Measuring the physiological and growth responses of potential short-rotation forestry species to variations in planting density

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- Short rotation forestry (SRF) has potential to provide biomass, contributing towards Irelands 2020 EU renewable energy target.
- There is a need to provide information on the optimum planting density to maximise production for a range of species over a short rotation period.
- The effect of planting density on juvenile competition, survival, growth and physiological response of three potential SRF species – Italian alder (*Alnus cordata*), Sitka spruce (*Picea sitchensis*) and shining gum eucalyptus (*Eucalyptus nitens*) – are being investigated.
- Two potted experiments (K1 and K2) at Teagasc Kinsealy, Co. Dublin were used to assess the impact of competition stress on height increment (K1) and leaf-level gaseous exchange and chlorophyll concentration (K2).
- Observations and measurements have included leaf-level gaseous exchange, chlorophyll concentration, shoot growth phenology, height and diameter increments and other measures of biomass production.
- SRF trials will take 8-12 years to mature. The data collected herein will provide information on likely responses to competition which can be scaled up from leaf to canopy level to enable stand productivity to be modelled. To this end a field trial site has been established at Teagasc Johnstown Castle, Co. Wexford.

Sitka, eucalyptus and alder growing in 35 litre pots at three planting densities at Teagasc Kinsealy, Dublin.

