

forest types and environmental factors showed that the elevation, slope, and annual average temperature were identified as the main influencing factors. Since the main forest types were classified according to the distribution ratio of the oak, the quality grade of standing trees was evaluated by considering the utilization of wood. The evaluation factors of the grade were the bending of stem, branch, stem damage and other defects. The results were as follows: *Q. acutissima* > *Q. variabilis* > *Q. serrata* > *Q. aliena* > *Q. mongolica* > *Q. dentata*.

C1t: PLANTATION FORESTS


Early growth of planted Norway spruce and Scots pine after site preparation in Sweden

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Norway spruce (*Picea abies* (L.) H. Karst) and Scots pine (*Pinus sylvestris* L.) have different site preferences, but silvicultural recommendations for their regeneration at planting (including site preparation) are often the same. Thus, there is a clear need for greater understanding of species-specific interactions between site preparation and site properties. To meet this need, the species' growth and survival have been monitored at both fertile and poor sites in Northern and Southern Sweden. At each of these sites, effects of three types of site preparation — removed humus (RH), deep soil cultivation (DSC) and control (C, no site preparation) — were compared. Results show that Scots pine grew more rapidly initially than Norway spruce, and DSC site preparation promoted growth of both species. However, on poor sites there was a delay in growth responses. In addition, removal of organic material in the RH treatment caused a sustained growth check of Norway spruce, but not for Scots pine. This study confirms that it is beneficial to use site preparation as it increases survival of both species and may increase growth. However, site preparation methods that reduce the amount of organic material in the planting spots should be avoided for Norway spruce.


Tree planting spatial arrangements and eucalypt clones interaction in southern Brazil: effect on growth

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Eucalypt stands in Brazil are, usually, highly productive and have been exploited at short rotations (≤ 7 years) as a result of the genotype selection for specific sites and the use of appropriate silvicultural techniques. The present study aimed at the selection of genotypes and spatial arrangements to obtain high productivity in plantations in the Brazilian Southern region. Hybrid clones of *Eucalyptus urophylla* x *E. grandis* (A, B) and *E. urophylla* x *E. globulus* (C, D) were planted in the arrangements 3.75 x 2.40 m; 6.0 x 1.5 m and 4.0 x 3.0 m. The stand variables were estimated by Gompertz model. The total height (Ht) and diameter (dbh) were measured annually up to 88 months. The Ht and dbh were the highest ($p \leq 0.05$) for clone B in the arrangement 4.00 x 3.00 m. The reduction of the distance between trees in the planting line (6.00 x 1.50 m), leading to increasing rectangularity, resulted in smaller dbh in relation to the 3.75 x 2.40 m, both with 9 m² per plant and, the individual volume was the largest in the 4.0 x 3.0 m, for all clones. Clone B showed the highest yield in the arrangement 3.75 x 2.40 m and, presented the largest annual mean increase at tree harvesting age. The regulatory rotation at 5, 6 and 7 years should be adopted. The results allow inferring that the tree planting arrangements with greater rectangularity should be avoided because they result in lower productivity and diameter growth. Wider spacings are more adequate to produce logs of larger diameter.

Identification of planting habitats and wood demand regions for *Micropholis venulosa* (Mart. & E. ex Miq.) and *Simarouba amara* Aubl. in Minas Gerais, Brazil

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The native wood species plantations are an alternative for supplying high quality wood demand of the Brazilian industries. Planting habitats and wood demand regions were identified for the state of Minas Gerais (MG), for *M. venulosa* and *S. amara*, largely used in the timber industry of that state (95,152 and 22,587 m³ of wood consumed in the last 11 years, respectively). The MaxEnt model was used for the environmental zoning, based on matching mainly climatic variables constraints and requirements of the natural occurrence sites with the planting sites. The wood demanding zoning was performed with the clustering algorithm (ArcGIS), using the Brazilian consumption records by species (DOF System - Document of Origin of the Wood). The total area suitable for planting was 208,820 km² for *M. venulosa* and 158,254 km² for *S. amara*. The models showed high precision (AUC ≥ 0.80). The variables temperature seasonality and warmer month maximum temperature were the most important ones to match species origin to planting sites. Three wood demand zones for these species were identified (R² ≥ 0.90) for Minas Gerais. The high demand zones included the microregions of Montes Claros (North MG) for *M. venulosa*, and Belo Horizonte (Centre MG), Juiz de Fora and Ubá (East MG) for *S. amara*. By planting these species in suitable habitats, near the industries based on indigenous wood species, implies in greater conservation of the species in their natural occurrence region and strengthening of the economy in the consumer centers (Supported by CAPES, CNPq, FAPEMIG and UFV).

Management units for pine in lands of the western Santa Catarina State, Brazil: development and application of methodology

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This study was carried out in order to develop and implement (in pilot area of 457.7 ha) an enhanced methodology for establishing management units for pine tree plantations, in lands of the west of Santa Catarina associated to the effusive rock spill of the Serra Geral Formation. The regional pine production system disregards the hypothesis of response to the nutrient deficiency improvement (DN). The methodology preferably requires semi-detailed soil mapping

and secondary local climate information. Each polygon of the soil map was associated with a database, which allowed the definition of the land limitation degrees (DN, water deficiency, oxygen deficiency, erosion susceptibility and management impediments) for the pine cultivation. The management units classes of pine cultivation were defined by a set of criteria, considering the different land limitation degrees achieved for each land polygon (from soil map). The most important land limitation degree for pine growth in the pilot area was the management impediments, due to limitations of the soil depth, terrain slope and rocky fragments. The following quantitative data from the management units were obtained in the pilot area: 111.6 ha of Lowly suitable (24.8% of the area); 282.0 ha Upper marginal (62.6% of the area); and 57.2 ha Lower marginal (12.7% of the area).

