Fungicides at seeding for management of cereal foliar diseases: powdery mildew in wheat

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Key messages

- Systemic seed dressing or in-furrow fungicides are applied preventatively (prophylactically) to address potential disease risk. They can delay onset, reduce severity or eliminate occurrence of disease often resulting in significant yield responses. In the absence of disease however, they are unlikely to provide yield or economic benefit.
- In four field experiments in at-risk environments in 2016, wheat powdery mildew was evident at three sites and reached yield limiting severity at one site.
- At two sites where powdery mildew infection commenced during stem elongation, seed dressings containing fluquinconazole, triadimenol or fluxapyroxad and in-furrow products containing flutriafol, triadimefon or azoxystrobin had significant impact on disease severity and incidence. Product differences were evident between sites.
- At the one site where powdery mildew was yield limiting, in-furrow and foliar fungicide treatments gave a significant yield response in a susceptible wheat variety.
- In three of four sites where disease severity was not yield limiting, neither foliar, seed dressing or in-furrow fungicides provided a yield response and would not have given positive return on investment.

Background and Aims

Powdery mildew (PM) has become more prevalent in WA wheat crops in recent years and was particularly widespread and damaging in several regions in 2015. A major concern for wheat producers is the susceptibility of several popular varieties, the time of onset of disease requiring early intervention in the cropping season and subsequent concerns over requirements for multiple foliar applications. Trial results from 2015 (Beard et al, 2016) clearly indicate that foliar fungicides can provide effective disease control and subsequent economic returns through reducing yield loss. Anecdotal reports from 2015 indicated that some systemic seed and fertiliser applied fungicides, registered in wheat for a range of fungal diseases, were delaying the onset of wheat powdery mildew. This paper describes results from trials at a range of locations, investigating the efficacy of seed dressing and fertiliser applied fungicides on the time of onset, rate of development and yield impact of wheat powdery mildew.

Method

Field trials established at five sites in 2016 were designed to evaluate the efficacy of seed, fertiliser and foliar applied fungicide on the severity and yield impact of wheat foliar diseases including PM. Sites were established with susceptible varieties at: Geraldton (Wyalkatchem⦹), Dalwallinu (Corack⦹), Moora (Corack⦹), Tambellup (Mace⦹) and Gibson (Sceptre⦹). The Gibson site was abandoned due to waterlogging. Dalwallinu, Tambellup and Moora sites were established on canola or lupin stubbles while the Geraldton site was established on wheat stubble from a PM infected crop in 2015. All sites were sown into moist soil between 4th and 11th May.
Fungicide products reported in this paper include; seed dressings fluxapyroxad (Systiva® 150mL/100kg seed), triadimenol (Baytan T® 150mL/100kg seed), fluquinconazole (Jockey Stayer® 450mL/100kg seed); in-furrow coated on granular fertiliser flutriafol (Flutriafol 250® 400mL/ha), azoxystrobin + metalaxyl-M (Uniform® 400mL/ha), triadimefon (Triadimefon 500 Dry® 200g/ha), and foliar propiconazole (Tilt® 250EC 250-500mL/ha) and prothioconazole + tebuconazole (Prosaro® 420SC 150-300mL/ha) applied at Z30-31, Z39-45 or Z55, with appropriate water rates and adjuvants as per label recommendations.

Disease severity was assessed regularly through the growing season by estimating leaf area affected by foliar disease symptoms on the top three or four fully expanded leaves of at least ten randomly selected plants per plot. Where multiple diseases were present, area affected was assigned to each disease. Where disease was present on stems or heads, incidence and severity of symptoms were recorded. Yield was determined by machine harvest and grain quality parameters assessed, including hectolitre weight, thousand grain weight, protein and screenings (2.0mm screen).

Disease severity and yield responses were analysed by ANOVA. Spatial trends were evident in responses at the Geraldton site and REML analysis was carried out for this site.

Results

Triadimenol seed treatment significantly reduced seedling establishment by 14-26% across all sites. Powdery mildew occurred at three of four sites, however despite all sites using varieties that were susceptible to this disease, Geraldton was the only location at which infection was severe enough to cause yield loss.

