

pruning trial in a commercial plantation of teak in the State of Rondonia in northwestern Brazil. Treatments consisted of pruning intensities of 25%, 50%, and 75% and the control treatment with no pruning. Differences among treatments in pruning and age were not significant at 25% and 50% intensities in contrast to the control, but were significant at 75% intensity. In addition, the pruning intensities caused no detrimental effect on the commercial height of trees at the age of 44 months. Current findings indicate that moderate pruning regimes are adequate for pursuing improvements to stem form and wood quality without having a strong effect on tree growth and stand yield in this portion of the Amazon.

**Evaluation of the effectiveness of the use of bokashi on seedling quality of *Balfourodendron riedelianum* (Engl.) Engl (Guatambu).** Garcia, M., Zorrilla Benítez, S., Enciso Gomez, M., Vera de Ortiz, M. (*Universidad Nacional de Asunción, Paraguay; marialisgarcia@gmail.com; ser-zorro@hotmail.com; manuelenci@yahoo.com; dircif@agr.una.py*).

The growing demand for native tree seedlings requires research related to the use of substrates capable of providing seedlings with high initial growth rates and survival after planting. *Balfourodendron riedelianum* (Engl.) Engl (Guatambú) is a native species of Paraguay whose wood is in high demand both nationally and internationally. This study evaluated the effectiveness of bokashi on the quality of seedlings of Guatambú, with and without fertigation. The applied experimental design was a randomized factorial design with 14 treatments, 5 replicates, and a control. Each experimental unit consisted of four plants, totaling 300 seedlings. Morphological parameters including height, collar diameter, shoot dry weight, root dry weight, root shoot dry weight ratio, slenderness index, and Dickson quality index were evaluated. No significant differences in the levels of fertilization were found. The treatment consisting of soil (70%) + bokashi (30%) + fertigation produced the best results in height. In diameter and shoot root dry weight ratio, the best results were obtained with the substrate composed of soil (80%) + bokashi (20%) + fertigation. For slenderness index and Dickson quality index, the substrate composed of soil (50%) + bokashi (25%) + cow manure (25%) with fertigation produced the greatest value.

**Enhancing mine and energy crop soils to promote willow and poplar growth using ash and biosolids: a greenhouse trial.** Gilbert, N. (*International Forestry Students Association, Canada; sno\_reason@inorbit.com*).

Wood ash from bioenergy production contains a high concentration of nutrients essential for plant growth and can neutralize acidity in soil. The objective of this study was to assess the growth of willow and poplar in soils amended with different amounts of bioenergy ash (0%, 0.5%, 1%, 2%). In two trials divided by soil type (sand and loam), clonal cuttings were grown in a greenhouse for 4 months. Three bioenergy ash differing in chemical properties, such as pH and CEC, and bioenergy system, boiler system versus gasifier, were used for this study. To supplement the nitrogen deficiency common of wood ash, biosolids were mixed into half the treatment samples. The acidic, well-draining, sandy soil produced the greatest yield of new growth in the mixed ash and biosolids combinations. In the neutral loam trial, the plants also responded best to the ash treatments mixed with biosolids. These results suggest a method of fertilization that not only promotes plant growth, but also provides a use for materials otherwise considered to be waste.

**Advanced oak seedling development as influenced by shelterwood treatments, competition control, deer fencing, and prescribed fire.** Gottschalk, K., Miller, G., Brose, P. (*U.S. Forest Service, USA; kgottschalk@fs.fed.us; gwmiller@fs.fed.us; pbrose@fs.fed.us*).

Advanced northern red oak (*Quercus rubra* L.) seedlings in an 85-year-old forest located in north-central Pennsylvania were observed for 10 years after manipulation of overstory density, herbicide control of interfering plants, exclusion of deer by fencing, and application of a single prescribed fire. A total of 24 treatment combinations including untreated controls were studied on 72 permanent plots. Seedling survival and seedling growth were enhanced by both exclusion of deer by fencing combined with a moderate (12% of basal area) to high (27% of basal area) removal of the overstory. Published dominance probabilities for site index 70 were applied to the average size and number of tagged advanced seedlings in each plot to determine which treatments produced the greatest predicted number of codominant oaks in the next stand after final harvest. Treatments that included exclusion of deer by fencing combined with a moderate (12% of basal area) to high (27% of basal area) removal of the overstory projected new stands with more than 50 percent oak composition. Fencing and no overstory removal, while producing much less growth, also predicted more than 50 percent oak composition. Oak seedling development and suggestions for writing silvicultural prescriptions to prepare for successful oak regeneration are discussed.

**Mixed-species plantations of *Eucalyptus* and *Acacia mangium* as an alternative for bioenergy production in tropical regions.** Hakamada, R. (*University of São Paulo, Brazil; rodrigo\_hakamada@yahoo.com.br*), Bouillet, J. (*CIRAD, France; jean-pierre.bouillet@cirad.fr*), Gonçalves, J. (*University of São Paulo-ESALQ, Brazil; jlmgonca@usp.br*), Voigtlaender, M. (*Institute of Forest Research, Brazil; mvoigtlaender@gmail.com*), Gava, J. (*Suzano, Brazil; jgava@suzano.com.br*), Leite, F., Mareschal, L., Nouvellon, Y., Mazoumbou, J., Koutika, L., Epron, D., Laclau, J. (*CIRAD, France; jean-paul.laclau@cirad.fr*).

Silvicultural practices that increase wood production in forest plantations are required to achieve society's demand for renewable energy sources. Mixed-species plantations of *Eucalyptus* and *Acacia mangium*, a N-fixing species, have been studied as a pathway of ecological intensification, enhancing nitrogen availability and carbon accumulation within the system. Our objective was to compare the potential of bioenergy production in pure and mixed-species plantations. We used calorific values from the literature along with data of wood production measured at five sites in Brazil and Congo with various levels of productivity to calculate the energy produced at the end of stand rotation (on average 6.2 years after planting). We compared pure *Eucalyptus* stands (100E) to mixed-species stands with the same density of *Eucalyptus* trees with 25% *Acacia* trees (100E:25A). At all sites, the mixtures generated energy gains ranging from 0.2 to 36.3% compared to *Eucalyptus* monocultures. These gains were highly correlated ( $R^2 > 0.99$ ) with total stemwood production, due to comparable calorific values for both species. This study opens the possibility for using mixed-species plantations of *Eucalyptus* with N-fixing tree species as a renewable source of bioenergy for both domestic and commercial uses.