Use of Arabinoxylan Polymers for Plant Defence

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Introduction

Successful control of plant diseases is a key priority in modern agriculture, often involving application of fungicides, often a few times a season, together with the use of resistant varieties.

However, pathogens are genetically adaptable, and they can become insensitive to fungicides and can overcome host resistance. There is a need, therefore, for alternative methods of disease control.

Every plant possesses the ability to defend itself and resistance to pathogen attack can be induced using resistance elicitors, including plant-derived materials.

The current project focuses on use of a plant-derived arabinoxylan polymer suitable for foliar application.

Previous work with this polymer demonstrated significant disease control, and suggested that the polymer formed a physical barrier on the leaf surface, thereby disguising leaf surface characteristics, and it also induced resistance.

This project focuses on barley, a crop of high economic importance, yielding 6.5 million tonnes a year from 1.1 million hectares in the UK alone, and leaf scald (or leaf blotch), caused by *Rhynchosporium secalis,* a major pathogen of barley (Figs 1 and 2). Leaf blotch causes annual yield losses in barley of 1.4% or 900000 tonnes in the UK (worth ~£7M), despite fungicide applications valued at over £25 million.

Here we report the results of a field experiment conducted in 2010 using the polymer on spring barley, as well as results of scanning electron microscopy of the polymer on barley leaf surfaces.

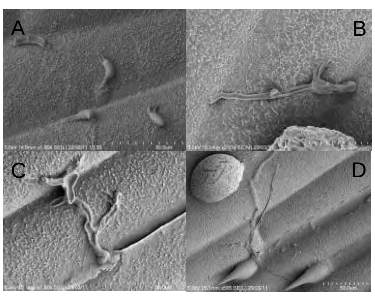


Fig 1 *R. Secalis* infecting barley: A) Germinating spores; B) Germ tube growth; C) Appressorium formation; D) Sub-cuticular growth

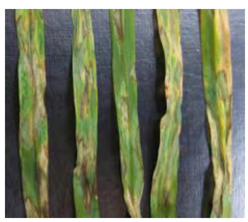
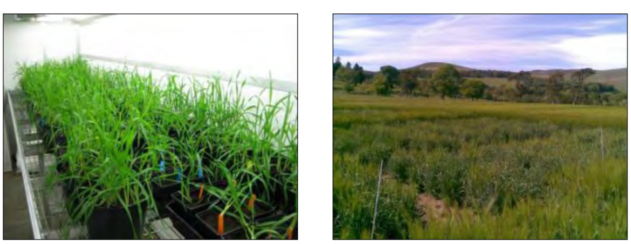


Fig 2 Lesions of *R. secalis* on barley leaves

Methods

- Experiments were carried out both in controlled environments and under field conditions



Experiment set-up in controlled environment (left) and in the field (right)

In the field experiment, treatments were applied in different combinations with known elicitors and/or fungicides. The polymer was applied to the spring barley variety Optic at different stages of crop development:
•GS24 (Polymer 1)
•GS24 + GS31 (Polymer 2)
•GS24 + GS31 + GS39 (Polymer 3)
•GS 31 + GS39 (Polymer 4)

Disease was assessed visually at various times during crop development.

Images of the polymer on the leaf surface were taken using scanning electron microscopy, following treatment of glasshouse-grown barley seedlings with the polymer.

Results

A field trial in 2010 demonstrated significant reductions in powdery mildew (*Blumeria graminis* f. sp. *hordei)* infection (Fig 3). Unfortunately, levels of *R. secalis* were too low to generate meaningful data.

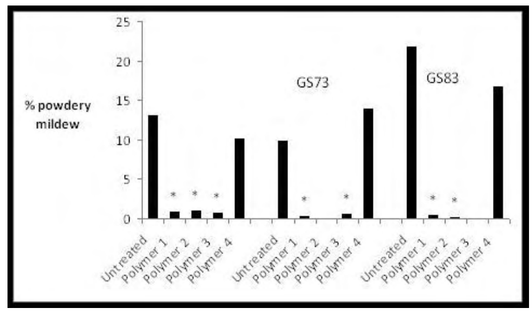


Fig 3 The effects of various polymer treatments on powdery mildew infection on the barley variety Optic in a field trial in 2010.

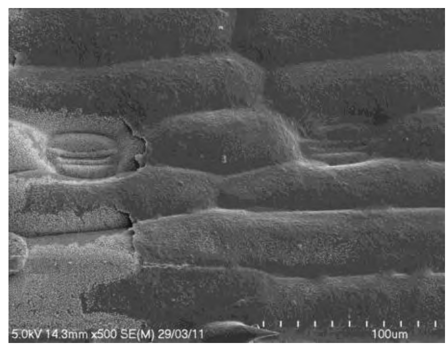


Fig 4 Film layer of arabinoxylan polymer on the surface of barley leaf

Conclusions

- Initial research demonstrated significant reductions in disease severity, including control of *R. secalis,* using the arabinoxylan polymer. In the field, polymer application provides high levels of powdery mildew control
- Confirmation and further characterisation of the resistance-inducing properties of the polymer would benefit agriculture, providing an environmentally-friendly and cost-effective measure of disease control, due to production of the polymer from a readily available and renewable source

References

Shipton, W.A., Boyd, W.J.A., Ali S.M. (1974). “Scald of Barley.” Review of Plant Pathology: 53, 839-61.

Walters, D., Jesson, C., Paterson, L., Fitchett, C. (2008). “Leaf surface coating for the control of pathogens of arable crops.” Proceedings Crop Protection in Northern Britain: 121-126.

Walters, D., Newton, A., Lyon, G. (2005). "Induced resistance: helping plants to help themselves." Biologist 52: 28-33.

Acknowledgements

The project is funded by Grain Research and Development Corporation (GRDC) of Australia.

Grains Research & Development Corporation