Geraldton: Seed dressing, in-furrow or foliar fungicides were applied as stand-alone treatments and due to limitations of experimental space multiple application treatments were not included. Powdery mildew was evident in untreated plots in early July (~Z31/32), approximately nine weeks after sowing and one week after first foliar application. At this time the average severity of foliar disease infection across the top 4 leaves was 0.6% PM and 2.4% yellow spot. Powdery mildew developed rapidly and all treatments significantly reduced disease incidence and severity (Figure 1). Powdery mildew infection rapidly diminished from the beginning of September while septoria nodorum blotch became evident at low severity on upper canopy leaves and some glumes.

Spatial analysis (using REML) revealed significant treatment yield responses (Table 2) and ANOVA revealed significant grain quality responses to fungicide treatments (data not presented). Yield responses greater than 13% (0.6t/ha) were significant, effective treatments included all foliar fungicide timings and fertiliser applied flutriafol and azoxystrobin.

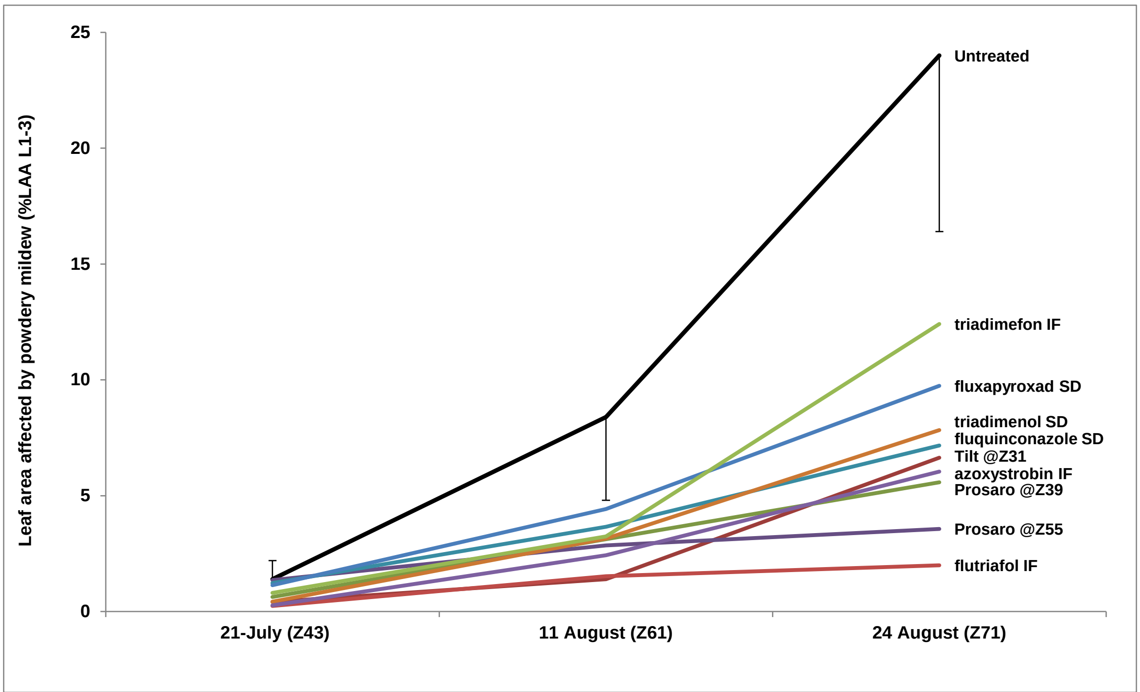

Figure 1. Effect of seed (SD), fertiliser (IF) and foliar applied fungicides on powdery mildew disease progress (average % leaf area diseased by powdery mildew on top 3 leaves) on Wyalkatchem⁽ᵗ⁾ wheat at Geraldton. Mildew first detected in early July at Z31/32 (Bar=Lsd at each assessment time).

Dalwallinu: Powdery mildew became apparent on 7th July (~Z30), approximately nine weeks after sowing. Infection incidence increased slowly for six weeks reaching 90% of plants affected but at a severity of less than 5% average leaf area affected (top 3 leaves). Fluquinconazole and triadimenol seed dressings and flutriafol in-furrow application delayed the development and spread of PM (Table 1). Prosaro® foliar fungicide applied at stem extension (Z30) as disease became apparent also significantly delayed development of infection. PM incidence and severity diminished rapidly by flowering and there was no disease response to the foliar fungicide applied at booting.

