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May 8, 1986

Centre municipal des congrès

Quebec City

MAPLE DECLINE

Québec

MAPLE DECLINE: TOWARD A SOLUTION

by Denis Lachance

Canadian Forestry Service
Sainte-Foy

A paper presented
at the
Maple Growers Information Session

Thursday, May 8, 1986

Centre municipal des congrès, Quebec City

MAPLE DECLINE: TOWARD A SOLUTION

by Denis Lachance

SUMMARY

Steps toward solving the decline problem can be plotted from the papers presented today. They may be arranged at the outset in three groups: (1) decline around the world; (2) extent of the decline in Quebec; and (3) state of research in Quebec.

Major problems of tree decline have often occurred and are still occurring in many parts of the world. Research to determine their causes has always been difficult and not always successful. The primary causes identified or suggested have always been multiple and highly variable, and on occasion none of them has been unanimously accepted by researchers. Tree decline remains an unusually complex problem, and ways of solving it emerge gradually.

Today in Quebec over 215,000 hectares of maple forest are affected by a marked decline. Our maple syrup industry is directly affected and threatened. Furthermore, the hardwood forests of southern Quebec also seem now to be threatened because the phenomenon has appeared in new territory and among deciduous species other than the sugar maple.

Researchers here and around the world appear to be inclining more and more toward the belief that atmospheric pollution is the primary but not the sole cause of the forest decline we are now observing. After outlining the origins of atmospheric pollutants and how they are carried and deposited, one lecturer described the Quebec network that monitors and samples some of these pollutants. Other researchers informed us (a) that stand density appears closely related to severity of decline, (b) that acid precipitation may directly cause severe leaching of exchangeable cations in the soil and (c) that ozone appears directly involved in causing lesions on foliage, and may lead to mineral deficiencies in trees.

The results of this research suggest possible steps toward solving or preventing decline: (1) maple stands should be thinned only very gradually so as to maintain a dense forest canopy rather than an open stand; (2) companion species to the maple should not be eliminated systematically, for they seem to stabilize and moderate soil composition; (3) precise, weighted applications of certain elements may restore vigour to trees temporarily. Lastly, some recent events, such as the present gathering, augur well for research support and are thus bringing us closer to possible solutions to the problem of maple decline.

MAPLE DECLINE: TOWARD A SOLUTION

by Denis Lachance

The papers that have been presented today have given us a clear understanding of the problem of maple decline and brought us up to date on what is known about its causes or the mechanisms that may be involved in this phenomenon. I have been asked to summarize the day's presentations briefly and give an overview of the problem. I shall also attempt to highlight individually the possible solutions that have been suggested by the speakers and, if possible, to bring forward any others that emerge from all the findings reported here or elsewhere.

The first presentation emphasized that tree decline is a complex phenomenon resulting from the interaction of physical and biological factors. In most cases these factors are hard to discern, even if the symptoms leave no doubt that the trees are under intense stress. I should like to focus on the complexity of the phenomenon, which seems to be very important if we are to avoid misunderstanding and frustration, particularly between researchers and the other parties concerned about the problem. Identifying its causes is and remains a slow, laborious process. We have to accept that our knowledge in this area will advance relatively slowly, as will the potential means of solving it, which will build up gradually. Moreover, even after the causes have been identified, the solutions that are recommended may be difficult to implement.

Next we heard about past and present declines. In the past, many tree species and groups of species have suffered from widespread decline, and in many countries. Often the causes of the blight were never determined. On occasion, the disease has even disappeared later without specific treatment. The best example of this remains the birch decline in Quebec in the forties and fifties. Intensive research carried out for nearly twenty years in northeastern Canada produced several theories as to the causes of the blight, but none has been accepted unanimously by the researchers involved, and naturally, no specific method of treatment was advocated. The disease vanished as mysteriously as it came. In many other cases of decline, the primary causes identified or suggested have varied considerably: climate, insects, management methods, inappropriate sites and stand origins have all been cited as causes at one time or another. It remains obvious that the phenomenon is complex.

