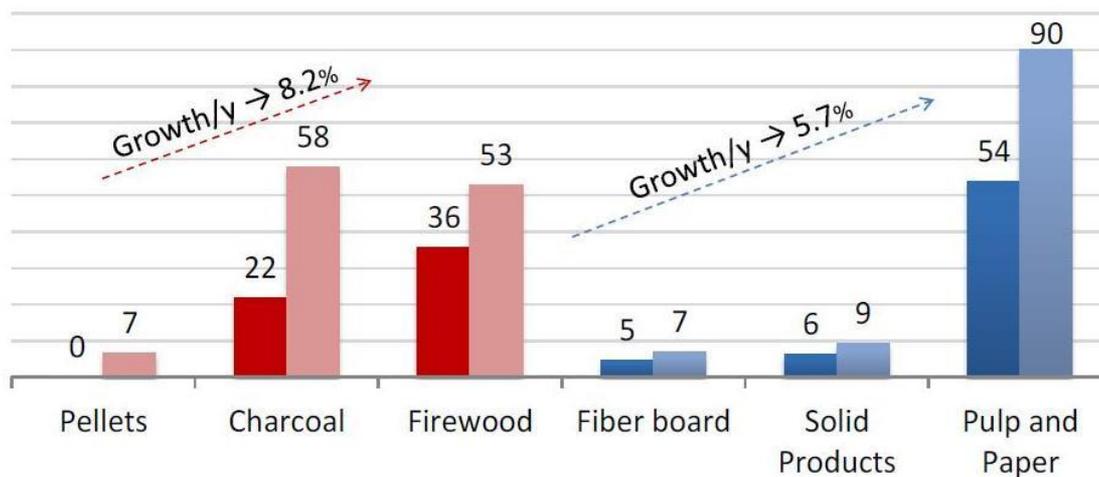
Source: EPE – Energy Research Business



Eucalypt Biomass Demand in Brazil

Eucalyptus demand by sector (million m³)

2012 – 2020

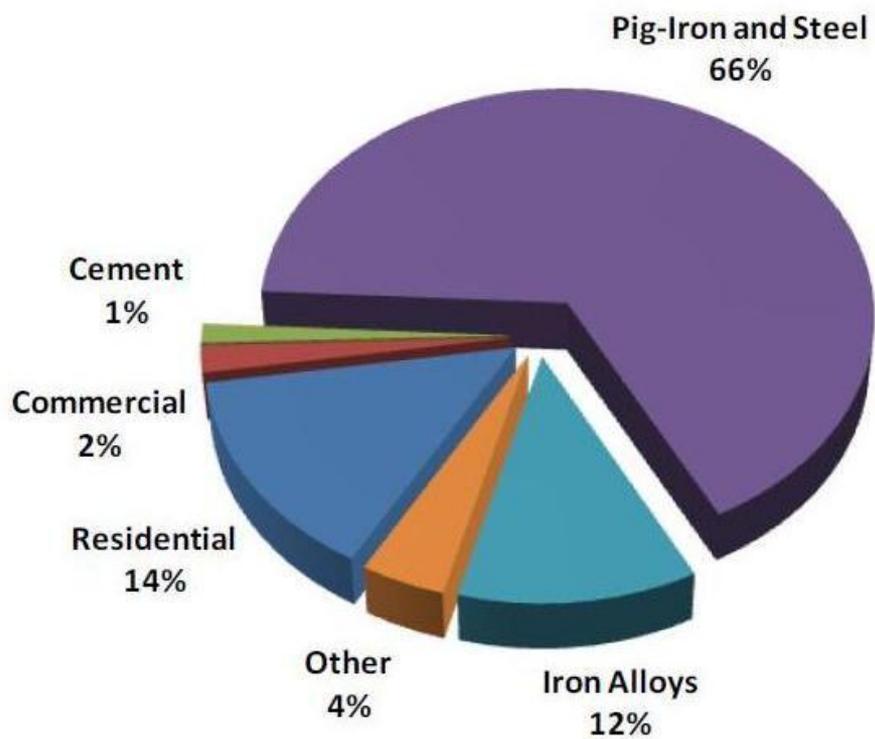


Volume demand (million m³)

Area demand (ha)

