# PhD position in Phytopathology / Plant Disease Epidemiology

Wheat pathogen adaptation to climate factors: A comparative study of plasticity and life-history trade-offs in *Zymoseptoria tritici* and *Puccinia graminis* f. sp. *tritici*

Start - autumn 2026. Duration - 36 months

## Research project

Wheat is affected by several fungal diseases. Climate change raises concerns not only about the capacity to maintain wheat production under agro-physiological constraints, but also about its impact on pathogen populations. The aim of this PhD project is to anticipate this threat by characterizing the adaptive potential of two major wheat pathogens using complementary experimental approaches. The PhD candidate will be tasked with characterizing how populations of the endemic pathogen *Zymoseptoria tritici* (*Zt*) and of the re-emerging pathogen *Puccinia graminis* f. sp. *tritici* (*Pgt*) may adapt to two key climatic factors: humidity and temperature. This research will account for their current population structure, biological characteristics, and the contrasting epidemiological contexts of France and Germany. It will focus on trade-offs in life-history traits expressed under a range of climatic conditions, from optimal to suboptimal, to address the following questions: How can these trade-offs be identified and characterized, if they occur? What is the genetic basis of adaptation, and could it explain the observed trade-offs?

It is proposed that the PhD candidate structure the work into three main parts:

*(1) Characterization of adaptation to climatic factors in* Zt *and* Pgt - The first part will focus on phenotypic plasticity and inter-individual variation within broad pathogen populations collected across multiple spatial scales, using both *in vitro* and controlled-condition phenotyping approaches. Adaptation will initially be characterized at the population level for *Zt* in response to humidity mainly at INRAE, based on the assessment of sporulating leaf area in planta. For *Pgt*, adaptation to temperature will be investigated mainly at JKI, primarily through analyses of spore germination rates in vitro.

*(2) Characterization of trade-offs among traits* - In this second part, adaptation will be investigated in a selected subset of strains previously characterized through the analysis of multiple phenotypic traits related to aggressiveness. Patterns of adaptation to climatic conditions and aggressiveness will be compared to identify potential trade-offs in life-history.

*(3) Genetic determinants of adaptation to humidity in* Zt - This third part will focus on the genomic basis of adaptation to humidity in *Zt*. Building on the phenotypic characterization and the availability of whole-genome sequence data, GWAS will be conducted to identify genomic regions associated with adaptive responses.

## Research environment

The project will be jointly conducted between INRAE and the Julius Kühn Institute, providing a unique binational research environment.

The French National Research Institute for Agriculture, Food and Environment (INRAE) ranks among the world's leading institutions in agricultural and food sciences, as well as plant and animal sciences. Its research aims to develop solutions for multi-performing agriculture, food systems of high quality, and the sustainable management of natural resources and ecosystems. The 'ADEP team' within the INRAE BIOGER research unit is recognized for its research on adaptive and epidemiological processes in wheat–fungal pathogen interactions.

Julius Kühn-Institut (JKI) is Germany's Federal Research Centre for Cultivated Plants, bringing together experts in plant science, crop protection, and agricultural research across several institutes and experimental sites. It is one of Europe's leading public research organizations in applied plant sciences, focusing on plant health, crop production, and sustainable agriculture. The Institute for 'Plant Protection in Field Crops and Grassland' is recognized for its research on cereal diseases and resistance, adopting a systems approach that considers both the crop and the pathogen. The Institute for 'Strategies and Technology Assessment' is known for its research in host-pathogen epidemiology and modelling to develop decision-support systems for agriculture.

## Working conditions and resources

Start - autumn 2026. *Duration* - 36 months

*Supervision* - Frédéric Suffert & Thierry Marcel (INRAE); Philipp Schulz & Bettina Klocke (JKI)

*Location* - INRAE BIOGER on the Campus Agro Paris-Saclay in Palaiseau (15 km south of Paris), with several research stays of several months (timing to be defined) at the JKI in Kleinmachnow (10 km south of Berlin).

*Working conditions* – 36-month INRAE employment contract with a gross salary of €2,300 per month (approximately €1,850 net + public health coverage + contribution to public transport costs); PhD awarded by the ABIES Doctoral School (AgroParisTech / Université Paris-Saclay).

## Requirements for applicants

The project covers the scientific disciplines of phytopathology, plant disease epidemiology, microbial ecology, and genomics. The candidate is expected to have skills and experience in experimental approaches to plant–pathogen interactions, phenotypic and/or genomic data analysis. Additional expertise in comparative epidemiology, fungal microbiology, genetics and statistics will be valuable, as well as a high degree of autonomy and the ability to work in an interdisciplinary, multilingual environment.

Due to administrative constraints, only **applicants currently residing in the EU** will be considered.

*Application requirements* – Please send your application (CV + tailored cover letter + Master's transcripts + contact of two academic referees) to frederic.suffert@inrae.fr, thierry.marcel@inrae.fr, Philipp.Schulz@julius-kuehn.de and Bettina.Klocke@julius-kuehn.de with the subject line "PhD INRAE–JKI".

An initial review of applications will be conducted for all submissions received by **June 26, 2026**. Applications received thereafter will be reviewed until the position is filled.