Flag smut, arising from soil borne inoculum, occurred in 0.8% of plants in untreated control plots. Seed treatment (fluxapyroxad, triadimenol, fluquinconazole) completely controlled infection (0%) and in-furrow fungicides reduced flag smut incidence (flutriafol 0.2%, Triadimefon 0.2%, azoxystrobin 0.6%), but not as successfully as seed dressings. Foliar application of Prosaro® had no effect on flag smut incidence (0.8%).

In the absence of yield limiting levels of powdery mildew or other foliar diseases, neither seed dressing, in-furrow nor foliar applied fungicides had an impact on grain yield or quality at Dalwallinu (Table 2).

Table 1: Effect of fungicide treatments on incidence of powdery mildew in Corack wheat at Dalwallinu in 2016. Mildew first detected at trace levels on 7^{th} July (~Z30).

Fungicide treatment	Incidence of powdery mildew (% plants affected)		
	21-Jul Z37	4-Aug Z45	17-Aug Z55
Untreated	70	77	90
Fluquinconazole (SD)	25	51	67
Fluxapyroxad (SD)	70	69	77
Triadimenol (SD)	10	40	60
Flutriafol (IF)	5	51	53
Triadimefon (IF)	25	47	73
Azoxystrobin+metalaxyl (IF)	65	80	65
Prosaro® 150ml -Z30	5	38	47
Prosaro® 150mL –Z45	-	-	47
p-value	0.063	0.012	0.002
Lsd (5%)	51	23	19

Note: SD = seed dressing, IF = coated on fertiliser applied in-furrow

Moora: Powdery mildew became apparent at trace levels at booting (~Z45), however disease development was slow and average severity in untreated controls was <1% leaf area affected, with infection primarily restricted to Flag-2. At-seeding and Z31 treatments had minimal effect on either incidence or severity of PM infection at any stage. Approximately 10% of untreated control plants had some level of head infection, Prosaro® applied at Z39 was the only treatment to significantly influence incidence of head infection.

Septoria nodorum blotch was present at low levels throughout the season, assessments at ~Z55 showed a small but significant effect of both foliar treatments and flutriafol and triadimefon in-furrow on necrotic leaf area. With late onset of PM and low severity of septoria nodorum blotch, yield and grain quality were not significantly improved by fungicide treatments (Table 2). This was the only site at which reduced emergence in triadimenol treated plots resulted in a negative yield response (-15%).

Tambellup: Powdery mildew did not occur at this site. In the absence of any significant foliar fungal disease infection, there was no difference in green leaf area retention and no subsequent yield impacts (Table 2).

Table 2: Effect of seed dressing, in-furrow and foliar applied fungicides on yield of wheat at Geraldton (Wyalkatchem), Dalwallinu (Corack), Moora (Corack) and Tambellup (Mace) in 2016.

Fungicide	Grain yield (t/ha)			
	Geraldton$^{\#}$	Dalwallinu	Moora	Tambellup
Untreated	4.6 (100)	2.7	4.5	5.0
Fluquinconazole (SD)	5.2 (113)	2.8	4.4	5.0
Fluxapyroxad (SD)	5.2 (113)	2.8	4.4	4.8
Triadimenol (SD)	5.2 (113)	2.6	3.8	5.0
Flutriafol (IF)	5.8 (126)	2.7	4.8	5.0
Triadimefon (IF)	5.2 (113)	2.7	4.6	4.8
Azoxystrobin+metalaxyl (IF)	5.3 (115)	2.8	4.6	4.7
Tilt® or Prosaro® @Z30/31*	5.4 (117)	2.6	4.4	4.9
Prosaro® @Z39/45	5.5 (120)	2.7	4.5	4.9
Prosaro® @Z55	6.0 (130)	-	-	-
p-value	*	ns	0.009	ns
Lsd (5%)	0.7	0.21	0.38	0.46

Note: SD = seed dressing, IF = coated on fertiliser applied in-furrow
* Tilt 250EC® at Geraldton, Prosaro® at Dalwallinu, Moora, Tambellup
$^{\#}$ Yield as % of Untreated control

