

ETIOLOGICAL STUDY OF THE SHORT
NEEDLE DISEASE OF PINE

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ABSTRACT

The short needle disease of pines consists of dwarfing, crooking, twisting, and excessive elongation of random needles, failure of buds to develop, reduced lateral branch development and the premature casting of needles. The disease was initially associated with a power plant source of air pollution in the eastern United States during 1969; at that time the cause of the disease was unknown.

An examination of the literature revealed the short needle disease of pines had not been associated with air pollution prior to 1969. Information obtained from a series of field surveys and studies conducted to ascertain the nature and cause of the disease suggests the cause is biological. Conversely, information obtained during the same period of time does not support the thesis that the causal agent is "acid rain."

Treatment of developing candles and buds of Scotch and eastern white pines with "fly ash" and sulfuric and hydrofluoric acids did not implicate "acid rain" as the cause of the short needle disease. This conclusion is substantiated by the following: i) Sulfuric acid solutions of pH 1.7 to 2.7 induced either candle necrosis or needle necrosis and chlorosis but not short needles in field grown Scotch pines. ii) Sulfuric acid solutions of pH 3.7 and higher had no apparent effects. iii) In addition to symptoms similar to those induced by sulfuric acid, hydrofluoric acid solutions resulted in the development of some short needles. iv) Solutions of hydrofluoric acid resulted in more severe effects than had sulfuric acid of the same concentration; hydrofluoric acid is a "weak" acid compared to sulfuric acid. v) Buffered solutions of the two acids resulted in effects similar to those obtained with non-buffered acid solutions of the same concentration. vi) Treatment effects were observed at lower pH values than those of rain samples collected from the area of the pollution source.

vii) Symptoms at the bases of short needles induced by hydrofluoric acid were different from symptoms observed at the bases of short needles of diseased plants in the field.

The hypothesis that the cause of the short needle disease is biological is supported by the following: i) Symptom patterns on twigs and individual trees were not uniform. ii) Disease development in some plantations was typical of infection center patterns of disease distribution. iii) There were discontinuities in the distribution of affected plantations with respect to distance and direction from the pollution source. iv) The disease was not observed in plantations of young trees adjacent to plantations of severely affected older trees and in some situations it was not observed in plantations of older trees adjacent to affected plantations of older trees. v) Similar symptoms were observed in plantations in remote areas of Pennsylvania, Minnesota and Wisconsin. vi) Symptoms were not observed in the second flush of Virginia pines that had possessed symptoms in the initial spring flush. vii) The short needle disease was controlled by applications of insecticides and miticides applied at or during bud break. viii) Calcium oxide, a compound that one would expect to eliminate the problem if "acid rain" was the cause, had no apparent effect in controlling the disease. ix) Symptoms were induced in seedlings of Scots and eastern white pines placed in charcoal-filtered atmospheres and exposed to diseased branches from affected trees. x) Lesions, similar to those observed on the bases of short needles from diseased trees in the field, were observed on the bases of short needles in seedlings exposed to diseased branches in charcoal-filtered atmospheres.