Norway spruce trees in the subalpine forests of the European Alps are increasingly attacked by the needle rust *Chrysomyxa rhododendri*. This biotrophic parasite undergoes a complex life cycle with a host shift between rhododendrons (*Rhododendron* spp.) and Norway spruce (*Picea abies*). It causes yellowing and defoliation of the current-year needles in summer and, in consequence, reduced growth or even dieback of infected trees. The susceptibility to infection varies between individual trees, and rarely resistant specimens can be found. Previous studies rebutted earlier hypotheses that this rust-resistance could be based on tree phenology (i.e. escaping infection by flushing after spore flight). However, there is evidence that plant defence compounds (i.e. fungicidal needle substances like phenols) or mechanical barriers (cuticula) may play a role. Main goals of this project are: (i) Development of new methods to quantify *Chrysomyxa* infections. Most important, drone flights will enable an improved quantification of infection rates at the tree and local canopy level. (ii) Comparison of the cuticula of susceptible and resistant trees via microscope imaging techniques. (iii) Analysis of phenolic needle compounds connected with resistance. This analysis will also focus on developmental changes and heritability of phenolic patterns. (iv) Genetic analyses. The phenotypic variation of resistance and the expression and variation of candidate resistance genes will be studied. Furthermore, the occurrence of the pathogen will be verified with molecular markers. Resistant and control plants will be tested as mature trees, rooted cuttings and as seedlings derived from the mature trees. The project is based on cooperation of research teams of the Department of Botany, University of Innsbruck, Federal Research and Training Centre for Forests, Natural Hazards and Landscape, BFW Vienna and University of Natural Resources and Life Sciences (BOKU) Vienna. It is also supported by the Forest Administration Tyrol, which provides help with search for resistant trees, seed collection and growth of cuttings. Project outcomes are important to better understand host-pathogen interactions and underlying resistance mechanisms. Genetic analyses and diagnosis tools will be important for future strategies to obtain and use resistant plant material for afforestation in Tyrol and other European regions. Sustainable management of mountain ecosystems is essentially important to society, especially in the face of the looming challenges predicted by climate change scenarios.