Conclusion

A range of seed dressing and in-furrow products are registered in wheat for diseases including smuts and bunts, rhizoctonia root rot, wheat rusts, yellow spot and septoria tritici but none are currently registered for powdery mildew. All products tested in these trials are registered for use in wheat and there is great interest to see how they influence powdery mildew development. These products are currently used prophylactically to address a wide range of disease risks. When disease occurs they can delay disease onset and reduce or eliminate the need for foliar applications but with low disease severity they are unlikely to provide yield benefit. The benefit of systemic fungicides applied at seeding is through the fungicide being available in newly emerging leaves, providing a continuous source of protection. The length of protection varies between products, rates and diseases encountered.

All products tested reduced incidence and severity of PM at the Geraldton site resulting in at least 0.6t/ha yield response. At this site with disease occurring during stem extension and conditions favouring disease development, the at-seeding treatments provided similar benefit as foliar applications at Z31 or Z39. Greater response may have been evident if at-seeding treatments had been followed by foliar applications.

Similarly at Dalwallinu where PM occurred during stem extension, at-seeding treatments and a foliar application at Z30 delayed development of disease, however at this site environmental conditions were not conducive for continuing disease development, disease severity was low and the epidemic diminished naturally by flowering.

At two of four sites, at-seeding fungicides were demonstrated to have a significant effect on PM development and at only one of four sites was a significant yield response measured. Consequently at only one site, Geraldton, was there a positive return on investment from fungicides applied at-seeding. However at the Dalwallinu site, some of the treatments applied at-seeding provided a delay of disease development until at least flag leaf emergence which may have prompted a decision to not apply a foliar fungicide at this time, potentially saving an in-season investment.

Differences between products were apparent both in disease limitation and in subsequent yield response. Yield in all fungicide treatments at Geraldton was at least 13% greater than the untreated, with flutriafol and azoxystrobin+metalaxyl applied in-furrow providing significant yield responses while also providing lasting protection from disease. At Dalwallinu, flutriafol in-furrow and triadimenol and fluquinconazole seed dressing provided greatest delay in disease build-up.

Some care and awareness of risks associated with fungicide resistance should be employed in utilisation of these products, particularly for powdery mildew. Despite being applied prior to crop growth, seed dressing and in-furrow fungicides are the first application in a seasonal fungicide program and therefore subsequent foliar fungicide choice and fungicide group rotation needs to account for the active ingredient used.

The seed dressing and in-furrow fungicide ingredients applied in these trials can delay or reduce PM infection at the rates tested. Where PM infection becomes severe they can provide a yield response, particularly if disease occurs at early growth stages such as during stem extension. In the absence of diseases that are affected by these products, or when infection is not severe then yield responses and positive return on investment may not occur.

Key words

Wheat, seed dressing fungicide, In-furrow fungicide, powdery mildew

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Fungicides at seeding for management of cereal foliar diseases: Spot type net blotch (STNB) in barley

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Key messages

- Registered systemic fungicides applied to seed, Systiva® (fluxapyroxad) or in-furrow on fertiliser Uniform® (azoxystrobin + metalaxyl-M), can provide significant reductions in development and severity of spot type net blotch (STNB) in barley.
- Yield response from single applications or combinations of at-seeding (Systiva, Uniform) or foliar (propiconazole, Prosaro®) fungicides ranged from 0-24% in six trials conducted in 2015 and 2016. Responses in the majority of trials were less than 10%. Greatest responses occurred when yields were more than 3t/ha.
- Yield response to Systiva seed treatment varied from 0-15% in five trials.
- Foliar fungicide applications before stem extension provide disease control but need additional follow up application for continued control and yield response.
- Systiva seed dressing can provide protection past head emergence from STNB and other necrotrophic diseases such as net type net blotch and scald.

Aims and background

Spot type net blotch (STNB) is a major disease of barley in Western Australia. This is primarily due to the predominance of susceptible varieties and increased exposure of crops to retained stubble, particularly with increasing area of continuous barley cropping. A range of foliar fungicide options are available for management of STNB and these are utilised widely in barley crops in WA. Recently both seed dressing (Systiva) and in-furrow (Uniform) fungicide options have also been registered for barley.