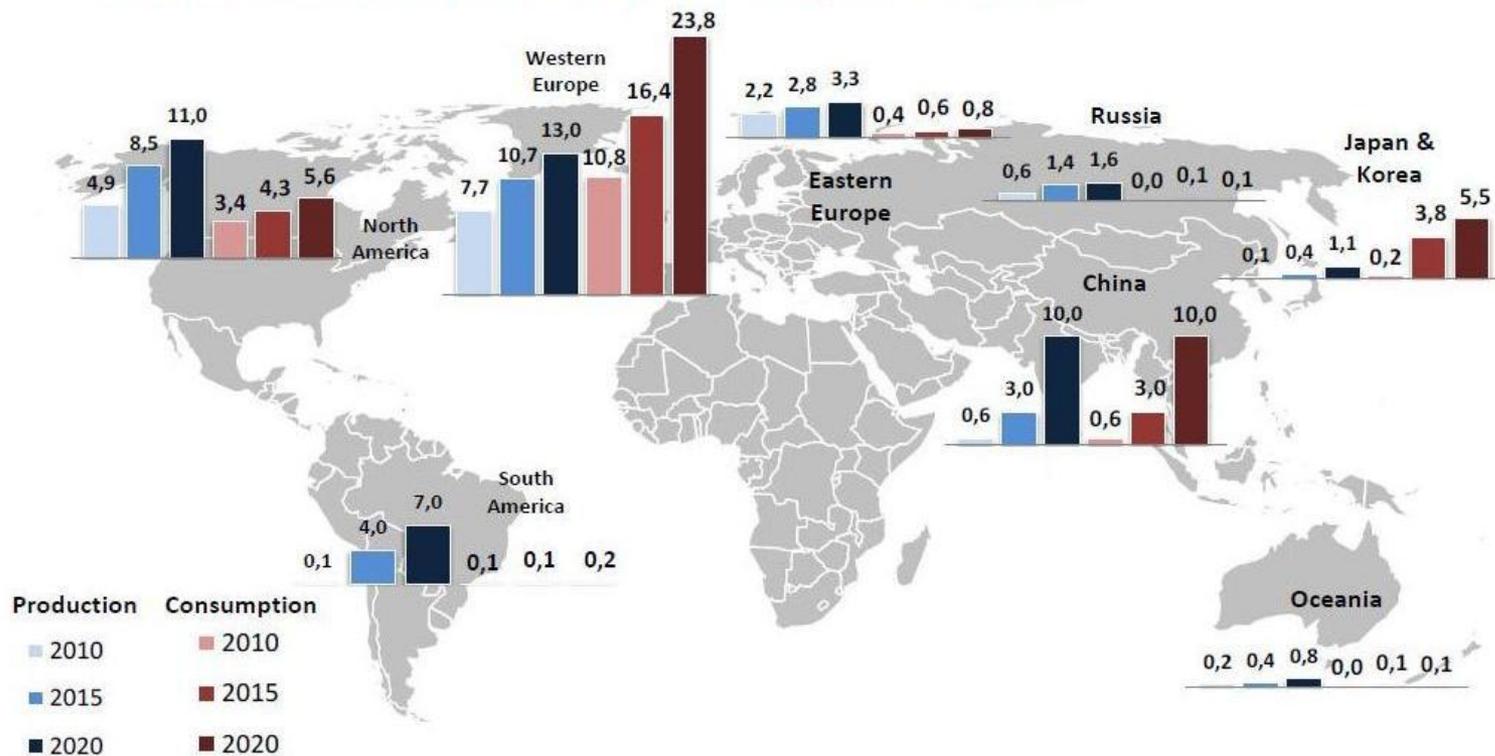


Charcoal Demand in Brazil



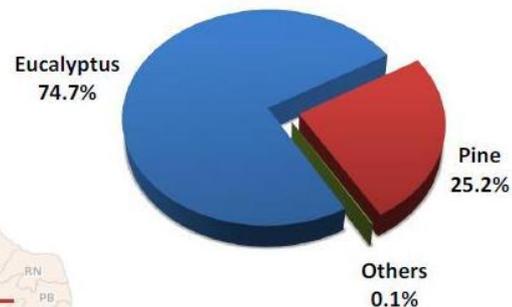
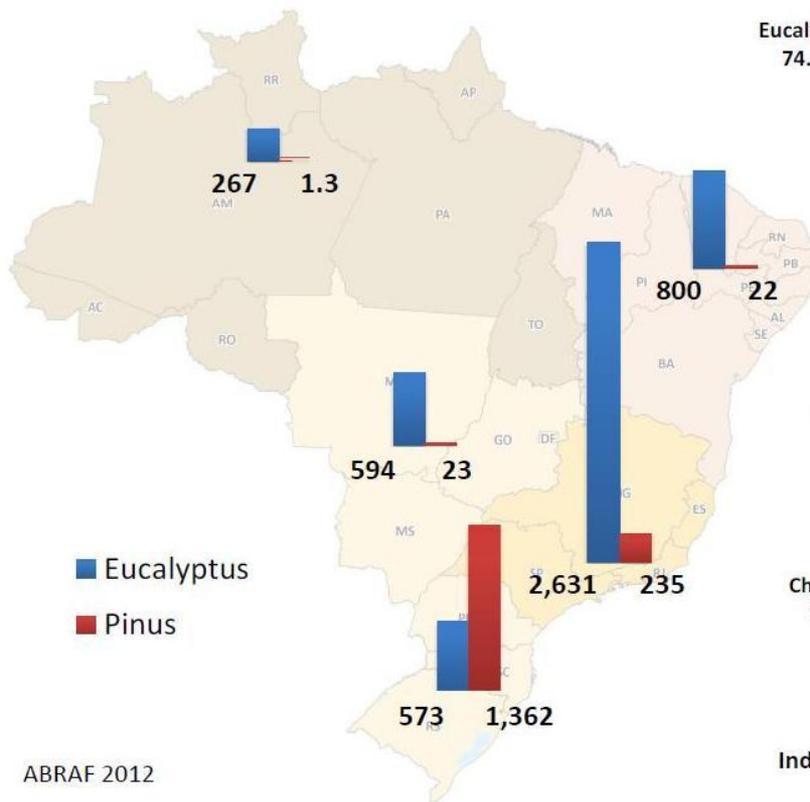
The World Market for Wood Pellets