Biodegradable containers in the production of *Pinus maximinoi* seedlings.

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Pinus maximinoi is an important and promising species in Brazilian forestry. This species has a sensitivity to physical impediments during its root system formation, requiring adjustments in its silviculture management. Biodegradable containers, specifically the paperpot system have been an alternative for seedlings production. However, the paper degradation range may affect the survival of the seedlings after planting, causing impediments to roots expansion. Therefore, the objective of this work was to evaluate five commercial papers with different degradation times in the production of *P. maximinoi* seedlings. Five types of paperpots were tested, three of them of Ellepot® brand, with durability times: (T1) + 12 months, (T2) 8-12 months, (T3) 4-6 months, one of Plantpaper® (T4) brand, and one of BCC® brand (T5), both without specification of durability. At 135 and 210 days of nursery, the quality of the seedlings and the level of the papers degradation was evaluated, using a percentages scale with four levels. At 210 days, the seedlings were planted in the field for future evaluations. The degradation levels were statistically different at 1% of significance in both evaluation periods. The T5 reached 100% degradation at 210 days, while the T4 paper showed no signs of degradation at the same period. T3 was the most promising paper, with an average of 54 and 75% degradation at 135 and 210 days respectively. The other two papers had 54% of degradation average at the end of the seedling production cycle.

The determinants of optimal leaf area in eucalypt plantations

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It is well understood that stand leaf area index (LAI) is extremely responsive to fertiliser application in Australian temperate *Eucalyptus* plantations. At energy-limited but nonwater-limited sites a high LAI is beneficial for maximising productivity and there is limited evidence to suggest that some of the leaf area may operate below the light compensation point and act primarily as a nutrient store. Conversely, on seasonally water limited sites, a high LAI has the potential for negative consequences for rotation-length plantation growth. The dynamics of these relationships, particularly the role that fertiliser application plays, are not yet well understood, and thus constitute an impediment to developing accurate, informed management prescriptions. In our study a range of fertiliser experiments in *Eucalyptus nitens* and *E. globulus* plantations were established along a temperature and precipitation gradient in southern Australia. We explored the relationship between nitrogen and phosphorus fertiliser treatments and stand LAI, the vertical distribution of leaf area and the longevity of N and P stored in leaves. We also explored differences in photosynthesis and respiration as a function of light, temperature and nutritional status. The outcomes of this research will include robust assessments of how the costs and benefits to plantation production of an increase in LAI are related to climatic conditions. This will facilitate the development of fertiliser prescriptions better tailored to local climatic conditions and assist with our understanding of how plantation nutrition may explain part of the inter-rotation productivity decline that has been observed at some water-limited sites across the estate.

Shade area and microclimate under the canopy of Cerrado trees in silvopasture systems / Área de sombra e microclima sob a copa de árvores do Cerrado para sistemas silvipastoris

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Em dezembro de 2015 implantamos um arboreto com 13 espécies arbóreas nativas do Cerrado (24 mudas de cada espécie) em uma área de aproximadamente 1,0 ha, na Embrapa Gado de Corte, Campo Grande – MS. Medimos a temperatura, a umidade relativa do ar e a radiação solar sob a copa de quatro indivíduos de oito espécies e a pleno sol, entre maio e junho de 2018. A partir dos dados coletados, calculamos os Índices de Temperatura e Umidade (ITU) e determinamos a porcentagem de bloqueio de radiação solar sob a copa das árvores. Adicionalmente determinamos a área projetada de copa às 12h00 em junho de 2018 com base das dimensões das árvores e o ângulo de elevação do sol. Comparamos as dimensões das árvores e área de sombra entre as espécies, e o índice de temperatura e umidade (ITU) entre espécies e ao longo das horas do dia, através da Análise da Variância (ANOVA) e teste Tukey a 5%. *Pterogyne nitens* e *Peltophorum dubium*, apresentaram maiores dimensões e maiores áreas de sombra projetada, dois anos e meio após plantio. Não houve diferenças ($p > 0,05$) entre as espécies e a pleno sol para ITU; diferindo apenas ao longo do dia ($p < 0,05$), com menores valores ao final da tarde. Em relação a porcentagem de bloqueio de radiação, *P. nitens* está entre as espécies com maior bloqueio enquanto *P. dubium* de menor bloqueio de radiação. Com base nessas características *P. dubium* e *P. nitens* são as espécies de maior potencial para uso em sistemas silvipastoris.

Survival of *Eucalyptus* spp. clones in different spacing arrangements in the semi-arid region of Pernambuco, Brazil / Sobrevivência de clones de *Eucalyptus* spp. em diferentes espaçamentos com condições climáticas extremas no semiárido pernambucano

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O Polo Gesso do Araripe, situado no semiárido pernambucano, é uma região bastante afetada pelas mudanças climáticas e grande consumidor da vegetação nativa com fins energéticos para indústria do gesso. Florestas de eucaliptos foram implantadas na região para atender a alta demanda energética da indústria gessosa, responsáveis por 95% da produção nacional. Desta forma, objetivou-se com esta pesquisa avaliar a sobrevivência de clones de *Eucalyptus* spp. em diferentes espaçamentos em condições de seca extrema. Os dados foram provenientes de um experimento inteiramente aleatório com três clones de *Eucalyptus*