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Scots pine blister rust in Swedish forest: current epidemics and foresight

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Conifer trees, specifically Norway spruce and Scots pine, dominate the forest in Fennoscandia. In Sweden, these two species account for about 40% of the standing volume in the forests each, holding significant ecological, economic, and cultural value. Their resilience is critical for sustainable forestry and ecosystem services.

My current research focuses on one of the most damaging diseases in Swedish forests: Scots pine blister rust (SPBR). The fungal pathogen, *Cronartium pini*, infects pine through needles or young shoots, eventually causing stem deformation and the death of branches, tree tops, or the whole tree. This disease has existed in Swedish forests for more than one hundred years without significant damages; however, more severe epidemics have been reported in recent decades. Our studies in Sweden and Finland found that the epidemics are associated with various environmental factors such as higher temperature and precipitation in June. Climate change is predicted to promote the SPBR epidemics in northern Sweden, therefore, more knowledge on this critical pathosystem is needed for disease management.

The causal agent *C. pini* is more complicated than regular rust fungi. It has two life-cycle forms: an autoecious form that completes its entire life cycle on pine, and a heteroecious form that requires two host species. The two forms are morphologically indistinguishable, but digital PCR and germination-based protocols have recently been developed for fast identification. New knowledge acquired through this development presents opportunities to address fundamental questions in forest pathology and mycology.

Breeding resistant pine is one of the most promising strategies to control SPBR. While it is known that resistance to SPBR is heritable, the genetic determinants underlying both qualitative and quantitative resistance in Scots pine remain largely unknown. To systematically identify resistant pine genotypes or clones, reliable artificial inoculation is needed to screen the pines in the forthcoming screening centre. Protocols for inoculating the two forms of Scots were developed recently and the colonization of the pathogen can be detected and monitored by microscopy and molecular methods. These protocols are the foundation for future studies on the genetic basis of host resistance and host-pathogen interaction.

Suitable environment, susceptible host, and virulent pathogen are the three key components in plant disease triangle. By addressing these three components in the SPBR pathosystem, my research line aims to mitigate the damage caused by SPBR and support the future forest health.