Foliar fungicides have been shown to provide significant reduction in severity of STNB infection and yield responses from reduced disease have also been demonstrated (Jayasena et al, 2002). However, yield impacts from STNB can be variable, dependent particularly on seasonal rainfall, and an economic response from fungicide management of STNB is not guaranteed (Hills et al, 2016).

During the 2015 and 2016 seasons a series of experimental field trials were carried out with foliar, seed dressing and in-furrow applied fungicides to determine the efficacy of these approaches in reducing STNB severity and providing a significant yield response in susceptible barley varieties sown onto barley stubble.

Method

Field trials established in 2015 and 2016 were designed to evaluate the efficacy of seed, in-furrow and foliar applied fungicide on the severity and yield impact of spot type net blotch (STNB) in barley. STNB susceptible varieties were sown with into STNB infected barley stubble at six locations: Coomalbidgup (Scope CLⓓ), Gibson (Hindmarshⓓ, La Trobeⓓ), Arthur River (Hindmarshⓓ, Bassⓓ) and Nukarni (Hindmarshⓓ, Scope CLⓓ) in 2015 and Grass Patch (Rosalindⓓ, La Trobeⓓ) and Nukarni (Scope CLⓓ, Spartacus CLⓓ) in 2016. Seeding and foliar treatments were included at all sites except Coomalbidgup, where only foliar fungicides were used.

Fungicide products reported in this paper include: Systiva® seed dressing (fluxapyroxad, 150mL/100kg seed); Uniform® coated on granular fertiliser in-furrow (azoxystrobin+Metalaxyl-M, 400mL/ha) and foliar sprays Prosaro® (prothioconazole+tebuconazole, 150mL/ha), propiconazole products (250g ai/L) (propiconazole, 250-500mL/ha), and Bayer product (prothioconazole+bixafen, 300mL/ha) applied at three timings (T1 = Z22-25, T2 = Z30-31, T3 = Z39-45) with appropriate water rates and adjuvants as per label recommendations. To avoid complications from smut diseases or rhizoctonia root rot, all untreated control seed was treated with Vibrance® (180mL/100kg seed), this fungicide is not registered or recommended for STNB control.

Disease severity was assessed by estimating leaf area affected by STNB symptoms on the top three or four fully expanded leaves of at least ten randomly selected plants per plot regularly through the growing season. Yield was assessed by machine harvest and grain quality parameters including hectolitre weight, thousand grain weight and screenings (% <2.2mm screen). At Grass Patch in 2016, herbicide drift damaged several plots in Rep 1, affecting significance of yield responses.

Results

At all sites STNB was the dominant disease and was apparent from seedling–tillering stage. At sites where two varieties were tested there was negligible difference between variety responses and averaged results are presented.

At all sites, Systiva seed dressing provided significant reduction of STNB severity up to flowering-grainfill growth stages. Combinations of Systiva seed dressing or Uniform in-furrow with foliar application at flag leaf–booting growth stage (T3 timing) provided similar protection (Table 1).

All double spray foliar fungicide treatments provided significant disease reduction up to grain fill. Single applications at stem extension ~Z30-31 (T2) provided lasting protection but were significantly less effective than double spray treatments that included that timing (Table 1). A single foliar application at early tillering ~Z22 (T1) at Coomalbidgup (Table 3) did not provide long term protection but inclusion of the tillering timing (T1) in two spray programs was effective (Table1, 3).

Yield responses to fungicide treatment varied between sites. At Gibson in 2015, with an untreated yield of 4.3t/ha, responses of >0.6t/ha (15-24%) occurred in all treatments including 15% response to Systiva as a stand-alone treatment (Table 2). At Coomalbidgup with untreated yield of 4.0t/ha, multiple spray treatments resulted in significant yield responses (9-11%) but the single early tillering (Z22, T1) foliar fungicide application did not (Table 3), reflecting poor long term disease control.

Despite significant reduction in STNB, treatment yield responses did not necessarily follow suit at other sites when spring rainfall was low. Responses ranged from 0-400kg/ha, with the majority being between 50-200kg/ha (2-6%). At both Grasspatch in 2015 (11%) and Nukarni in 2016 (6%), Systiva seed treatment plus foliar fungicide at Z39-45 (T3) resulted in greatest yield response (Table 2).

