Understanding the Barley Leaf Rust Pathogen Is the Key to its Successful Management

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Key Messages

- Barley leaf rust (LR) was observed on barley regrowth in the lower Great Southern and South Coast of WA in the summer/autumn of 2016. This contributed to the first observations of infected barley crops in the region in July 2016. All barley varieties including those with Adult Plant Resistance (APR) were under severe disease pressure and responded to application of fungicide.
- The high levels of LR in 2016 and the possibility of barley regrowth in autumn 2017 means a significant LR risk for the 2017 season and fungicide programs for APR varieties should be considered.
- LR is a social disease and all growers should be proactive in eliminating the volunteer barley green bridge. To minimise early onset of LR, the regrowth barley should be eliminated at least 4 weeks before seeding.
- Star of Bethlehem (an alternate host) should be sprayed to eliminate the likelihood of new pathotype developing in the region.
- Selecting varieties with adult plant resistance genes will reduce grain yield loss. However, performance of these varieties against LR is influenced by seasonal weather, time of disease onset, crop agronomy, and is hard to predict season to season. Depending on the LR pressure in the crop they may need early foliar fungicide intervention to reduce development of disease on plants during the growing season.
- Oxford possess two partial resistance genes (*Rph20* and *Rph24*), and under high LR pressure application of foliar fungicides increased yield up to 64 per cent.

Background and Aims

Leaf rust (LR) caused by fungal pathogen *Puccinia hordei* is an important disease of barley (*Hordeum vulgare*). The potential losses due to LR have been estimated to be A$21 million annually with present losses around A$11 million per annum (Murray and Brennan, 2009) in Western Australia (WA). Growing susceptible varieties on the South Coast of WA can result in yield losses of around 18% to 49% depending on seasonal disease pressure. Also, heavy LR infection can significantly impact grain quality, increasing screenings which is one of the key parameters for determining the malt or feed grade.

The annual recurrence of LR in South Coast crops is mainly due to the abundance of susceptible varieties and retention of summer regrowth for stock feed. As LR can only survive in living plants, summer rains can encourage the regrowth of barley which in turn can harbour the pathogen and contribute to the reinfection of new crops.

Until 2015, Leaf rust has been managed by the use of resistant varieties in conjunction with the application of foliar fungicides. The use of varieties with major gene (*Rph3*) to manage risk has been ineffective from 2013, due to detection of a virulent pathotype (5457P-) in the southern region of WA. At present, 5457P- is widely distributed across barley growing areas WA and has become the dominant pathotype.

The weed species *Ornithogalum umbellatum* (commonly called “Star of Bethlehem”) is an alternate host for LR and supports the sexual cycle of the fungus. This alternate host was detected in 2013 near Ravensthorpe, on the South Coast of WA. While this detection is thought to have been eradicated, the risk of further outbreaks and potential extent of distribution of this alternate host at present is not known.

The expression of Adult Plant Resistance (APR) in a variety varies from tillering (Z20) to full head emergence growth stage (Z59) and is primarily influenced by temperature and other environmental and plant growth factors (R. Park, pers. comm.). In the 2016 season, considerable concern was raised among growers and agronomists as to the level of LR that was present in some varieties carrying APR and questions regarding the use of fungicide raised.

The aim of this paper is to present research information available on role of foliar fungicide mixtures with new chemistry against barley LR in a variety with known APR.

Materials and Method

Fungicide Efficacy Studies

An experiment was conducted in 2016, near Wellstead (Latitude -34.456838° and Longitude 118.433749°). Barley variety Oxford was sown at 75kg/ha on 22 May using a farmer’s air seeder. Seed treated with and without seed dressing fungicide Systiva® @ 150mL/100kg seed was sown as alternate strips onto 2015 Oxford stubble. The strips were 13m wide and 50m long and subsequently pegged to create 13m by 10m plots for foliar fungicide spraying. The trial design was strip plot with 4 replications.

Foliar fungicides were applied across the plots with and without the seed dressing Systiva®. Registered and unregistered foliar fungicide formulations (mixtures with different actives) were used. Except for Prosaro® all other fungicide mixtures containing products listed in Table 1 were applied at Z35. Prosaro® was applied to all the plots except for untreated plots as a second spray at Z65. For complete disease control (yield comparison) three fungicides were used on the following sequence Radial® at Z25, Tilt® at Z35 and Prosaro® at Z65.

