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INTRODUCTION

Septoria tritici blotch (STB) is an important foliar disease on wheat in the UK, caused by the fungus *Zymoseptoria tritici*. Breeding STB-resistant wheat varieties is high priority, as chemical control has proven inconsistent¹. Symptoms occur 7-9 days after infection when lesions appear on infected leaves, affecting their photosynthetic activity (Fig. 1a). Reduced photosynthetic activity is the result of permanently damaged reaction centres of Photosystem II which have to dissipate the excess energy through chlorophyll fluorescence or Non-Photochemical Quenching (NPQ). NPQ is a photoprotective mechanism that can be measured and used to assess the physiological status of the plant and response to environmental stress² (Fig. 1b).

The most recent and successful native wheat resistance gene is *Stb6* – plants show no symptoms or no pycnidia are developed³.

Aims of this project are to (1) identify the role of NPQ in compatible and incompatible wheat – Z. tritici interactions and (2) identify other components of photoprotective responses, such as Reactive Oxygen Species (ROS) and carotenoids, involved in resistance to Z. tritici conferred by Stb6.

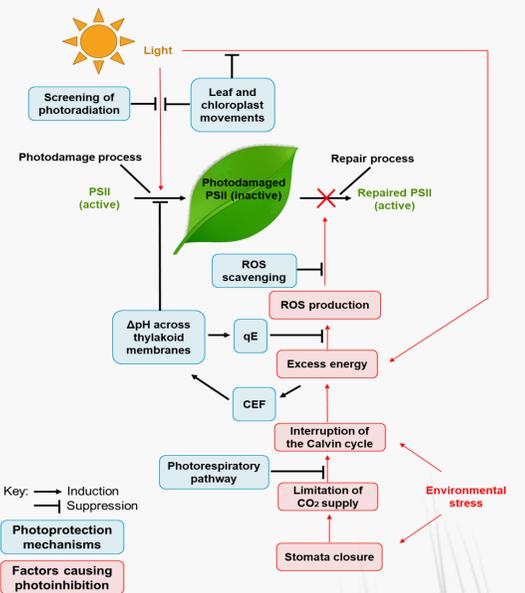


Figure 1a. Severe disease symptoms on wheat leaf, 1b. A model of the photoprotective mechanisms in plants².

MATERIALS & METHODS

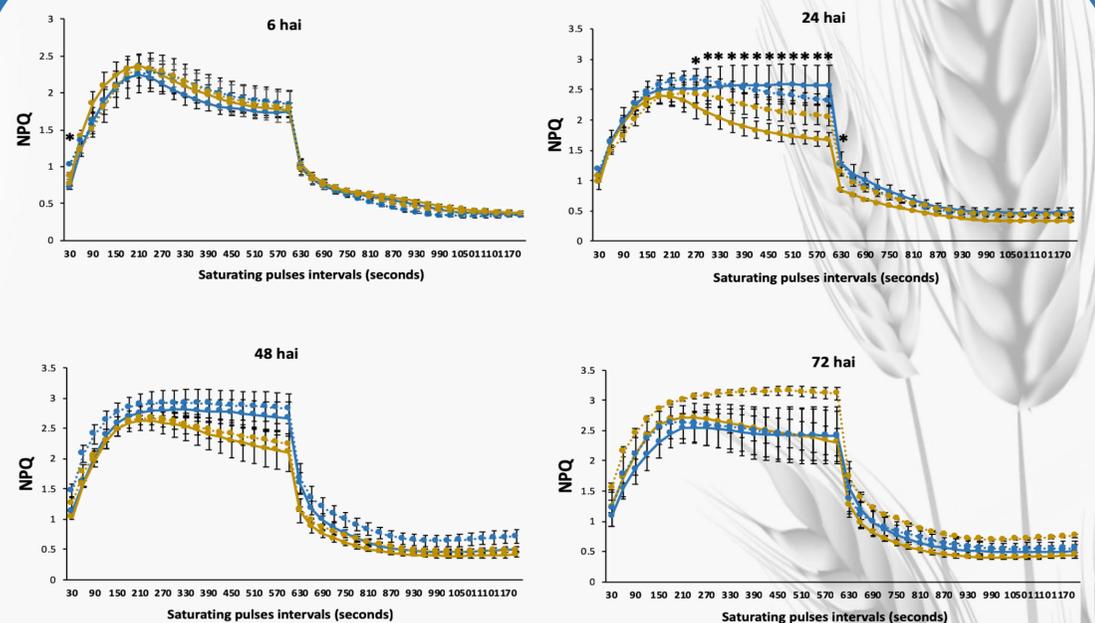
Plant material included:

- Resistant genotype Chinese Spring (+*Stb6*)
- Susceptible Near Isogenic Line (NIL) of Chinese Spring (-*Stb6*) (Fig. 2)

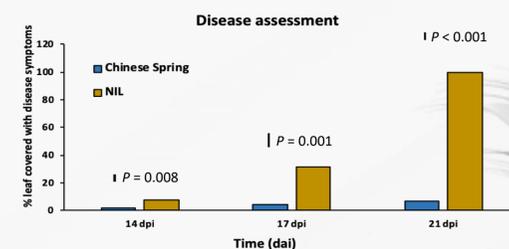
1. Spray-inoculation of the youngest, fully-expanded leaf (GS 25) with *Z. tritici* isolate IPO323
2. Attached leaves were screened using the Fluorcam (Fig. 3a, 3b)
 - NPQ Induction & Relaxation curves (saturating pulses every 30 secs - 10 minutes of light followed by 10 mins of darkness)
 - Measurements at 6, 24, 48 and 72 hours after inoculation (hai)
3. Visual disease assessment at 14, 17 and 21 days after inoculation (dai)



RESULTS



* Indicates a significant interaction between the Genotypes and the Inoculation treatment ($\alpha = 0.05$)



DISCUSSION

1. The effect of the disease on NPQ was detected as early as 24 hai
→ The resistant Chinese Spring reduced NPQ under inoculation in contrast to the susceptible NIL
2. The susceptible NIL had a faster relaxation under dark than the resistant Chinese Spring – *potential trade-off between photoprotection and signaling?*
3. No significant interaction at 48 and 72 hai, however there were separate effects of the genotypes and the inoculation on NPQ
4. NPQ responses were significantly related to symptoms expression

CURRENT & FUTURE WORK

- Currently testing a set of transgenic lines over-expressing PsbS - the protein involved in the regulation and induction of NPQ
- Screening of transformed susceptible lines that have been cloned to contain *Stb6*
- Detailed analysis of more physiological parameters (photosynthesis, stomatal conductance) on all lines
- Reactive Oxygen Species and carotenoid assays
- Test other *Zymoseptoria tritici* isolates with altered virulence

1. Brown JKM, Chartrain L, Lasserre-Zuber P, Sainetac C (2015) Genetics of resistance to *Zymoseptoria tritici* and applications to wheat breeding. *Fungal Genetics and Biology*.

2. Takahashi S & Badger MR (2011) Photoprotection in plants: a new light on photosystem II damage. *Trends in Plant Science*.

3. Sainetac C, Lee W-S, Cambon F, Rudd JJ, King RC, Marande W, Powers SJ, Bergès H, Phillips AL, Uauy C, Hammond-Kosack KE, Langin T, Kanyuka K (2018) Wheat receptor-kinase-like protein *Stb6* controls gene-for-gene resistance to fungal pathogen *Zymoseptoria tritici*. *Nature Genetics*.