WHEAT BLAST: EARTH OBSERVATION AND CLIMATE FORECASTS FOR RISK MANAGEMENT

Locations	Australia, Bangladesh, India, Thailand, United Kingdom
Dates	27/09/2023 - 26/03/2025

Summary

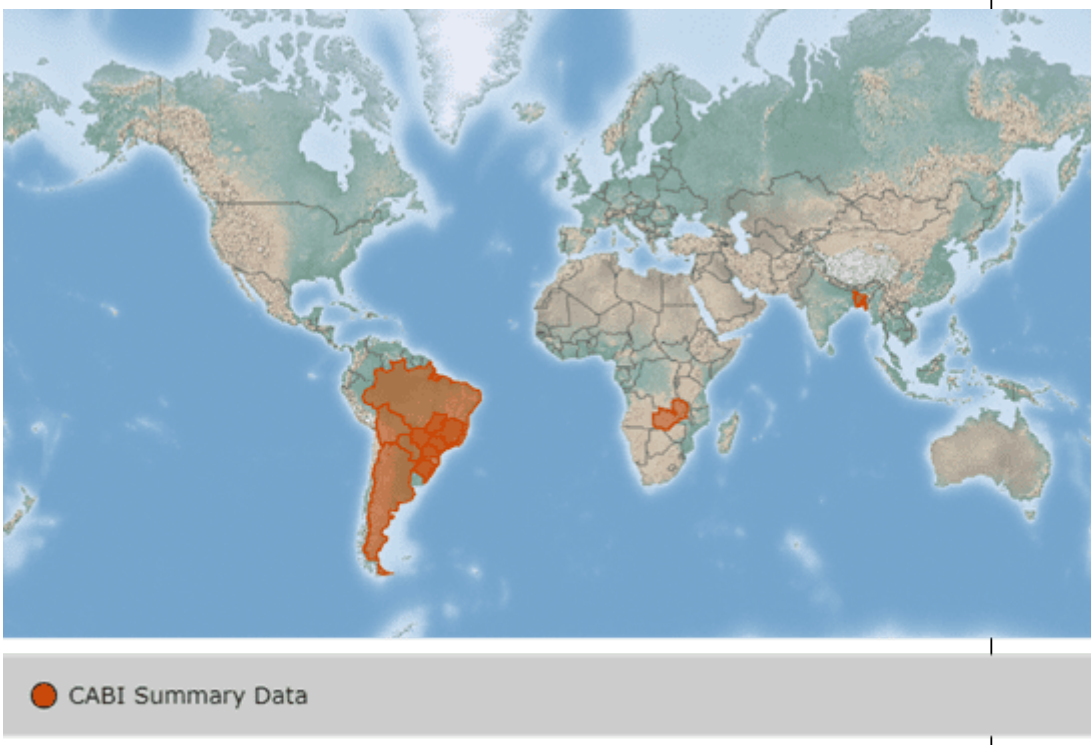
Wheat Blast *(Magnaporthe oryzae Triticum or 'MoT')* is a plant disease of global concern, threatening crop production and biosecurity. Known to favour humid, warmer climates, the disease is a severe problem in Bangladesh and South America. However, the consequences of climate change pose the risk of the disease infecting other wheat-growing areas. Coupled with its ability to spread rapidly through the air and infected seeds, Wheat Blast's devastating effects and limited control options are leading to heavy yield losses and a threat to global food security. This project brings together a project consortium formed of experts in Earth observation, remote sensing, pest and disease modelling, datasets and information dissemination to produce Wheat Blast risk maps and actionable advice as part of a framework. The framework will be used by key stakeholders as part of a targeted management approach to the disease.

The problem

Wheat Blast is a highly destructive disease resulting in yield losses of over 50% when environmental conditions are favourable. It is caused by *Magnaporthe oryzae Triticum (MoT)*, a fungal pathogen that spreads quickly and travels long distances in the air through infected seeds and spores.