Today, however, we find a certain concensus as to the primary cause of the present decline. We have all heard about forest decline and mortality in Germany and the rest of Western Europe. The red spruce stands of northeastern North America seem to be suffering from unusual decline at present. The same problems have been observed in Central America and in some other parts of the world. And here in Ontario and Quebec, we have the problem of maple dieback. Everywhere, atmospheric pollution is the first factor to be suspected and even accused. Is this because of group hysteria or inadequate communication between researchers in different countries? Is atmospheric pollution the true primary cause? There are several indications that it is, but little hard proof has been produced so far. There are very great differences between the species affected, the climates in the affected areas and the types and levels of pollution in the various countries. If we accept the theory that atmospheric pollution is the primary causes, we have still to identify what types of pollutants are to blame.

Next, the extent of the maple decline problem in Quebec was presented. An aerial survey of southern Quebec carried out in the summer of 1985 by the Department of Energy and Resources revealed that 215,000 ha of maple forests are significantly affected by decline. This represents some 40% of the maple forest covered by this survey. Comparison with a similar survey conducted in summer 1984 shows that the problem is becoming somewhat more severe and is spreading rapidly. Furthermore, several deciduous species other than the sugar maple are now reported to show symptoms of decline. For us in Quebec, the problem is thus substantial and acute. This blight affects a large number of maple syrup producers, for whom the consequences are serious and sometimes dramatic. The socioeconomic impact of the problem is building, and directly threatens the very core of our maple products industry. Moreover, as the phenomenon spreads and affects species other than the maple, the hardwood forests of southern Quebec appear to be threatened. The socioeconomic consequences could become even worse than they are now.

Another speaker outlined the relations between the various sources of pollutants and how they combined and travelled through the atmosphere. We also saw how they are deposited in the soil. This presentation included a description, of the Quebec Department of the Environment's precipitation sampling network, which comprises forty-six stations scattered across the province.

Lastly we heard reports on research, including that of Mr Gagnon and Mr Roy of Energy and Resources and Dr Bernier of the Forestry and Geodesy Department at Laval University.

Two importants points emerged from the presentations by the Energy and Resources researchers. Firstly, a close relationship seems to have been established between the severity of the disease and stand density: there is a higher proportion of sick trees and they are more severely affected in open stands, where the forest canopy is light, in comparison to stands where the canopy is dense. This observation suggests one possible way of solving or rather preventing decline: maple stands should be thinned only with the greatest discrimination so as not to make large gaps in the forest canopy. In other words, thinning should be done very gradually if it must be done at all. I expect that if I turned the floor over to the audience now, ten sugarbush owners would immediately tell me that their maples have been dying back severely even though they have not been thinned for several years. My answer to these hypothetical comments would be that large gaps may occur in the forest canopy naturally, because of windfalls and the death of large trees. Such stands might also be located on sites especially vulnerable to decline, where they were bound to be affected, and might be in even worse shape if they had been thinned.

Bearing in mind the need to preserve the forest canopy, we might also suggest to owners suffering from dieback in their sugarbush that they delay cutting trees that are only slighlty affected, so as not to break up the cover and thus make surrounding trees more vulnerable. I should emphasize, however, that the relationship between low tree density and more severe decline remains only one out of many observations. It does not mean than any break in the forest canopy inevitably leads to decline. We are dealing with a very complex biological system whose reactions often do not correspond to even the best-researched scientific predictions.

The second point to emerge from the first scientific paper has to do with the perceptible decrease in exchangeable cations, in particular calcium (Ca^{++}), magnesium (Mg^{++}) and potassium (K^{+}). This decrease is observed in most of the pedons or soil samples analysed recently in comparison to samples taken ten to eighteen years ago. These findings suggest damage due to acid precipitation, which may directly affect soil pH or acidity, and hence the leaching process for these elements. While this is happening to the soil, the same acid precipitation or other atmospheric pollutants may also be harming the upper parts of the tree, thereby doubling the stress on the organism. Lower quantities of exchangeable cations in the soil have also been observed frequently in Germany and elsewhere. To counteract this, adding lime to the soil has often been recommended. This product is favoured because it is readily available and because farmers and woodlot owners are fairly familiar with its use. Unfortunately, experiments in Europe with liming forest soils have been less successful than was hoped. Moreover, many soil specialists are afraid that long-term use of lime will cause its own problems.

