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LACTIC ACID PRODUCTION IN THE ROOTS OF *Nyssa sylvatica* var. *biflora* (Walt.) Sarg.

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Although the swamp milieu is generally regarded as undesirable for tree growth, swamp tupelo (*Nyssa sylvatica* var. *biflora*) and water tupelo (*N. aquatica* L.) live and thrive almost exclusively in this habitat. How these species are able to do this to the exclusion of other species is unexplained.

Some physiologists contend that sufficient gas exchange occurs between stem lenticels and roots to permit aerobic respiration in the roots. Another common explanation is that the roots of such species respire anaerobically. At present, substantial evidence to support either view is inadequate.

To test the hypothesis that gas exchange occurs between stem lenticels and roots, seedlings of swamp tupelo were grown in liquid culture in a closed system with atmospheric air (aerobic) or purified nitrogen (microaerobic) bubbled through the culture. The entire stem of one-half of the seedlings (4) in each treatment was coated with a paraffin-lanolin mixture. Roots of these seedlings were prestained with crystal violet so that new root growth could be observed.

Results from this experiment indicated that the paraffin-lanolin coat did not retard root development in the near-anaerobic environment. From this we assumed that gas exchange through stem lenticels was not the

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primary limiting factor for initial root development under these conditions. Consequently, we assayed the root tips of seedlings from aerobic and microaerobic treatments for end products of anaerobic respiration; i.e., ethyl alcohol and lactic acid. No ethyl alcohol was found in the root extracts by sensitive enzymatic assays, but additions of lactate dehydrogenase to the root extract and incubation for 2 hours resulted in higher pyruvic acid concentrations in the microaerobic root extracts. The increased concentrations indicated that lactic acid fermentation might be occurring.

We conducted additional experiments, using the same basic set-up, and the root tips and the liquid culture (distilled water) in which they were grown were analyzed directly for lactic acid. Higher concentrations of lactic acid were found in root tips grown in near-anaerobic conditions than in aerobic conditions. Also, traces of lactic acid were found in the liquid culture from near-anaerobic treatments.

We hypothesize that lactic acid fermentation functions as an alternate respiratory pathway in swamp tupelo roots; i.e., under high oxygen tensions, pyruvic acid is primarily reduced to lactic acid, and under low oxygen tensions, pyruvic acid is primarily oxidized through the normal oxidative pathway. This physiological duplicity appears to be one means by which swamp tupelo is able to thrive with its roots under water for prolonged periods of time.

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