

Markers of Environmental Stress in Forest Trees.

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Abstract

Gradual long-term changes in soil and environmental factors due to human activity, may affect forest trees and lead to loss of forest productivity. In most cases, the symptoms of stress appear too late for their effects to be reversed through management and/or treatment. The availability of early biochemical indicators/markers that can assess the current status of stress in visually healthy trees in a forest is crucial for planning a potential treatment or management practice for either alleviating the deleterious effects of the stress or removing the cause of stress. Recently, considerable attention has been paid to the study of changes in polyamine metabolism in plants subjected to various kinds of environmental stress. Polyamines (putrescine, spermidine, and spermine) are open-chain polycations of low molecular weight found in all organisms. They play an important role in the growth and development of plants.

Abiotic stress conditions such as low pH, atmospheric SO₂, high salinity, osmotic shock, nutrient stress such as K or Ca deficiency, low temperature, ozone, and Al stress all lead to an increase in cellular putrescine levels within hours to days. Polyamine concentrations are inversely related to concentrations of cellular ions such as Ca, Mg, Mn, and K in response to Al treatment. The present studies were aimed at studying the relationship between soil nutrients and foliar putrescine in trees growing under varying soil conditions. We have evaluated the use of polyamines as "early markers/indicators" of stress in "visually asymptomatic trees". Trees growing in soils having variable soil Al:Ca ratios or trees growing in soils treated with chronic nitrogen additions, liming, herbicide, or ozone were analyzed for foliar polyamine levels. The results showed a strong correlation between soil nutrient deficiencies (e.g. Ca and/or Mg) and increased foliar putrescine. Our data support the hypothesis that in conjunction with soil chemistry, foliar putrescine can be used as a marker of general stress in visually healthy trees.

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