Global Pellet Production and Consumption – 2010, 2015 and 2020

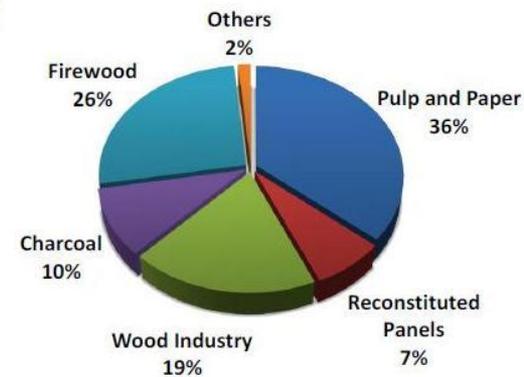


Forest Plantations in Brazil

Planted Area (thousand ha) - 2012



Planted Forests : ≈ 6,5 Mha

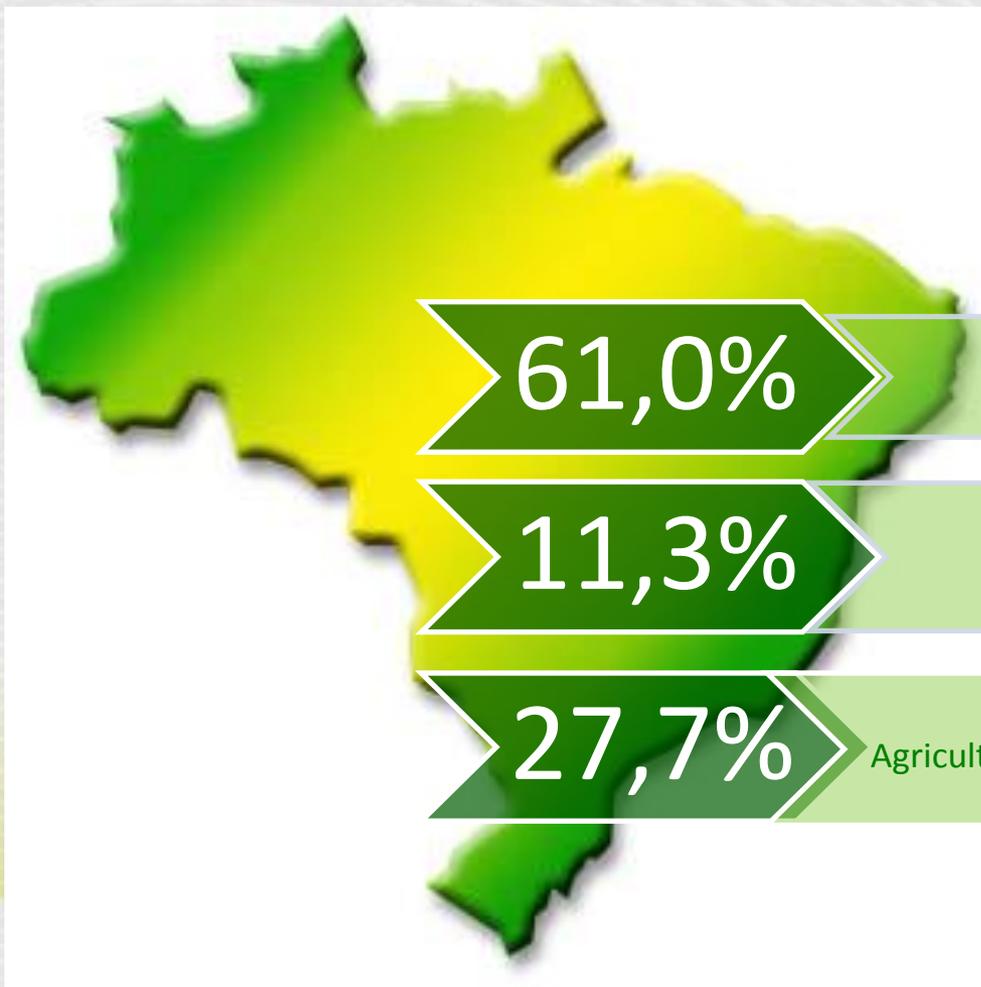


Industrial Wood Consumption ≈ 170 M m³



Land Use in Brazil

Total area 851 million ha



61,0%

519 million ha
Native vegetation

11,3%

96 million ha
Cities, roads, etc...

27,7%

236 million ha
Agriculture, livestock, planted
forests

0,8%
Planted forests



Closely Spaced Eucalypt Plantations in Brazil



Closely Spaced Eucalypt Plantations in Brazil

A study on the initial planting spacing of eucalypts in Brazil

Influência do espaçamento no crescimento do *Eucalyptus urophylla* de origem híbrida, cultivado na região de Coronel Fabriciano, Minas Gerais. Departamento de Engenharia Florestal, Universidade Federal de Vicosa, Vicosa, Minas Gerais, M. Sc. thesis, Laercio Couto, 1977.



Closely Spaced Eucalypt Plantations in Brazil

A study about the nature of the timber production function in Brazil

The Nature of the Timber Production Funcion: *Eucalypts grandis* W. Hill ex Maiden in Brazil. Faculty of Forestry, University of Toronto, Toronto, Ontario, Canada, Ph.D. thesis, Laercio Couto, 1982.



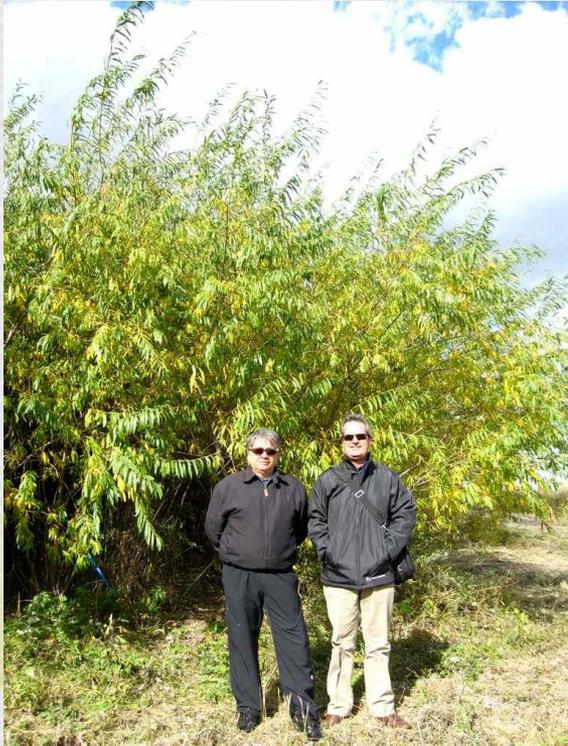
Closely Spaced Eucalypt Plantations in Brazil

Post Doctorate study at Colorado State University

SHORT ROTATION EUCALYPT PLANTATIONS IN BRAZIL: SOCIAL AND ENVIRONMENTAL ISSUES Dr. Laércio Couto[1] and Dr. David R. Betters[2]
[1]Departamento de Engenharia Florestal, Universidade Federal de Viçosa 36570.000, Viçosa, Minas Gerais, Brasil [2]Department of Forest Sciences, Colorado State University, Fort Collins, CO 80523 Date Published: February 1995 Prepared under purchase order 19XSM 842V for Biofuels Feedstock Development Program, Environmental Sciences Division Published by OAK RIDGE NATIONAL LABORATORY Oak Ridge, Tennessee 37831-6352 managed by MARTIN MARIETTA ENERGY SYSTEMS INC. for the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400



