Genetic variation and control of chloroplast pigment content in *Picea rubens, Picea mariana,* and their hybrids, under ambient and elevated CO2 environments

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Traits related to light-energy processing have significant ecological implications for plant fitness. Our objective was to examine and compare chloroplast pigment content traits from a red spruce (RS) (*Picea rubens* Sarg.) – black spruce (BS) (*P. mariana* (Mill.) B.S.P.) genetic complex under ambient and elevated CO2 conditions. We used two genetic experiments: 1) a comparative species' provenance experiment from across the near-northern part of the RS range, and 2) an intra- and interspecific controlled-cross hybrid experiment. Results from the provenance experiment showed total chlorophyll content (a and b) was, on average, 15% higher under ambient than elevated CO2 ($P < 0.001$). Under ambient CO2, BS populations had, on average, 11% higher total chlorophyll and carotenoid content than RS populations ($P < 0.001$). There were significant species, CO2, and species x CO2 interaction effects, where chlorophyll content decreased on average 7% and 26% for BS and RS, respectively. Results from the hybrid experiment showed hybrid index 25 (25% RS) had the highest total chlorophyll content, and hybrid indices 75 and 100 had among the lowest. Initial analysis of the hybrid experiment supported a more additive model of inheritance; however, parental analysis showed a significant and predominant male effect for chlorophyll content. Crosses with BS males had 10.6% and 17.6% higher total chlorophyll content than crosses with hybrid and RS males under ambient and elevated CO2 environments, respectively. Our results show a strong genetic control of chlorophyll content, and that these traits have a positive correlation with productivity within and across species. A significant positive correlation between chlorophyll content and nitrogen assimilation rate was also found ($r = 0.872$). Results from a light x water environment effects will also be presented. Results indicate that RS would most probably be at a competitive disadvantage in a higher CO2 environment.