Wheat Blast was first discovered in Brazil in 1985 and gradually spread to Bolivia, Paraguay and Argentina. In 2016, it emerged in Bangladesh, and in 2018, it was observed in Zambia.

The map below shows the global spread of Wheat Blast in 2023. Whilst the majority of the world's grain-growing regions remain free of the disease, Wheat Blast is a key biosecurity concern to nations worldwide due to its devastating effects on yields.



CABI, 2024. Magnaporthe oryzae Triticum pathotype. In: CABI Compendium. Wallingford, UK: CAB International.

Climate change has altered the way pests and diseases establish and spread around the world. Countries and habitats that would historically be deemed inhabitable by a species, are changing due to rising temperatures and changing precipitation patterns which are expanding the distribution of species into new areas. Likewise, the consequences of increased global trade and pathways have led to pests and diseases travelling between countries accidentally, widening the species' reach.

Under these conditions, Wheat Blast is expected to spread mainly in tropical regions. A more humid and warmer climate in the future will likely increase the number of suitable areas for Wheat Blast, in particular, in the Southern hemisphere.

What we are doing

This project is developing a proof-of-concept framework that will produce advisories for use by key stakeholders in biosecurity and pest management extension services.

By integrating the novel use of Earth observation data and modelling methods, the framework will enable targeted management of Wheat Blast. It will also allow

tools to be developed that will help understand and manage biosecurity risk for countries that are currently free of the disease.

The project's key research objectives include using Earth observation data to classify crop types in temporally and spatially complex environments in Bangladesh; linking niche and infection models with crop-type models to derive actionable risk products; identifying unique spectral signatures of wheat blast using high-resolution remote sensing data, and engaging with key stakeholders to understand Wheat Blast management and how information is currently delivered.

Capturing local data and validating it will enable the project to collaborate with an existing research programme in Wheat Blast management and extension and outreach programmes in Bangladesh. The project is also working with key stakeholders in India and Thailand to understand how information is currently communicated in these countries and evaluate the potential risk of the disease.

The project aims to:

1. Produce a consistent, systematic and dynamic crop map product to identify areas that can be affected by Wheat Blast
2. Produce a spatio-temporal model of climate risk to focus surveillance and management attention
3. Collect field drone hyperspectral measurements of infected wheat and understand how these link to Earth observation data
4. Explore the pathways to impact through stakeholder engagement in Bangladesh, India, Thailand and Australia.

Results so far

CABI has developed a Wheat Blast CLIMEX model (a niche model that is used to indicate where and when pest and diseases may occur given certain weather conditions (temperature, precipitation)) to investigate the potential distribution of the disease using eco-physiological tolerances (how plants, animals and micro-organisms function together) and global occurrence records. Our initial results show a good fit between the modelled suitable areas and the known distribution of the disease, including potential suitable areas in other countries including Central and North America, Africa and Australia.

Future work will focus on improving the distribution models with more refined stress parameters – conditions that affect the cycle of the disease pathogen such as cold-wet, hot-dry or moist-freezing.

Our partners, Cervantes Agritech, are developing an infection model that will identify locations and times when MoT infections can occur. This model will be implemented with the DYMEX modelling platform (a model that helps to predict pest populations (spatial and temporal) and disease infection) to model MoT dynamics in Bangladesh. Earth observation data is also being used to detect the biological stresses of Wheat Blast on wheat in Bangladesh, while scaling drone-mounted hyperspectral reflectance of Wheat Blast is being explored.

CABI is also leading on impact pathways and stakeholder consultation for the project. We are collaborating with key stakeholders in Bangladesh, Australia, India and Thailand to understand the current knowledge-sharing pathways for Wheat Blast information within these countries.

Donors

Science and Technology Facilities Council (STDF)

Partners

Assimila Ltd, Cervantes Agritech, The University of Leicester, RAL Space, CSIRO, New South Wales Department of Primary Industries

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