Closely Spaced Eucalypt Plantations in Brazil



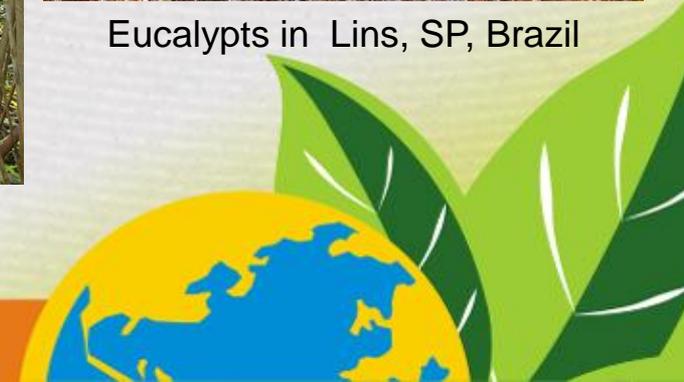
Syracuse, NY, USA



Willow em Syracuse, NY, USA



Eucalypts in Lins, SP, Brazil



Closely Spaced Eucalypt Plantations in Brazil

The basic research in Brazil

In 2002, with the support of CNPq, Capes, CEMIG, ANEEL, RENABIO and ArcelorMittal Bioenergia, a research team of UFV established in Itamarandiba, Minas Gerais an experimental area to produce biomass for energy in closely spaced short rotation eucalypt plantations



Closely Spaced Eucalypt Plantations in Brazil

The first Ph.D. thesis on closely spaced eucalypt plantations

Clone

E. grandis x E. camaldulensis

Initial spacings: 3.0 x 0.5 m

3.0 x 1.0 m

3.0 x 1.5 m

3.0 x 2.0 m

3.0 x 3.0 m

Data collection:

Survival

DBH and basic density

Height

Biomass



Closely Spaced Eucalypt Plantations in Brazil

Data collection

Data collected in 2004, at the age of 2 years used in a Ph.D. Thesis at the Department of Forestry of the Federal University of Vicosa



Closely Spaced Eucalypt Plantations in Brazil

Ph. D. thesis

In 2005, the Ph.D. thesis was defended by graduate student Marcelo Dias Muller, at the Department of Forestry, Federal University of Vicosa

PRODUÇÃO DE MADEIRA PARA GERAÇÃO DE ENERGIA ELÉTRICA NUMA PLANTAÇÃO CLONAL DE EUCALIPTO EM ITAMARANDIBA, MG



Closely Spaced Eucalypt Plantations in Brazil

A view of the closest spacing 3.0 m x 0.5 m at the age of 2 years



Closely Spaced Eucalypt Plantations in Brazil

Dry tons per hectare at the age of 2 years



Closely Spaced Eucalypt Plantations in Brazil

Where are the biomasses in the trees ?



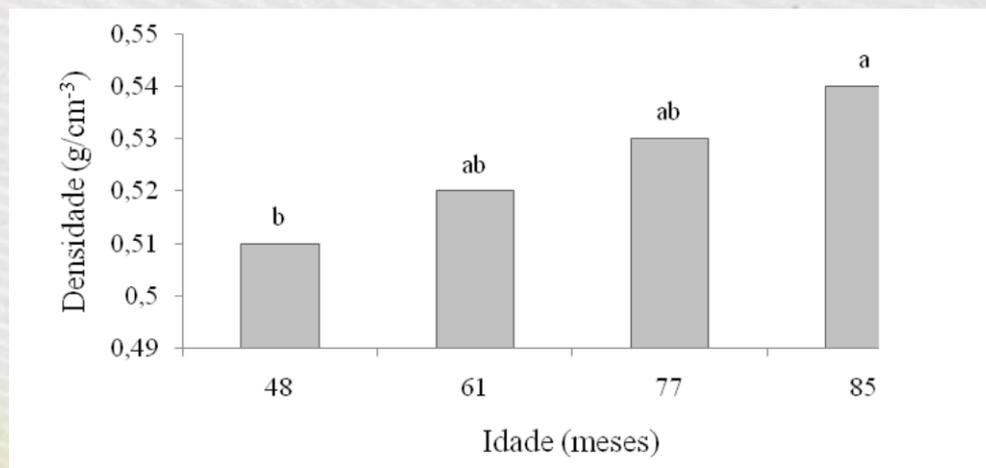
Tratamento (m)	Peso de matéria seca (ton/hectare)			%	
	Copa	Fuste	Total	Copa	Fuste
3,0x0,5	12,16	42,00	54,16	22,44%	77,56%
3,0x1,0	10,18	35,71	45,89	22,18%	77,82%
3,0x1,5	8,72	29,82	38,54	22,62%	77,38%
3,0x2,0	8,53	26,33	34,86	24,47%	75,53%
3,0x3,0	6,98	21,10	28,08	24,88%	75,12%



Closely Spaced Eucalypt Plantations in Brazil

Three M. Sc. theses were developed using the same research trial

Influencia da idade e do espaçamento na produtividade e propriedades da madeira de Eucalyptus grandis x Eucalyptus camaldulensis para energia (Maria Fernanda Vieira Rocha – DEF – UFV – 2011)



Closely Spaced Eucalypt Plantations in Brazil

Three M. Sc. theses were developed using the same research trial

Eficiencia Nutricional, Area Foliar e Produtividade de Plantacoes de Eucalipto em Diferentes Espacamentos Estimados com Redes Neurais Artificiais (Bruno Oliveira Lafeta – UFVJM – 2012)