Grain quality differences were evident where yield responses were significant and even in some cases where they were not. At Nukarni (2015), screenings were reduced (from >33% to 18-25%) in Scope CL® by all multiple fungicide application treatments despite the lack of yield impact (data not presented).

Inclusion of Systiva treated Litmus® barley in inoculated small plot disease nurseries at South Perth and Medina indicates that fluxapyroxad has long term impact on a range of diseases, as indicated on the product label. Severity of the necrotrophic diseases, spot and net type net blotch and scald were significantly lower in treated plots compared to untreated controls when assessed at flowering (data not presented).

Table 1. Effect of seed, in-furrow and foliar applied fungicides on severity of spot type net blotch (average % leaf area diseased of Flag-1 to Flag-3) in barley at five field sites (average response across varieties at each site) in 2015 and 2016. Coomalbidgup data presented in Table 3.

Fungicide treatment and timing[#]	Gibson	Arthur River	Nukarni	Grass Patch	Nukarni
	2015	2015	2015	2016	2016
	Z65	Z65	Z72	Z65	Z72
Untreated control	15.9	3.1	21.6	22.5	11.7
Systiva SD*	2.7	1.7	11.9	9.3	3.3
Foliar T2			15.4	12.4	8.1
Foliar T3				14.2	2.8
Systiva SD + Foliar T3[b]	1.3	1.7	8.8	8.2	2.2
Uniform IF* + Foliar T3				9.2	1.5
Foliar T1 + Foliar T3			9.5	11.0	2.1
Foliar T2 + Foliar T3[a]	3.7	2.7	8.5	9.7	3.0
Foliar T2 + Foliar T3[b]	1.9	1.7			
Foliar T2 + Foliar T3[c]	0.1	1.6			
p-value	<0.001	<.001	<0.001	<.001	<0.001
Lsd (5%)	4.7	1.0	3.1	1.9	3.7

* SD = Systiva seed dressing (150mL/100kg), IF = Uniform in-furrow (400mL/ha)
[#] Fungicide timing all sites: T1 = ~Z25, T2 = Z30-31, T3 = Z39-45
[#] Fungicide treatments at each site:
Gibson & Arthur River 2015 T2 & T3 = a: propiconazole (250mL/ha), b: Prosaro (150mL/ha), c: Bayer product (300mL/ha)
Nukarni, 2015 T1 & T3 = Prosaro (150mL/ha), T2 = propiconazole (250mL/ha)
Grass Patch, 2016 T1 & T2 = propiconazole (250mL/ha), T3= Prosaro (150mL/ha)
Nukarni, 2016 T1, T2, T3 = propiconazole (500mL/ha)

Table 2. Effect of seed, in-furrow and foliar applied fungicides on grain yield (t/ha) of spot type net blotch infected barley at five field sites (average response across varieties at each site) in 2015 and 2016. Coomalbidgup data presented in Table 3.

Fungicide treatment and timing[#]	Gibson 2015		Nukarni 2015		Arthur River 2015		Grass Patch 2016		Nukarni 2016	
	(t/ha)	% of Nil	(t/ha)	% of Nil	(t/ha)	% of Nil	(t/ha)	% of Nil	(t/ha)	% of Nil
Untreated control	4.31		2.80		2.46		3.75		2.56	
Systiva SD*	4.93	115%	2.79	99%	2.52	103%	3.90	104%	2.62	102%
Foliar T2			2.92	104%			3.95	105%	2.61	102%
Foliar T3							3.92	105%	2.64	103%
Systiva SD + Foliar T3[b]	4.99[a]	116%	2.62	94%	2.46	100%	4.16	111%	2.73	106%
Uniform IF* + Foliar T3							3.93	105%	2.68	105%
Foliar T1 + Foliar T3			3.00	107%			4.09	109%	2.62	102%
Foliar T2 + Foliar T3	5.11[a]	119%	2.96	106%	2.50	102%	3.87	103%	2.65	104%
Foliar T2 + Foliar T3	5.17[b]	120%			2.37	96%				
Foliar T2 + Foliar T3	5.34[c]	124%			2.65	108%				
p-value	<0.001		0.128		0.354		0.160		0.078	
Lsd (5%)	0.237	6%	0.295	11%	0.266	11%	0.280	7%	0.098	4%

