RESPONSE OF CHESTNUT OAK AND RED OAK TO DROUGHT AND FERTILIZATION: GROWTH AND PHYSIOLOGY

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Abstract: Chestnut oak (*Quercus prinus* L.) and red oak (*Quercus rubra* L.) seedlings were grown for two seasons under two nutrient regimes: **fertilizer +** (NPK) and **fertilizer -** (No NPK). Beginning two weeks after budbreak, water was withheld for 10 weeks during the second growing season. Leaf water potentials, gas exchange measurements and growth measurements were made on a subset of plants on alternate weeks (5 sample weeks).

Red and chestnut oak growth was positively influenced by the **fertilizer +** treatment. Over the ten week treatment period, seedling diameter, height, and shoot weight were all significantly greater in the **fertilizer +** treatment, with the greatest differences measured during weeks 8 and 10. Red oak shoot and root weights were significantly greater in the **water +** treatment. Budbreak of red and chestnut oaks in the **fertilizer +** treatment was on average, 3 days earlier than for individuals in the **fertilizer -** treatment. Based on growth over the ten weeks, the treatment rankings for both red and chestnut oak were: $H_20+/NPK+ > H_20-/NPK+ > H_20+/NPK- > H_20-/NPK-$.

Over the 10 week treatment period, measures of red and chestnut oak carbon gain rates, stomatal conductance, transpiration rates and water use efficiency were all significantly reduced by the **water -** treatment. The greatest reduction in carbon gain rates occurred during weeks 8 and 10. By week 10 chestnut oak carbon gain rates were significantly reduced in the **water -** treatment (27% reduction) as compared to the **water +** treatment. Although red oak exhibited a greater reduction in carbon gain rates than chestnut oak (37% reduction), this was not significant due to the greater variation among the seedlings.

For chestnut oak, significant reductions in carbon gain rates occurred before significant reductions in leaf water potentials occurred. Although predawn leaf water potentials and mean diurnal leaf water potentials in the **water -** treatment were not significantly lower until week 10, carbon gain rates, water use efficiency, stomatal conductance and transpiration rates were all significantly reduced by week 8 in the **water -** treatment.

The **fertilizer +** treatment did not ameliorate carbon gain rates for seedlings of red or chestnut oak in the **water -** treatment. In both the **water +** and the **water -** treatments, unfertilized seedlings had significantly greater carbon gain rates, stomatal conductance, transpiration rates, predawn and diurnal leaf water potential than fertilized seedlings. Based on

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the measures of carbon gain rates during the final week of drought, the treatment rankings for red oak were: H_2O+/NPK- > H_2O+/NPK+ > H_2O-/NPK- > H_2O-/NPK+ and the treatment rankings for chestnut oak were: H_2O-/NPK- > H_2O+/NPK+ > H_2O+/NPK- > H_2O-/NPK+.

PHYSIOLOGICAL AND STRUCTURAL FOLIAR CHARACTERISTICS OF FOUR CENTRAL PENNSYLVANIA BARRENS SPECIES IN CONTRASTING LIGHT REGIMES

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Abstract: Four central Pennsylvania barrens species, black oak (*Quercus velutina*), chestnut oak (*Quercus prinus*), red maple (*Acer rubrum*), and sassafras (*Sassafras albidum*), in the sapling size range were tagged and monitored in juxtaposed understory and full sunlight conditions. Five times during the 1990 growing season diurnal gas exchange measurements were collected along with stomatal and tissue leaf structure on all species in both light regimes. Concurrently, tissue pressure-volume (P-V) analysis and soil moisture analysis were conducted to compare inter-site and inter-species water relations parameters. One sampling date was conducted at the end of a mild drought period to determine if adjustments had occured in water relations parameters. Leaf structure data indicated that guard cell length and stomatal density were fixed over the growing season, but differences existed between the contrasting light regimes. Also, the full sunlight treatment leaves were relatively thicker than the understory leaves. Species diurnal gas exchanges measurements were similar within light regimes, but differences in species diurnal patterns existed. Sassafras usually peaked soon after full sunlight conditions existed and then tailed-off markedly; whereas all three other species reached a plateau in mid-morning and maintained moderate levels of net photosynthesis during the afternoon. Soil moisture did not decrease to drought conditions at anytime during the growing season. However, the fourth diurnal measurement on August 3, 1990 showed a 50% decrease in soil moisture to 6%. This decrease in soil moisture did not significantly affect pre-dawn leaf water potentials or the calculated parameters from the P-V analysis. However, the P-V analysis did show the high capacitence and relatively high wilting point exibited by sassafras compared to the other three species.

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