If acid precipitation is the major cause of this exchangeable cation deficiency, there is no doubt that cutting down acid precipitation is the ultimate solution. For the moment, perhaps we can plan to maintain a certain quantity of companion species to the sugar maple in our sugarbushes. This could maintain greater soil stability and a better balance of the elements in it. Conifers in particular use far fewer exchangeable cations than deciduous trees. Moreover, the principle of avoiding breaks in the forest canopy due to thinning should be applied by not cutting companion species blindly. Until we have evidence to the contrary, we should treat these species kindly, remembering that prevention is better than cure. Temporarily at least, let us accept a major change in traditional sugarbush management practices. Companion species may be more important than we thought.

In the day's second presentation on research, I also noted two important points. The first is that acid precipitation seems to have a determining but long-term effect on maple decline. A review of recent scientific literature on this subject and research here at Université Laval point to this conclusion. Foliage and soil analyses in maple stands affected to varying degrees indicate noticeable losses of elements important to plant growth. Excessive leaching is the most plausible theory. Nevertheless, we still do not have firm proof that acid precipitation directly causes decline.

The second topic covered in this presentation was the symptoms produced in trees by oxidants, especially ozone. The visual presentation of this part of the research was particularly impressive. We noted that ozone mainly affects the structure of the organs responsible for photosynthesis, that is, leaves and needles. It seems to make cell membranes more permeable, thus exposing them to losses of important nutritive elements, perhaps by leaching. In trees noticeably affected by dieback, typical symptoms of nutritional deficiencies were observed. From this there is only one step before ozone-related symptoms are connected with subsequent mineral deficiencies in a tree.

If ozone does indeed prove to be a major cause of decline, the solution we would naturally turn to would be to reduce at their sources, those oxidants precursors of ozone, that is, nitrogen oxides and hydrocarbons. This is a long-term solution, however, for ozone precursors are mainly generated by internal combustion in automative engines. It would be unrealistic to expect that our society will change its attitude to the automobile overnight.

The other suggestion put forward earlier, keeping a full forest canopy in sugarbushes, may also prevent ozone damage. Because this gas is carried by moving air, it will cause less harm if it cannot circulate freely under the forest canopy. Since ozone concentrations in the air vary greatly from day to day, since only a few hours of high concentration are enough to injure a plant, a good leaf cover or barrier may prevent ozone from entering a stand and moving through it rapidly. This may sometimes mean the difference between a stand severely affected by a temporary and local concentration of ozone and one that remains almost untouched.

The deficiencies observed in trees with dieback can apparently be remedied in part by the addition of certain elements. Dr Bernier's precise experiments with fertilizers as well as others reported from Germany appear to confirm their beneficial, indeed almost spectacular, effects. Fertilizing with Mg^{++} or K^{+} has sometimes given very satisfactory results in Germany. However, this type of amendment should not be widespread at this stage, because its aim is to correct an imbalance in the soil's nutrient status. The addition of a non-deficient element would aggravate the imbalance, and thus aggravate the problem. Plainly, fertilization is another important path toward solving our problem. It does not, however, offer a permanent solution; it can keep trees alive for a time, but it does not correct the underlying cause.

In addition to the few indications of temporary solutions we have just discussed, I wish to dwell today on other recent developments that will probably have an equally beneficial effect on the decline problem. Among these I include: (1) the acceptance of the Davis-Lewis report on acid precipitation by President Reagan of the United States, which means that the Americans at least are finally acknowledging that this is a real problem; (2) the announcement by the Canadian Forestry Service's Laurentian Forestry Centre of a specific research project on the problem of maple decline in Quebec, which will immediately increase research into the problem in Quebec and thus contribute more understanding; (3) the public's and media's growing awareness of this problem and the search for solutions, as evidenced by the large attendance at this information session, which emphasizes the urgent need to address this problem and solve it; and (4) the willingness expressed by government to find means and support research to solve the problem of maple decline as quickly as possible; this is where we shall find the moral and financial support to push forward with research in this field.

This demonstration of solidarity by the public, government and scientific authorities and researchers themselves in the search for the solution or solutions to the problem is certainly the most encouraging omen at present, and gives us hope that before long we shall succeed, first in controlling the decline of our maple stands and then in enabling them to flourish as in years past.