Closely Spaced Eucalypt Plantations in Brazil

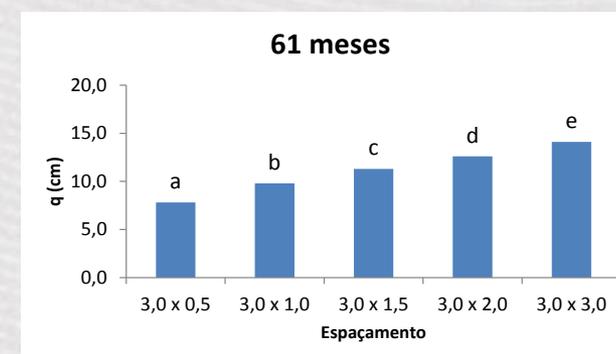
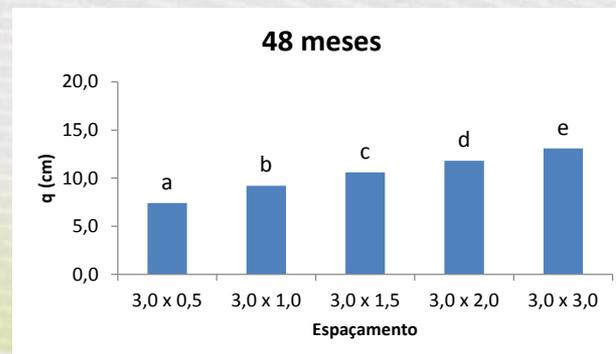
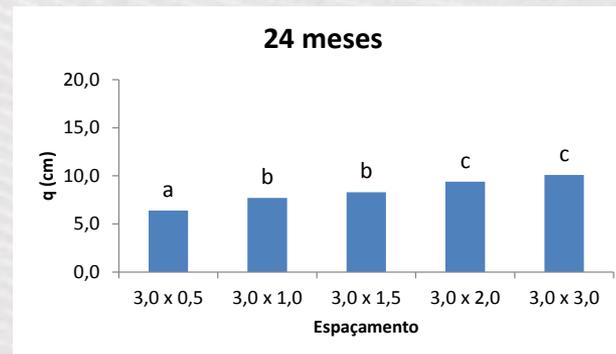
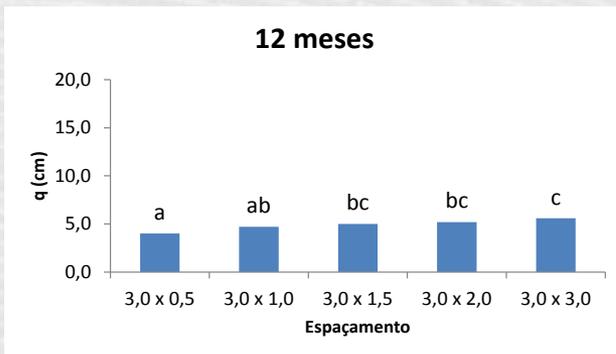
Three M. Sc. theses were developed using the same research trial

Efeito do Espacamento e do Tempo sobre a Producao de Biomassa e Energia em Povoamentos de Clones de Eucalipto (Erik Junior Paulino – UFVJM – 2012)



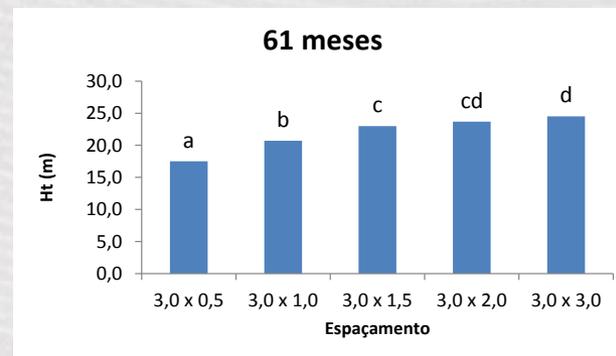
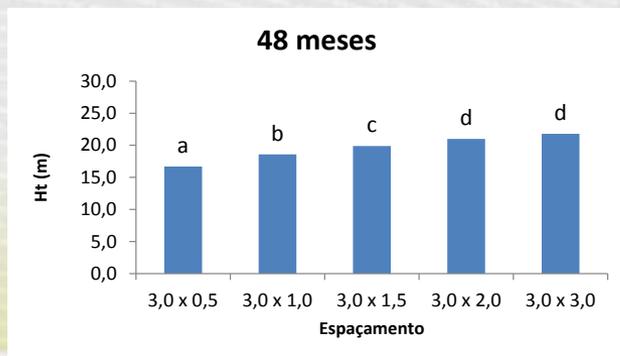
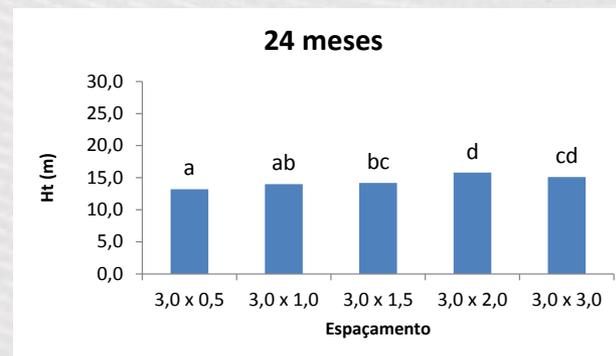
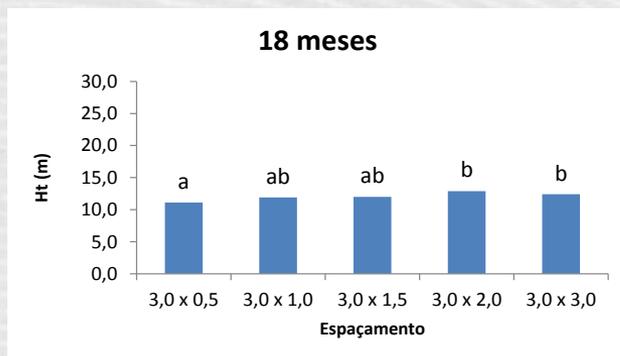
Closely Spaced Eucalypt Plantations in Brazil

