

FIELD PERFORMANCE AND BIOENERGY CHARACTERISTICS OF FOUR COMMERCIAL EUCALYPTUS GRANDIS CULTIVARS IN FLORIDA

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For several methods utilizing woody biomass for energy (Rockwood and others 2008), one of the challenges is the large, continuous fuel supply required. For example, proposed biomass plants in Florida may each require one million tons of biomass/year. When supplies of forest residues and urban wood wastes are limited, short rotation woody crops (SRWC) are a viable alternative (e.g., Langholtz and others 2007). Eucalypts are ideal as SRWCs because of their fast-growth and site tolerance (Rockwood and others 2008). Their coppicing ability also provides 2-5 coppice harvests before replanting (Langholtz and others 2007). Eucalypts could be grown throughout Florida, and their potential uses range from landscape mulch to biofuel production (Rockwood and others 2008).

Resulting from four decades of genetic improvement, *E. grandis* cultivars E.nergy™ G1, G2, G3, and G4 (US Patents PP21,582, PP21,571, PP21,569, and PP21,570, respectively) were released by the University of Florida in 2009 and are now commercially available. They were selected based on 18 tests across the state on site/soil types including infertile “flatwoods,” sandhills, dredged bay soil, muck soil, and clay soil in phosphate-mined lands. These cultivars have fast growth, excellent stem form, tolerance to various site conditions, coppicing ability, freeze resilience, and ease of propagation compared to 4th-generation *E. grandis* seedlings. We describe 1) the unique characteristics of the four cultivars and 2) report their early field performance.

The four cultivars differ in several characteristics, their genetics, and wood chemistry (Table 1). Cultivar G3 was susceptible to high velocity winds while G4 was resistant. The cultivars showed average to excellent frost tolerance and good coppicing ability. G1 and G2 are 4th-generation selections, while G3 and G4 are 2nd-generation selections. Their “genetic fingerprints” have been determined for eight

microsatellite markers. G4 has the densest wood with lowest moisture content, G3 has the lightest wood and highest moisture content, and G2 has more typical *E. grandis* wood density and moisture content. Based on annual average number of freezes and land types represented by the tests, all four cultivars are suitable for planting in south Florida while only G2, G3, and G4 are suitable for central and even north Florida.

Three cultivars, planted at six peninsular Florida sites ranging from productive agricultural land to underutilized phosphate mined lands in 2009 and another seven sites in 2010, survived well under often adverse weather conditions, were up to 6.9 m tall in 16 months (Figure 1), and typically tolerated the exceptionally cold weather of January-February 2010. The cultivars had minimal to no freeze damage during the 2009-2010 freezes except in one test. Commercial plantings, two in 2009 and two in 2010, further substantiated cultivar performance in the 13 studies.

Wood analyses have identified bioenergy products for which the cultivars may be used. The major saccharides in one cultivar were glucan and xylan at 41.8 and 10.4 percent, respectively, which resulted in a Polydispersity of Plant Biomass Recalcitrance (PPBRg-x) of 4.5 percent, a relatively low value compared to other biomass feedstocks (Zhu and others 2011).

Overall, progress to date with *E. grandis* and its potential illustrate how genetics and biotechnology can produce optimal tree populations for bioenergy production. Because of their exceptional performance and potential as SRWCs, the G1, G2, G3, and G4 cultivars may be widely planted in Florida for mulchwood, pulpwood, and various bioenergy applications.

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Table 1—Description and recommended planting areas of G1, G2, G3, and G4 cultivars

Characteristic	Cultivar			
	G1	G2	G3	G4
Growth	Fast	Fast	Fast	Fast
Freeze-resilience	Average	Good	Excellent	Excellent
Windfirmness	Susceptible	Average	Average	Resistant
Coppice	Good	Good	Good	Good
Tissue Culture Propagation	Readily	Readily	Readily	Good
Propagation induced variability	No	No	No	No
Pedigree (generation)	4 th	4 th	2 nd	2 nd
Wood density (kg/m ³)	-	522	470	640
Wood moisture content (dry wt)	-	104%	129%	89%
Recommended planting area				
South Florida (<2 freezes)	Yes	Yes	Yes	Yes
Central Florida (2-5 freezes)	No	Yes	Yes	Yes
North Florida (>5 freezes)	No	Yes	Yes	Yes

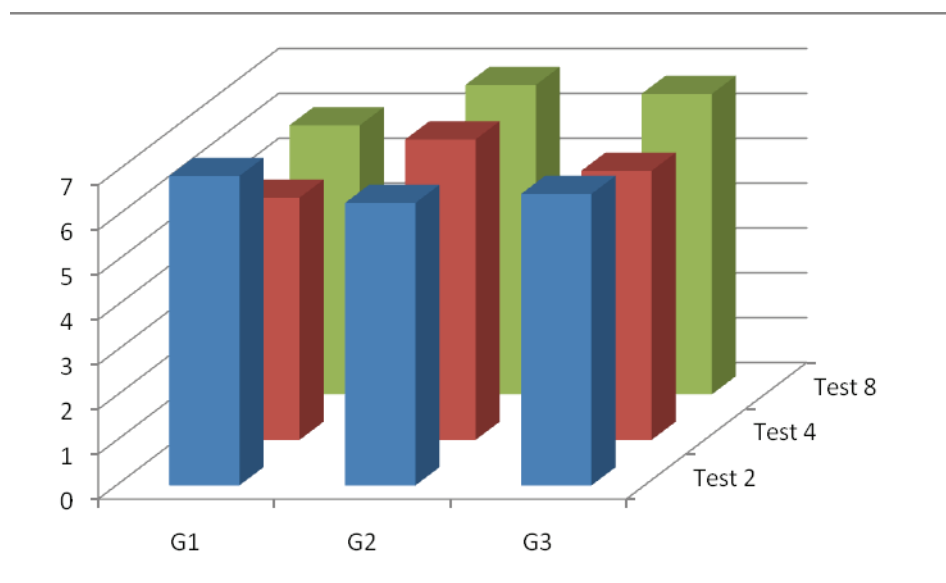


Figure 1—Average height (m) of G1, G2, and G3 cultivars in three tests at 15, 15, and 16 months, respectively.