Targeted detection of *Zymoseptoria tritici* in wheat

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Global population is expected to increase to 11.2 billion by 2100, increasing food demand by 60%. Additionally, climatic variability is expected to heavily decrease dominant crop production. Overall, highlighting the need to increase current crop yield. 520 million tonnes of wheat are produced annually with 361 million tonnes of that being produced in Europe alone, making wheat a major staple crop globally and in Europe. Pathogens cause substantial yield loss in wheat with the most damaging being *Zymoseptoria tritici* causing an estimated loss of up to 5 tonnes per hectare. Current treatment methods for *Z. tritici* include blanket application of broad spectrum fungicides at key growth stages that is both expensive (costing $1.2 billion annually in Europe) and damaging to the environment. *Z. tritici* is a hemibiotrophic pathogen usually identified through the presence of necrotrophic lesions on leaves however, before visible damage occurs there is a latent asymptomatic phase that lasts 9 -16 days. If *Z. tritici* could be detected early before necrotrophic damage has occurred a reactive targeted fungicide application could be used which would increase yield. I have developed a remote sensing technique based on hyperspectral sensing to detect presence and stage of lifecycle of *Z. tritici*, as well as infer multispectral image data to capture. The multispectral images are processed and analysed with a semi-supervised AI machine learning approach which can detect *Z. tritici* infection with high accuracy. Use of this method in the field could result in reactive targeted application of fungicide which would 1) increase yield through reduced crop loss to infection, 2) reduce the cost of fungicide application 3) reduce damage to the environment through reduced fungicide application and 4) increase profit for a farmer. There is also potential in the future to apply the method to other diseases and crops.

Tuesday | Session 5

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New insights into the infection process of *Fusarium fujikuroi* in rice using a GFP expressing isolate

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Fusarium fujikuroi (teleomorph: *Gibberella fujikuroi*) is the main seed-borne pathogen of rice, causal agent of bakanae, a disease that in the last years has become of increasing economical concern in many Italian rice-growing areas. A virulent *F. fujikuroi* isolate was tagged with the green fluorescent protein (GFP) gene, using *Agrobacterium tumefaciens*-mediated transformation, and the virulence of the GFP isolate has been confirmed. By using the GFP isolate, fungal development during the *F. fujikuroi*/rice interaction was analysed by LASER scanning confocal microscopy (LSCM). The infection of rice roots was investigated from 24 h to 12 days post-inoculation both in resistant and susceptible cultivars. Roots of resistant genotype seem to trigger a hypersensitive response at the infection site and LSCM analysis of root sections allowed the visualisation of fungal growth within host tissues. Gene expression analysis of genes involved in pathogenesis and hypersensitive response is currently under way, by qPCR on the *F. fujikuroi*-infected rice roots. Analysed genes include chitinases, peroxidases and genes involved in gibberellin synthesis. The knowledge of plant infection and colonization mechanisms, together with the host response, will provide useful information for developing better control strategies of the pathogen and for improving breeding programmes for bakanae resistance.

Tuesday | Session 6

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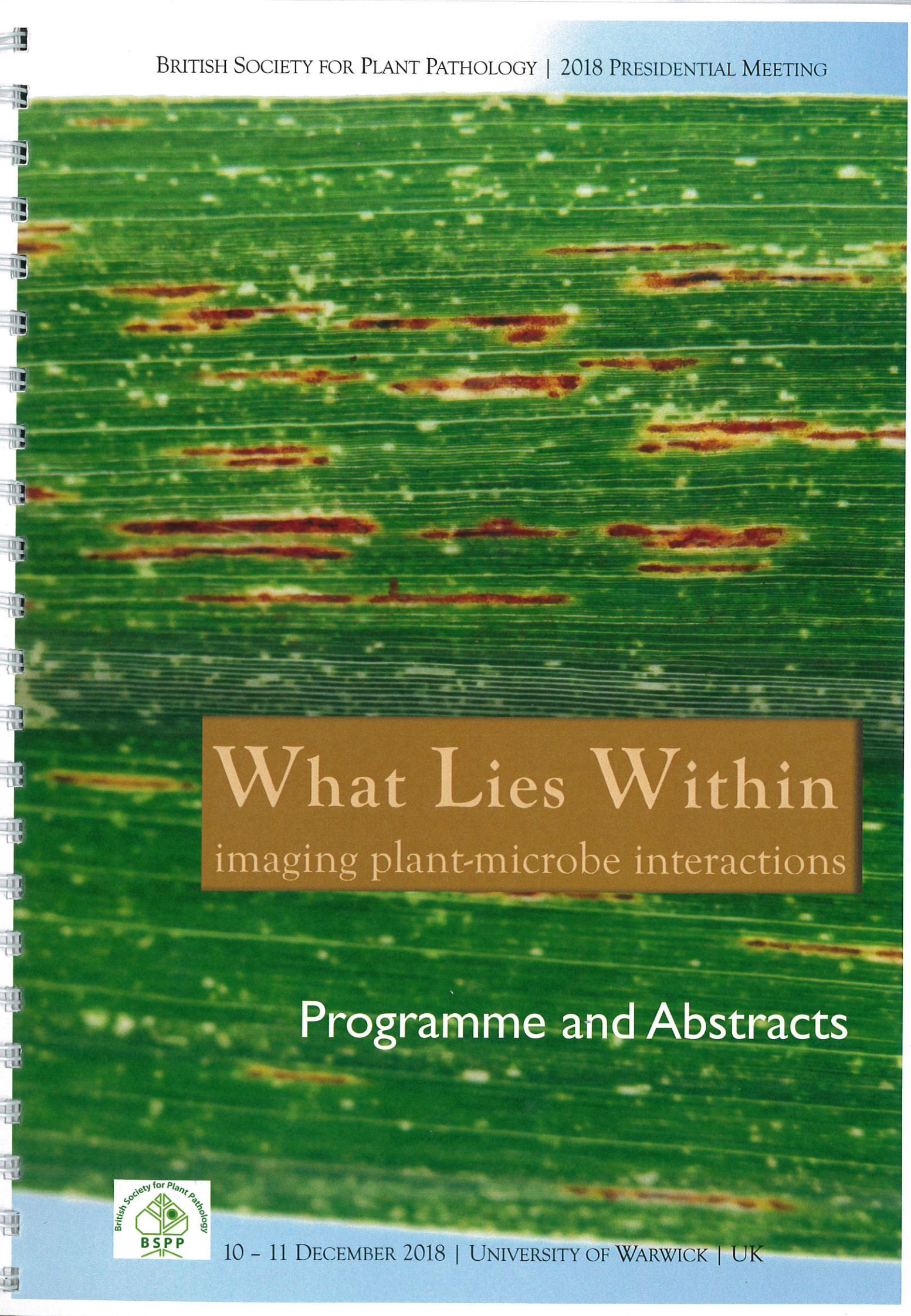

What Lies Within

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