The application timings and rates are shown in Table 1. The percentage leaf area affected by disease on all open leaves was recorded at bi weekly intervals. GenStat 16th Edition was used to analyse the data. To reduce the variance in the % leaf area diseased, the data was analysed after angular transformation. Plots were machine harvested for grain yield.

Table 1: Foliar fungicide mixtures, active ingredients, rates used and growth stage at application at Gnowellen, 2016

Fungicide	Active constituents	Rate (mL/ha)	Growth stage (Zadok's)
Radial®	75g/L azoxystrobin and 75g/L epoxiconazole	420	25, 35
Prosaro® 420SC	210g/L prothiconazole and 210g/L tebuconazole	150	65
Tilt® 250EC	250g/L propiconazole	500	35
Product 1	75g/L bixafen and 150g/L prothioconazole	500	35
Product 2	41.6g/L epoxiconazole and 66.6g/L pyraclostrobin and 41.5g/L fluxapyroxad	750	35

Results and Discussion

Fungicide Efficacy Studies

The LR pressure was high at the trial site. Disease was first evident at Z22 in low levels in untreated plots. LR severity assessment at early ear emergence (Z53) on open top three leaves revealed that there was no difference between seed dressing with Systiva (2.7%) treatment and untreated (3.1%) (data not shown).

The fungicide efficacy study shows the combination of the fungicides mixtures on disease severity and yield (Table 2). These products tested were effective in reducing LR severity (Table 2). The average LR severity on top three leaves (Flag to Flag-2) varied from 9% (Product 2) to 45% (untreated) among the treatments at milk development stage (Z72). Furthermore, in untreated plots the LR severity on top three individual leaves (Flag, Flag-1 and Flag-2) were 14%, 46% and 90% respectively (data not shown).

All foliar fungicides reduced LR severity by over 67% compared to untreated. Treatments 3 and 4 (with Products 1 and 2) gave greater control to LR than the other two treatments (Radial® followed by Prosaro® or Radial® followed by Tilt® and Prosaro®) but did not differ from each other. There was no difference between the disease severities in Treatment 2 (Radial® followed by Prosaro®) or Treatment 5 (Radial® followed by Tilt® then Prosaro®).

Table 2. Effects of fungicide foliar sprays on leaf rust severity and grain yield in Oxford barley at Gnowellen, 2016.

No	Foliar Treatments	Disease Severity on Z75 (18 Oct) *ang(avF to avF-2)	Yield (t/ha)	% yield increase over nil
1	Nil (untreated)	45a♣	1.6a	-
2	Radial at Z35 & ♣Prosaro at Z65	15b	2.2b	38
3	Product 1 at Z35 & Prosaro at Z65	10c	2.6b	64
4	Product 2 at Z35 & Prosaro at Z65	9c	2.4b	52
5	Radial at Z25 +Tilt at Z35 + Prosaro at Z65	14b	2.4b	54
		<0.001	<0.006	
	lsd(5%)	2.6	0.49	

Conclusion

Oxford barley is purported to possess several rust resistance genes (*Rph3*, *Rph20* and *Rph24*) and in the DAFWA 2017 Barley variety guide is categorised as susceptible (S) as a seedling and resistant (R) as an adult plant. In March 2016, Oxford barley regrowth with heavy infection of LR was observed in South Stirling area. Pathotype testing by Plant Breeding Institute at the University of Sydney revealed the pathotype present was 5457P-.

This observation was further confirmed during the 2016 cropping season, indicating that in at least some situations, Oxford is vulnerable to heavy infection by *P. hordei*. This could either be because early onset of infection in susceptible seedlings impacts APR expression or that the slow rusting genes *Rph20* and *Rph24* do not provide adequate protection in the South Stirling environment.

This trial reinforces earlier DAFWA findings that varieties containing APR genes will still benefit from well-timed foliar fungicide application when disease pressure is very high. Application of foliar fungicide mixtures containing different actives reduced disease severity and increased the grain yield. Two unregistered products tested against LR were promising compared to current existing registered foliar fungicide products.

Previous DAFWA trials have demonstrated the value of improved resistance for slowing LR development and limiting yield losses (Jayasena et al 2015). However, in the highly favourable environment of WA particularly in the lower Great Southern and South Coastal areas where LR can be present from as early as stem extension, APR varieties such as Oxford or Flinders can benefit from a programmed foliar fungicide approach.

Key words

Barley, Leaf Rust, Alternate Host, Fungicide.

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