DBH



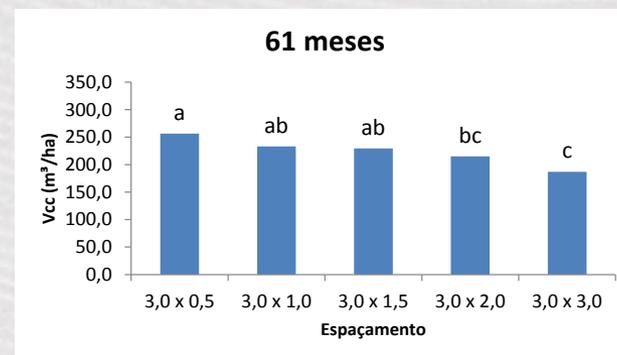
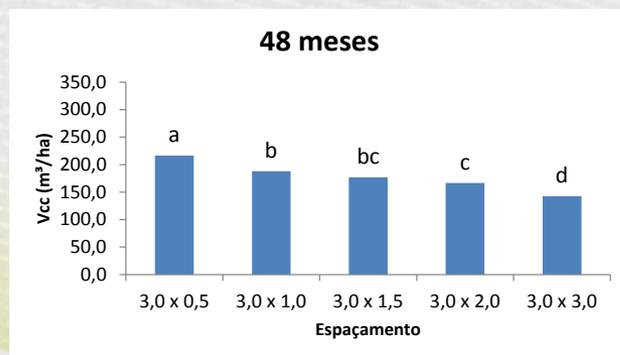
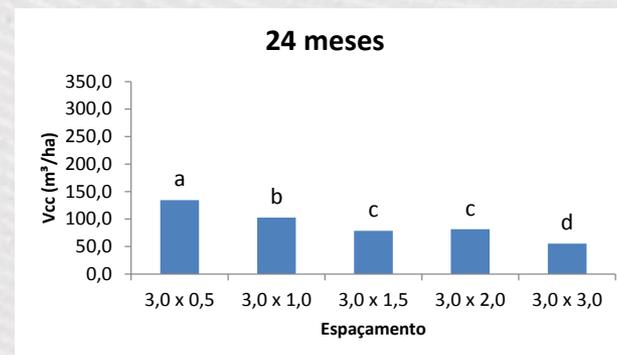
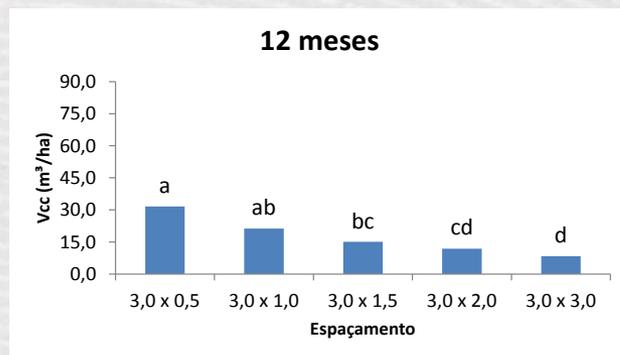
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Height



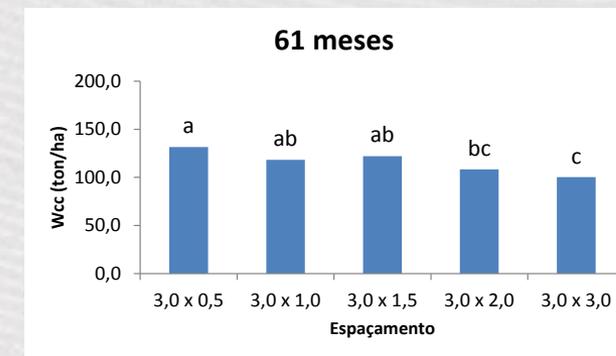
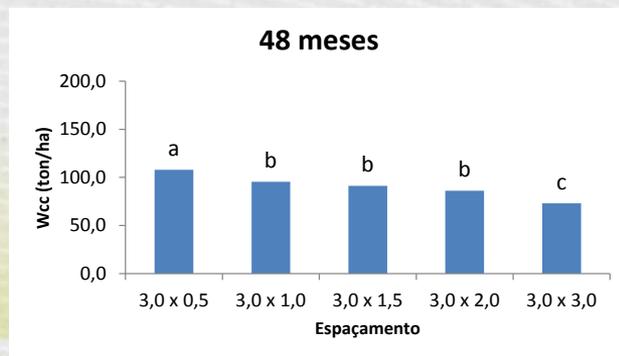
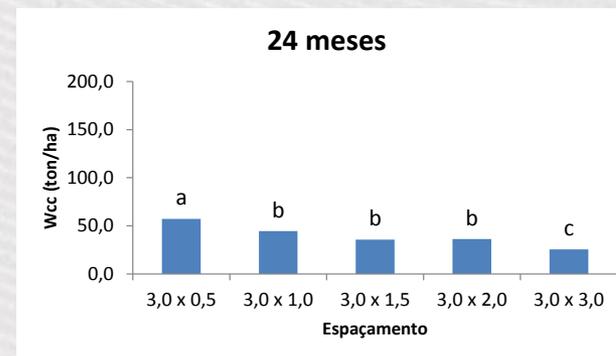
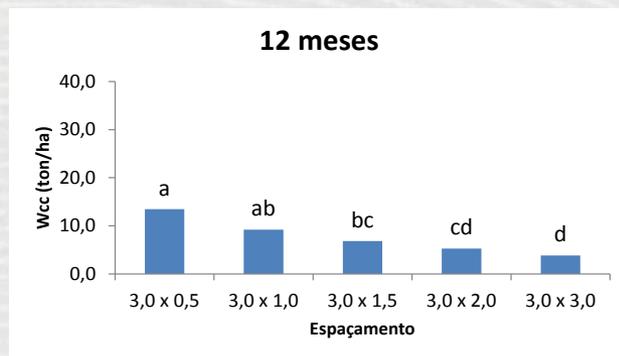
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Volume



