Wheat stem rust: a potential biosecurity risk under a changing climate

NSW will likely remain highly suitable to wheat stem rust under a changing climate, with varying suitability throughout the year at different locations.

Developing industry-informed climate planning information

Climate change is altering the biosecurity risks for many agricultural commodities across NSW. Primary producers need evidence-based information about the changing climate, and the risks and opportunities it may bring.

Through its Vulnerability Assessment Project, the NSW Department of Primary Industries is increasing the resilience of our primary industries by providing information and data to help the sector better plan for, and respond to, climate change. The project has determined climate change impacts for extensive livestock, broadacre cropping, marine fisheries, forestry, horticulture and viticulture, and important cross-cutting biosecurity risks to inform sound planning, risk management and adaptation decisions.

Wheat stem rust in NSW

Wheat stem rust is a fungal disease caused by the pathogen *Puccinia graminis* f.sp *tritici.* Although generally regarded as the most damaging disease of wheat, severe outbreaks of wheat stem rust have been rare in Australia due to the deployment of resistant varieties. The most severe outbreak occurred in south-eastern Australia during 1973-74, resulting in an estimated loss of AUD 200-300 million to the wheat industry[1]. Wheat stem rust remains an important threat to wheat production as severe outbreaks may occur when exotic or new virulent pathotypes overcome existing resistance found in wheat currently in cultivation.

Although wheat is the primary host, the pathogen can affect barley, oat, rye, and triticale under suitable conditions. Infection can occur on stems, leaves, and heads, and severe infections may produce shrivelled grain. Severe infections on susceptible hosts under disease conducive conditions may cause 50-100% yield loss.

The fungus survives from one season to the next on volunteer wheat plants — green bridge — which act as primary source of rust inoculum. It is important to note that the fungus does not survive in soil, stubble, or grains.

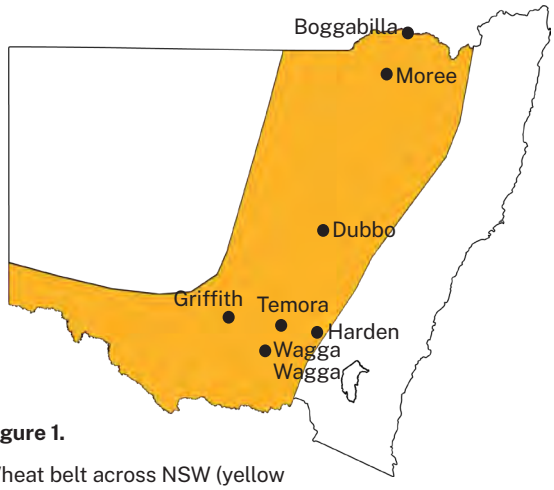

Figure 1.

Wheat belt across NSW (yellow region). Locations indicate key wheat growing sites.

[1] Addai D, Hafi A, Randall L, Tennant P, Authur T and Gamboso J. 2018. Potential economic impacts of the wheat stem rust strain Ug99 in Australia, ABARES research report, prepared for the Plant Biosecurity Branch, Department of Agriculture and Water Resources, Canberra.

Climate and wheat stem rust

Overall, the likely impacts of wheat stem rust by 2050 under a changing climate in NSW are projected to slightly increase in spring and autumn and decrease during summer. Changes in climate suitability are likely to occur across the infection and incubation stages of the pathogen's lifecycle.

Climate risks likely to impact wheat stem rust distribution in NSW include:

Warmer temperatures and more extreme heat days will likely reduce the potential for wheat stem rust to survive from one crop season to the next by decreasing the summer green bridge should an incursion occur. However, summer rainfall may allow remaining seeds to germinate and act as hosts to spread wheat stem rust to the following year's crop.

Climate impacts: what to expect

Infection

- **Decreased climate suitability** in the wheat belt from November to March (*low to high confidence*).
- **Increased climate suitability** in the wheat belt from April to June and August to October (*low to high confidence*).
- **Maintained historical climate suitability** in the wheat belt in July.

Incubation

- **Decreased climate suitability** in the wheat belt from November to February (*low to high confidence*).
- **Increased climate suitability** in the wheat belt in April and October.
- **Maintained historical climate suitability** in the wheat belt in March and from May to September.

Methodology and data

Climate projections were sourced from Climate Change in Australia's 'Application Ready Data'. This dataset is comprised of projections from an ensemble of 8 global climate models, each presenting a plausible future climate. The models differ in their projections, giving rise to uncertainty in our modelling. Low confidence in the projected changes due to differences between the models is noted in the text. Care should be taken when interpreting these results.

The Vulnerability Assessment Project is intended to highlight potential industry-or regional-level changes. Intermediate and high emissions scenarios were used in the assessments (RCP4.5 and RCP8.5), but these are not the only future scenarios possible. The inclusion of climate variables important to each biosecurity risk was based on published research, expert knowledge and data quality and availability.

Impact on key NSW primary industries

Under the future emissions scenarios, the climate suitability for southern NSW is likely to become more suitable for *P. graminis*, potentially leading to a higher likelihood of an outbreak of wheat stem rust should exotic or new virulent strains overcome the existing resistant wheat varieties. These decreases in climate suitability throughout the summer months have the potential to reduce the summer green bridge opportunity for wheat stem rust.

Severe outbreaks may occur again if exotic or new virulent strains overcome the existing resistant wheat varieties. The highest risk of pathogen spread in NSW comes from the fungus being moved or introduced by humans.

If wheat stem rust does emerge as a problem in NSW, grain growers may need to adapt by adopting earlier-maturing varieties, to minimise or avoid the wheat stem rust window, or by increasing late-season fungicide applications, which carries an enhanced risk of exceeding maximum residue limits in grains prior to harvest.

FOR MORE INFORMATION

Please get in touch with vulnerability.assessment@dpi.nsw.gov.au

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