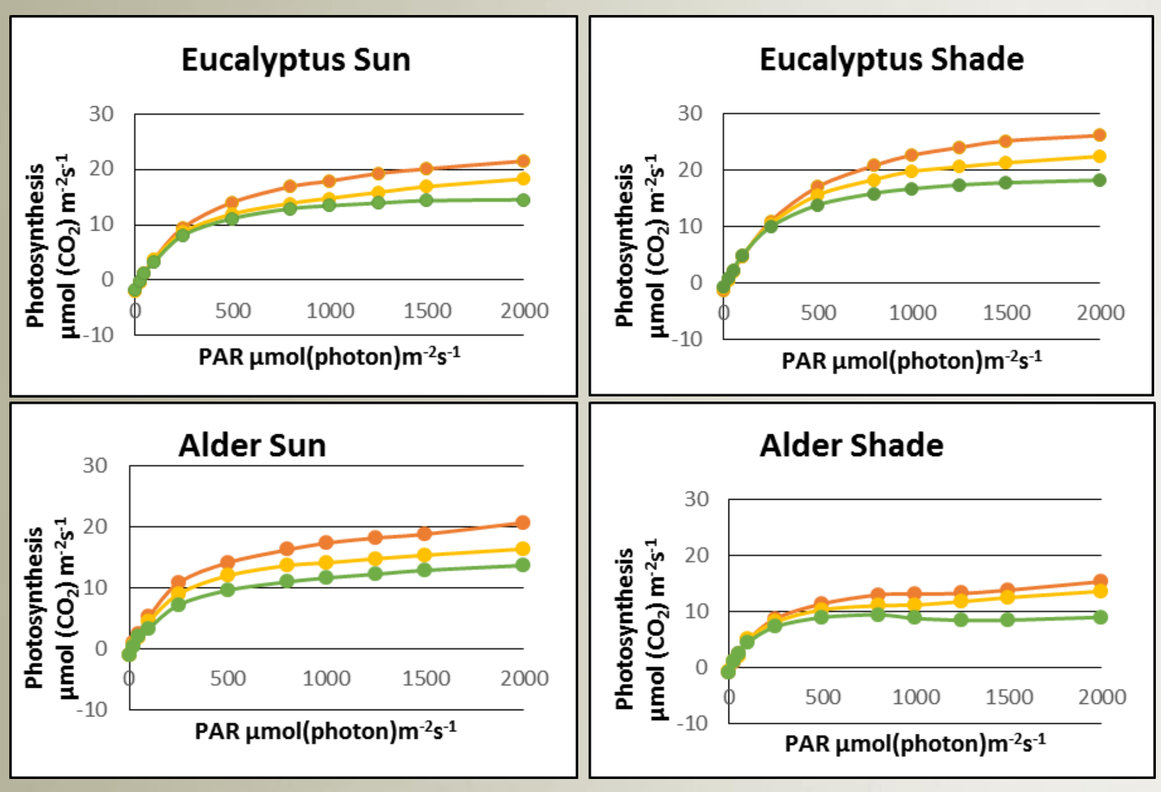


Figure 1: Light response curves on K2 alder and eucalyptus, sun and shade leaves at three planting densities. Low density ≈ 79500 stems ha^{-1}, medium density ≈ 318000 stems ha^{-1}, high density ≈ 637000 stems ha^{-1}. PAR (Photosynthetically Active Radiation).

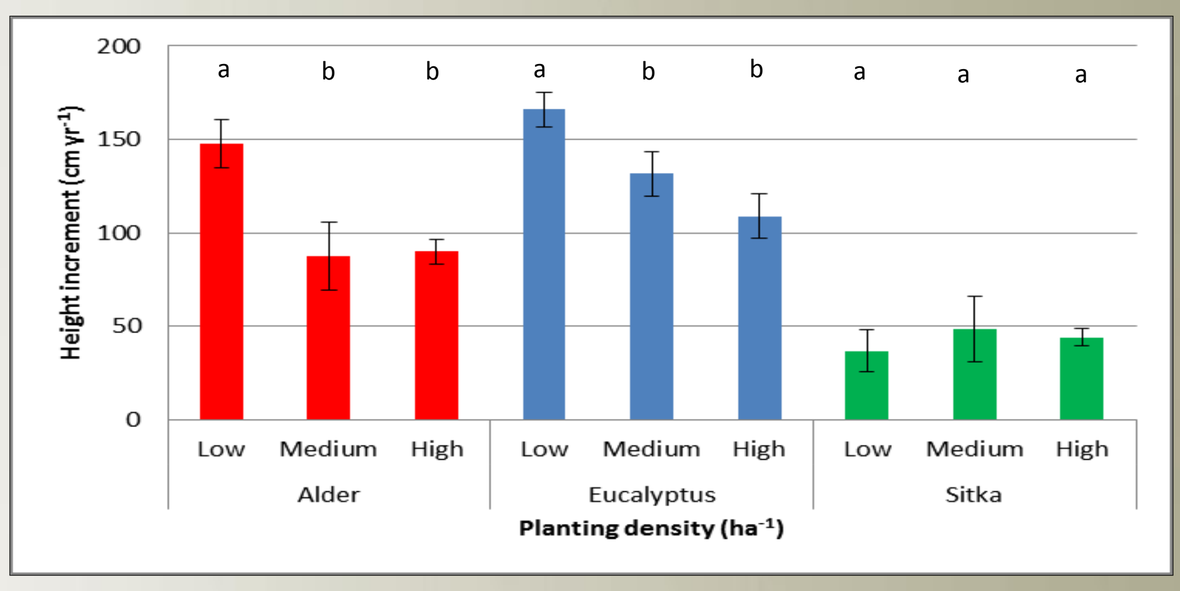
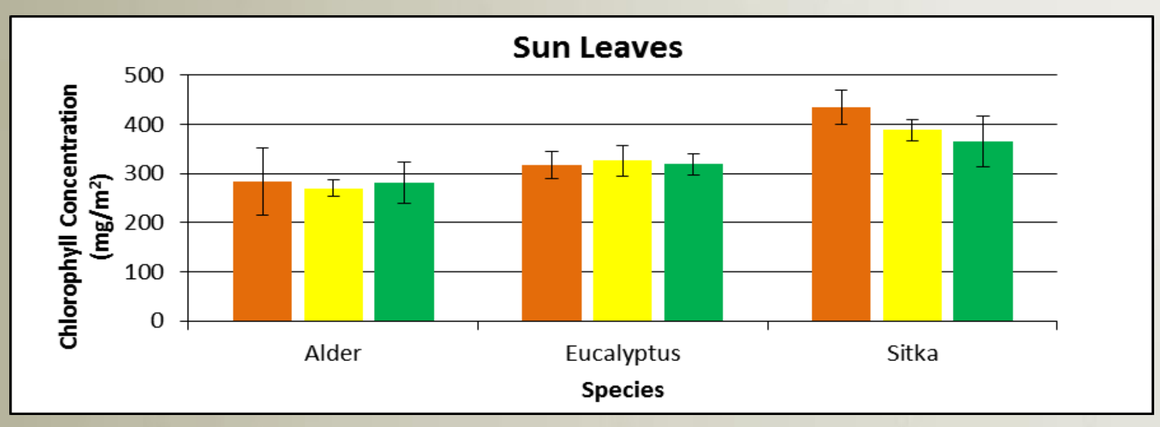