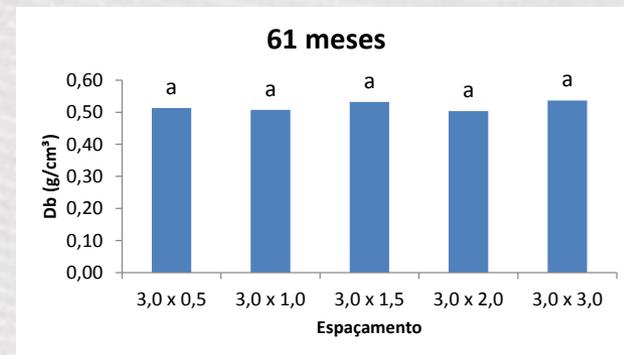
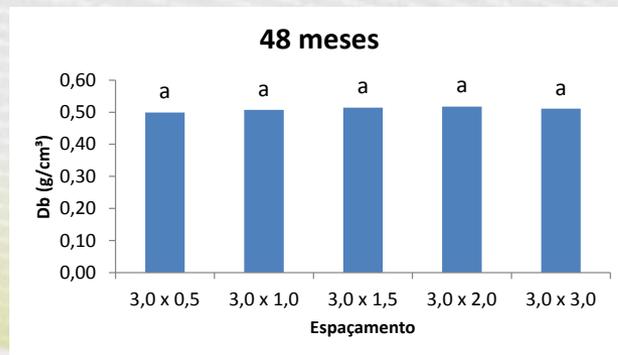
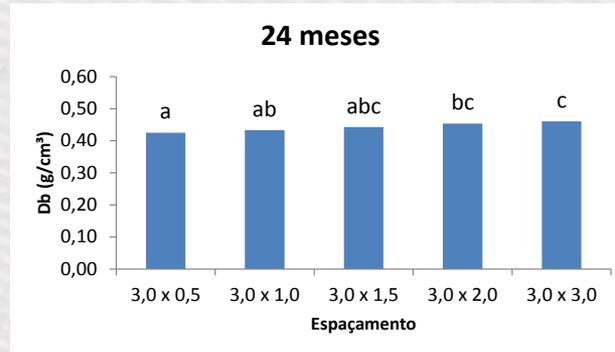
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Biomass



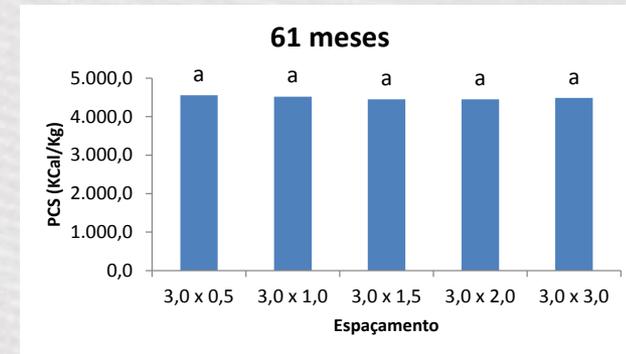
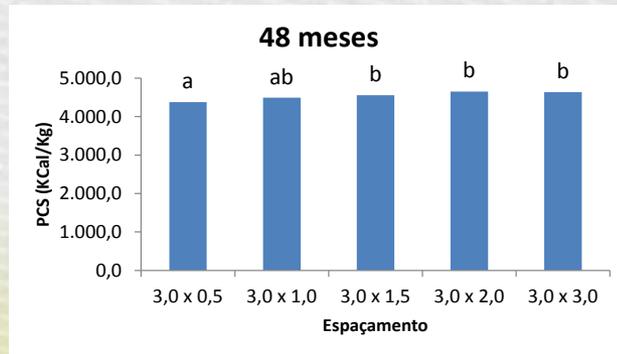
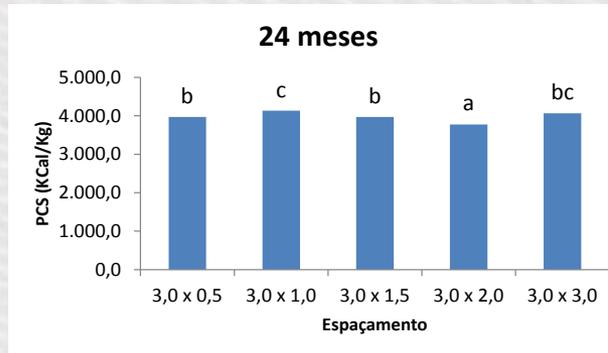
Closely Spaced Eucalypt Plantations in Brazil

Basic density



Closely Spaced Eucalypt Plantations in Brazil

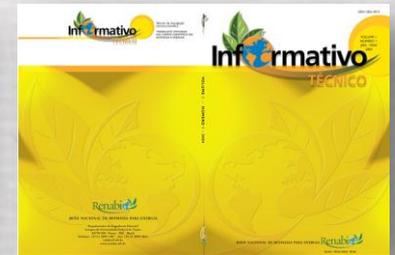
Calorific power



Closely Spaced Eucalypt Plantations in Brazil

Publications

In 2005 – 2006, the Minister of Mines and Energy approved a project of RENABIO to establish a network to generate and spread technical and scientific information in Brazil



Closely Spaced Eucalypt Plantations in Brazil

Mato Grosso do Sul

In 2006, a trial with 5 different genetic material was established by RAMIRES Reflorestamentos Ltda, in Ribas do Rio Pardo, Mato Grosso do Sul, with the support of RENABIO and the MME



Closely Spaced Eucalypt Plantations in Brazil



Closely Spaced Eucalypt Plantations in Brazil

São Paulo

In 2007, a sugar and ethanol producer, Usina Rio Pardo of Avaré, São Paulo, established in Brasil, the first pilot area with closely spaced eucalypt plantations to produce biomass for cogeneration



