Tree Damage From Chlorine Gas: A Selected Bibliography

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The literature on chlorine gas damage to trees is based upon laboratory exposures of trees (usually small and juvenile trees) to chlorine gas and hydrochloric acid, or upon accidental releases of chlorine gas into the environment. Accidental releases are valuable for assessing damage but remember: data control is poor; observations of the damage is assumed to be directly related to the accidental exposure without proof of exposure; and, information about climatic factors at the time of exposure may be limited. Trees exposed to chlorine gas vary in their reactions from no visible symptoms to death.

Below is a selection of important literature which present studies, observations, and authors involved in the study and understandings of chlorine gas exposure to plants with an emphasis on trees and landscapes. This is not a comprehensive review, but a list to assist tree health care professionals gain access to the literature.

Brennan, E., I.A. Leone, & C. Holmes. 1969. Accidental chlorine gas damage to vegetation. Plant Disease Reporter 53(11):873-875.

Brennan, E., I.A. Leone, & R.H. Daines. 1965. Chlorine as a phytotoxic air pollutant. International Journal of Air and Water Pollution 9(12):791-797.

Brennan, E., I.A. Leone, & R.H. Daines. 1966. Response of pine trees to chlorine in the atmosphere. Forest Science 12(4):386-390.

Coder, Kim D. 2004. Chlorine Gas Exposure & Trees. University of Georgia School of Forest Resources Outreach Publication SFR04-5. Pp.6.

Coder, Kim D. 2004. Internal and External Tree Reactions to Chlorine Gas. University of Georgia School of Forest Resources Outreach Publication SFR04-6. Pp.5.

Coder, Kim D. 2004. Landscapes & Calcium Hypochlorite. University of Georgia School of Forest Resources Outreach Publication SFR04-8. Pp.2.

Coder, Kim D. 2004. Trees & Chlorine Gas: Dosage, Damage & Treatments. University of Georgia School of Forest Resources Outreach Publication SFR04-7. Pp.5.

Coder, Kim D. 2004. Tree Reactions to Chlorine Gas Exposure. University of Georgia School of Forest Resources Outreach Publication SFR04-9. Pp.8.

Gullett, B.K., P.M. Lemieux, C.K. Winterrowd, & D.L. Winters. 2000. PCDD/F emissions from uncontrolled, domestic waste burning. (poster summary). Organohalogen Compounds 46:193-196.

Griffiths, R.F. & L.E. Smith. 1990. Development of a vegetation-damage indicator as a means of post-accident investigation for chlorine releases. Journal of Hazardous Materials 23(2):137-165.

Harger, J.R.E. 1973. Damage to vegetation by chlorine gas. International Journal for Environmental Studies. 4:93-108.

Heath, R.L. 1980. Initial events in injury to plants by air pollutants. Annual Review of Plant Physiology 31:395-431.



UNIVERSITY OF GEORGIA WARNELL SCHOOL OF FOREST RESOURCES OUTREACH PUBLICATION SFR04-10* Jacobson, J.S. & A.C. Hill (editors). 1970. Chlorine (and Hydrogen Chloride). Pages F4-F8 in **Recognition of Air Pollution Injury to Vegetation: A Pictorial Atlas**. Informative Report #1 of TR-7 Agricultural Committee of the Air Pollution Control Association, Pittsburgh, PA.

Lacasse, N.L. & M. Treshow. 1978. Diagnosing vegetation injury caused by air pollution. USEPA-450/3-78-005. Valencia, PA. EPA, Applied Science Association. Pp. 274.

Landolt, W. & T. Keller. 1985. Uptake and effects of air pollution on woody plants. Experientia 41:301-310.

Lockman, I.B. & N.J. Sturdevant. 1999. Three-year evaluation of effects of chlorine on Douglas-fir and ponderosa pine near Alberton, Montana. USDA-Forest Service, Rocky Mountain, Forest Health Protection Report – Northern Region #99-11. Pp.7.

Loomis, R.C. & W.H. Padgett. 1974. Air Pollution and Trees in the East. USDA-Forest Service, State and Private Forestry, Southeastern Area. Pp.28.

National Academy of Sciences. 1976. Atmospheric chemistry of chlorine compounds. Chapter 4, pages 59-91, in **Medical and Biologic Effects of Environmental Pollutants: Chlorine and Hydrogen Chloride**, National Research Council, Assembly of Life Sciences, Division of Medical Sciences. Washington, DC. Pp. 249.

National Academy of Sciences. 1976. Effects of chlorine and hydrogen chloride on vegetation. Chapter 6, pages 145-162, in **Medical and Biologic Effects of Environmental Pollutants: Chlorine and Hydrogen Chloride**, National Research Council, Assembly of Life Sciences, Division of Medical Sciences. Washington, DC. Pp. 249.

Ricks, G.R. & R.J.H. Williams. 1975. Effects of atmospheric pollution on deciduous woodland part 3: Effects on photosynthetic pigments of leaves of *Quercus petraea*. Environmental Pollution 8:97-106.

Rhoads, A.F. & E. Brennan. 1976. Responses of ornamental plants to chlorine contamination in the atmosphere. Plant Disease Reporter 60(5):409-411.

Schreuder, M.D.J. & C.A. Brewer. 2001. Effects of short-term, high exposure to chlorine gas on morphology and physiology of *Pinus ponderosa* and *Pseudotsuga menziesii*. Annals of Botany 88(2):187-195.

Schreuder, M.D.J. & C.A. Brewer. 2001. Persistent effects of short-term, high exposure to chlorine gas on physiology and growth of *Pinus ponderosa* and *Pseudotsuga menziesii*. Annals of Botany 88(2):197-206.

Skelly, J.M., D.D. Davis, W. Merrill, E.A. Cameron, H.D. Brown, D.B. Drummond, & L.S. Dochinger (editors). 1987. **Diagnosing Injury To Eastern Forest Trees.** National Acid Precipitation Assessment Program, Forest Response Program, National Vegetation Survey. Pennsylvania State University, Agriculture Information Services, College of Agriculture. State College, PA. Pp.122.

Vijayan, R. & S.J. Bedi. 1989. Effect of chlorine pollution on three fruit tree species at Ranoli near Baroda, India. Environmental Pollution 57(2):97-102.

Wood, F.A. 1968. The influence of smoke from the combustion of polyvinyl chloride insulation on northern hardwood forest species. Phytopathology (Annual Abstracts) 58:1073.