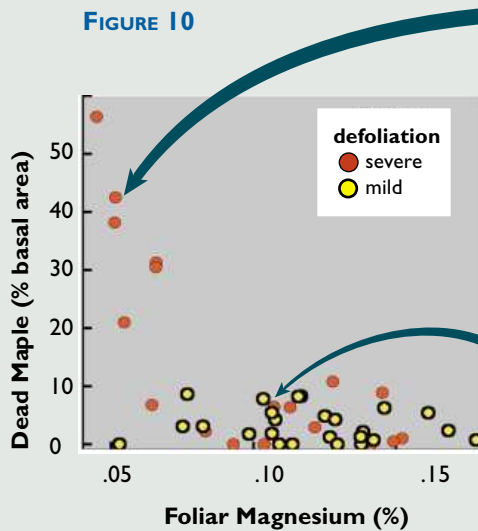


upper slopes of unglaciated sites contain low calcium and magnesium supplies as a result of more than half a million years of weathering combined with the leaching of these elements by acid deposition. Low levels of these base cations can cause a nutrient imbalance and reduce a tree's ability to respond to stresses such as insect infestation and drought (see Figure 10).

Sugar Maple Decline: a multiple stress syndrome



Multiple stresses have led to sugar maple decline at a forest in Ridgway Township, Pennsylvania. As shown here, there has been severe sugar maple mortality on the upper slopes of this forest where long-term leaching has produced nutrient poor soils and high levels of acid deposition have contributed to the loss of additional base cations from the soil. Two years of moderate to severe insect defoliation produced high levels of crown dieback and tree mortality. In contrast, a nearby site at a lower elevation in the same watershed that is richer in nutrients and therefore more buffered from the effects of acid deposition, was subject to the same level of insect defoliation, but was able to withstand the stress and does not show symptoms of decline (after Horsley et al. 2000).

In addition to the forest stands in Pennsylvania, forests in other areas of the Northeast contain sugar maples with foliage having low calcium and magnesium concentrations. Sugar maple trees in these forests may be susceptible to decline if stress levels surpass a threshold. For example, twig and branch dieback, gaps in the forest canopy and premature coloration of leaves have been observed at the HBEF and may represent the early stages of tree decline.

Finally, it is logical to consider whether hardwood species such as white ash and basswood that seem to be found primarily on sites high in base cations may also be susceptible to decline similar to that of sugar maple. Mortality of white ash has been associated with ash yellows, caused by pathogens, but an association between nutrient imbalance and mortality of white ash or basswood has yet to be clearly documented.



Premature coloration and twig and branch dieback in a sugar maple at the HBEF.