Closely Spaced Eucalypt Plantations in Brazil



Clonal eucalypts to produce biomass for energy, 3 m x 0.5 m age 20 months



Closely Spaced Eucalypt Plantations in Brazil

Sao Paulo

In 2009, the Bertin Group established in Lins, São Paulo, the biggest closely spaced research plantation of eucalypts for bionergy in Brazil



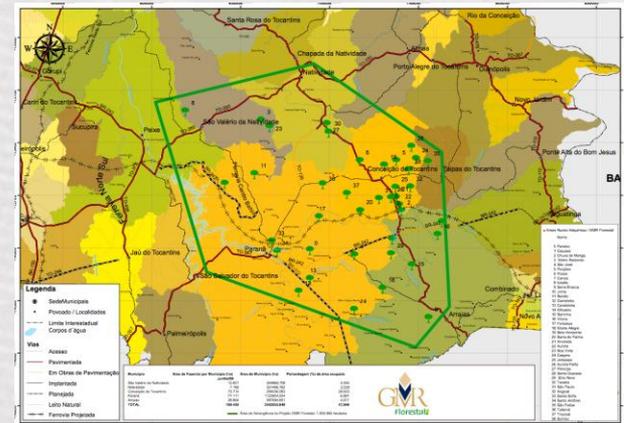
Closely Spaced Eucalypt Plantations in Brazil



Closely Spaced Eucalypt Plantations in Brazil

Tocantins

In 2009, GMR Florestal established in Tocantins, the first research area in the state to produce biomass for energy



Closely Spaced Eucalypt Plantations in Brazil

Maranhão e Piauí

In 2009, Suzano Energia Renovavel established in Maranhão and Piauí, closely spaced eucalypt plantations to produce biomass for pellet production



Closely Spaced Eucalypt Plantations in Brazil

Bahia

In 2011 and 2012 Energias Renovaveis do Brasil established the plantation of several eucalypt clones in a 3.0 m x 1.0 m, in Bahia



Clonal eucalypt 15 months of age



Closely Spaced Eucalypt Plantations in Brazil

Goias



COMIGO plantation in a 3.0 m x 1.0 m spacing



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



Uruguai



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



China e EUA



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



Uruguai



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



Duratex e BioSystems Australia



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



EUA e Uruguai



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



GAIA e EucaClone



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



Suzano e John Deere



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



Chile e Duratex



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



New Holland



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



International Paper



Closely Spaced Eucalypt Plantations in Brazil

National and international visits to Lins



Caterpillar e Duratex



Closely Spaced Eucalypt Plantations in Brazil

Uses of the biomass:

- steam and electricity
- charcoal and MDF
- pellets and briquettes
- cellulosic ethanol
- biofuels and hydrogen



Eucalypt bark



Eucalypt



Closely Spaced Eucalypt Plantations in Brazil

Eucalypt based groforestry systems:



Closely Spaced Eucalypt Plantations in Brazil

Harvesting:

At the beginning the same equipment used in USA, Sweden and UK



Closely Spaced Eucalypt Plantations in Brazil

New Holland being tested in Brasil:



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Bionic Beaver developed in Australia:



Closely Spaced Eucalypt Plantations in Brazil

Special projects: CanaLyptus



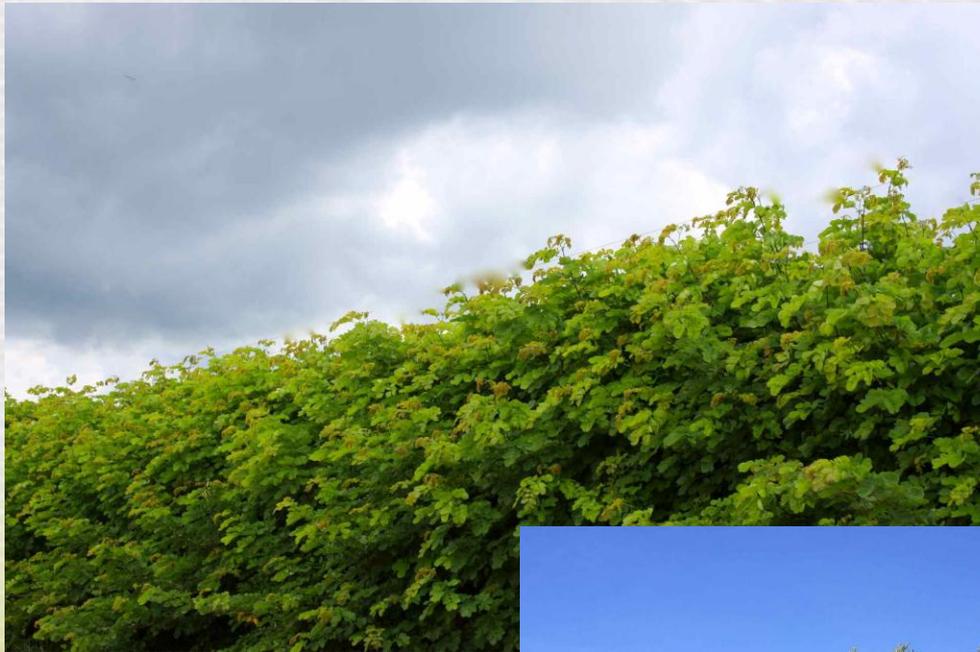
Closely Spaced Eucalypt Plantations in Brazil

Special projects: EuCapim



Closely Spaced Eucalypt Plantations in Brazil

Alternative sources of biomass:



Acknowledgments:

ECOM Group (Brazil and Mexico)

ERB - Energias Renovaveis do Brasil

WBA + World Bioenergy Association

CNA – Brazilian Confederation of Agriculture and Livestock

RENABIO – Brazilian Network of Biomass for Energy

University of Toronto

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