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Alder tree decline in Europe: how does climate affect the spread of damaging pathogen?

Milder winters under climate change could increase the extent of alder tree (*Alnus glutinosa*) decline in Europe due to the increased spread of the pathogen *Phytophthora alni*, a recent study has found. However, this may be offset by hotter summers, which reduce the severity of the disease.

In recent times, a growing number of plant pathogens have invaded forests and other ecosystems throughout Europe. Several factors, such as human disturbance to forest ecosystems, increased international trade transporting alien pathogens, and climate change have been identified as potential causes which promote their emergence and spread.

P. alni is a fungus-like pathogen associated with the decline of alder trees in Europe since the early 1990s. The researchers in this study aimed to understand the effect of climatic conditions on the severity of *P. alni* outbreaks, and determine if recent climate change could explain the emergence and spread of the disease.

The researchers created computer models to simulate the effects of climate and local environmental conditions on the severity and spread of *P. alni* outbreaks, based on data collected from 16 sites in north-east France over six years. The data included measures of alder decline and environmental conditions, such as season, soil acidity and texture, rainfall and temperature, over 10 days before sampling the trees, and *P. alni* levels measured in soil.

The accuracy of the model was checked against a series of 16 alder sites in south-west France where alder decline due to *P.alni* had been monitored between 1998 and 2003, and generally matched well to observed levels of decline in this area.

Finally, the model was used to assess if recent climate change could explain the emergence of the disease in the 38 sites (16 north-east and 16 south-west) over 40 years of observed climate data from 1970 to 2010.

The main factors influencing alder decline were winter and summer temperatures in the previous year. The model indicated that the most unfavourable conditions for the disease were colder average daily winter temperatures of below around 3.5°C and average daily temperatures in the previous summer of 21-22°C in July and August.

The model also showed that the climate in south-west France over the preceding 40 years was more favourable for the disease than in the north-east. The reason for this was mostly the colder winters in the north-east, averaging 2.5°C.

The results suggest that many areas that currently benefit from cold, disease-limiting winters, such as Germany and the Czech Republic, could face increases in *P. alni* induced alder decline as the climate warms. Additionally, in more southern areas a warming climate may itself be detrimental to alder tree growth, since this species generally grows near rivers and streams with a good supply of water which may decline as climate change progresses.

However, a warmer climate may not have negative consequences everywhere. For example, in areas where cold winters have not limited *P. alni* alder decline, such as south-west France, hotter summers could limit disease severity. Indeed, the authors highlight that in south-east areas of France which experience hot Mediterranean summers *P. alni* induced alder decline is seldom reported.

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