Figure 2: Mean height increment of K1 alder, eucalyptus and Sitka after 8 months growth. Low density ≈ 79500 stems ha^{-1}, medium density ≈ 318000 stems ha^{-1}, high density ≈ 557000 stems ha^{-1}. Error bars = 95% confidence interval of the mean. Letters indicate significant differences (P<0.05) within a species.



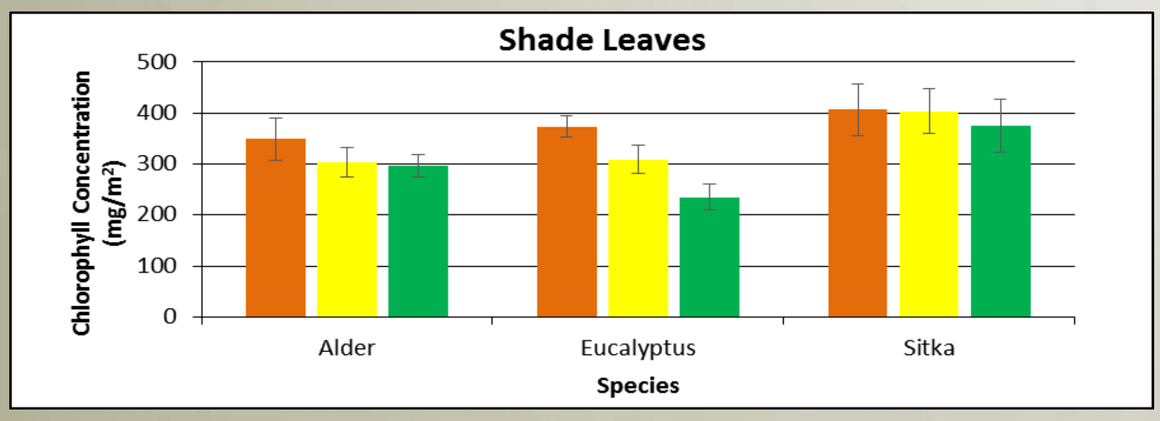


Figure 3: Chlorophyll concentration (mg/m^2) of K2 alder, eucalyptus and Sitka leaves at three planting densities: ≈ 79500 stems ha^{-1}; ≈ 318000 stems ha^{-1}; ≈ 637000 stems ha^{-1}. Error bars = 95% confidence interval of the mean.

- Light response curves of eucalyptus suggest there is some effect on photosynthesis rate caused by planting densities tested (Figure 1).
- Photosynthesis rates of sun and shade leaves of alder appear lower than for eucalyptus (Figure 1).
- There was no difference in Sitka height increment between the three planting densities (Figure 2).
- Both alder and eucalyptus had significantly greater height increment at low planting density than at medium or high density (Figure 2).
- Chlorophyll concentration of Sitka sun and shade leaves suggest no difference across planting density treatments when error bars are included (Figure 3).
- Eucalyptus shade leaves indicates chlorophyll concentration decreases from low to high planting density treatment (Figure 3).
- There is no apparent difference in chlorophyll concentration across planting density treatments for alder sun or shade leaves (Figure 3).
- Sitka has a higher chlorophyll concentration in both sun and shade leaves across planting density treatments than either alder or eucalyptus (Figure 3).

Acknowledgement
Funding was provided by the COFORD and administered by the Department of Agriculture, Food and the Marine.