* SD = Systiva seed dressing (150mL/100kg), IF = Uniform in-furrow (400mL/ha)
[#] Fungicide treatments and timings as per footnote in Table 1

Table 3. Effect of timing of foliar applied fungicide (Prosaro 420 SC) on spot type net blotch severity (average % leaf area diseased of Flag-1 to Flag-3) and grain yield (t/ha) of Hindmarsh barley at Coomalbidgup in 2015.

Fungicide timing[#]	Leaf area diseased (average % F-1:F-3) Z65	Grain yield (t/ha)	Relative yield (% Nil)
Untreated control	10.2[a]	4.02[b]	100%
Foliar T1	11.7[a]	3.97[b]	99%
Foliar T1 & T2	5.7[b]	4.40[a]	109%
Foliar T1, T2 & T3	3.6[b]	4.47[a]	111%
p-value	<.001	0.017	0.015
Lsd (5%)	2.2	0.33	8%

[#] T1 = Z22, T2 = Z31, T3 = Z42

Conclusion

The recent registration of seed dressing and in-furrow products for STNB control has provided new management options for this disease in barley crops, particularly those sown on barley stubble. Both Systiva (fluxapyroxad) as a seed dressing and Uniform (azoxystrobin + metalaxyl) as an in-furrow treatment significantly reduce progress of STNB in susceptible varieties sown into infested stubble. In the trials reported here, the period of protection they provided was evident until at least flag leaf-booting stage (Z39-45) and for Systiva until flowering-grain fill (Z65-75).

Systiva seed treatment gave longer period of disease control than foliar sprays applied prior to stem extension. At Coomalbidgup, application during early tillering (Z22) gave short term reduction of disease severity but this was not enough protection to contribute to yield responses without follow up foliar fungicide application. Where early, sustained disease control is required, seeding fungicides are likely to be more effective.

Yield responses to fungicide application are not guaranteed despite significant reductions in STNB severity (Hills et al 2016). Under high disease pressure and with good spring rainfall supporting yield potential, responses of greater than 0.6t/ha (>15%) were measured, including from Systiva seed dressing without foliar fungicide support. However, in other trials yield responses were typically <10% (<250kg/ha) with associated grain quality improvements (screenings) in Scope CL⏀ at Nukarni and Comalbidgup. Economic benefits are more likely where disease pressure is high and seasonal conditions, particularly spring rainfall, favour higher yield potential.

Use of either Systiva seed dressing or Uniform in-furrow can significantly reduce STNB severity in barley crops. Disease protection from Systiva alone resulted in significant yield response in one trial and when supported by foliar application at flag leaf-booting growth stage (Z33-45) significant yield response to seeding treatment was as likely as from a multiple spray approach.

Some care should be employed in utilisation of these products, both in regularity of use of individual products between seasons and with choice of foliar fungicide groups to follow within season. Despite being applied prior to crop growth, they are the first application in a fungicide program and, as such, subsequent foliar fungicide choice and fungicide group rotation needs to account for the ingredient used (eg. DMI – triadimenol, fluquinconazole, SDHI – fluxapyroxad, QoI – azoxystrobin). Utilisation of the same product in repeated years without the use of an alternative foliar fungicide group for support constitutes a risk for resistance developing. Rotation of at-seeding product groups and foliar fungicide groups, and including other integrated management options (especially avoiding barley on barley rotations), should reduce risks associated with fungicide resistance.

Inclusion of Systiva seed dressing (fluxapyroxad) or Uniform in-furrow (azoxystrobin + metalaxyl) can be an effective approach for management of barley diseases, particularly stubble borne diseases like STNB. Utilisation in the second year of a continuous barley rotation could provide a significant benefit. They are an effective addition to an integrated approach including variety choice, crop rotation, stubble management and foliar fungicide application.

Key words

Barley, seed dressing fungicide, In-furrow fungicide, Spot type net blotch, fluxapyroxad, azoxystrobin

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