Control of loose smut, spot form net blotch, powdery mildew and leaf rust through soil and foliar fungicides in Bass barley

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AIM

- Evaluate early foliar disease suppression of soil applied fungicides.
- Compare early soil disease control to a foliar only strategy.
- Compare efficacy of different foliar fungicides on yield at a ~Z31 and Z39 applications.
- Comparison of seed treatment and Aviator® Xpro™ foliar for SFNB.

TRIAL SITE

Location: Dandaragan
Soil Type: Sandy loam
Soil Test Results: Predicta B sample taken from the site indicated a medium risk of rhizoctonia
Rotation: 2014 Canola

BACKGROUND SUMMARY

- SFNB is currently a weakness in the disease tolerance of many newly released varieties and is a stubble borne disease making tight rotations problematic and conducive to high levels of infection.
- Delayed plant emergence on a crusting soil type can cause establishment issues. The SDHI class active ingredient in EverGol® Prime “penflufen” does not impact emergence like triazole fungicides.
- The use of seed treatments for early foliar disease suppression can be useful to buy time for an early foliar application in a wet year with stubble borne diseases like yellow leaf spot but may not provide as much benefit in a dry start. This trial aims to establish the best strategy.
- Foliar fungicides provide the best return on investment when applied from around Z30 to Z39 when applied proactively to protect the yield producing top 3 leaves including the flag.
- Aviator Xpro is anticipated to be registered for use in the 2017 season and contains the high performing triazole prothioconazole + bixafen the first registered SDHI for foliar application.

TRIAL DESIGN

Date Sown: 25th May 2015
Variety: Bass barley
Seeding Rate: 80kg/ha
Nutrition Pre: 80kg/ha Gusto Gold, 40kg/ha Urea top-dressed + 60L/ha UAN banded
Tillage Type: Knife points and press wheels on 25.4cm row spacing
Plots size and replication: 2.5 m x 12 m x 3 replications

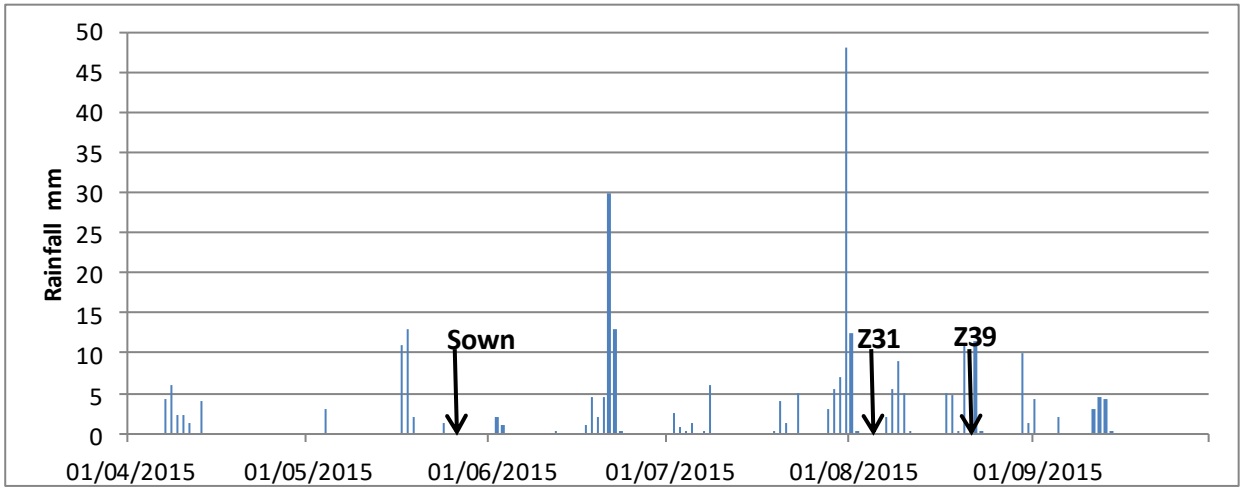
Herbicides Applied
Pre-emergent: 2L/ha Sprayseed + 2.5L/ha Boxer Gold+ 75g/ha Metribuzin
Post-emergent: 1 L/ha Velocity + Hasten 1 %

Insecticides: 1L/ha Chlorpyrifos + 200mL/ha bifenthrin at sowing
Fungicides as per protocol applied at 100 L/ha using LD11002DG nozzles at 2 bar
Application C: Z31/32 4/8/15, Application D: Z39 20/8/15

SITE COMMENTS

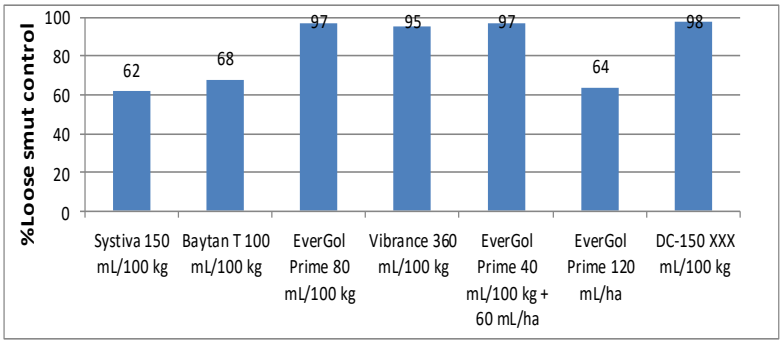
- A Predicta B sample taken from the site indicated a medium risk of rhizoctonia although patches did not express during the season.
- Early establishment across the site was severely impacted by non-wetting affected all plots across the trial with the worst of it commencing around plot 215 and increasing in severity throughout replicate 3. Early dry conditions further staggered the crop emergence.
- Good rains through late July and into early August ensured the crop was growing well albeit patchy across the trial with high levels of disease present at both the Z31 and Z39 applications. Only 48.9 mm of rain fell from the second Z39 application to the end of October reducing the benefits to yield of the different fungicide treatments.
- Increasing variability in the trial due to the sub-soil issues from plot 215 into replicate 3 was a significant factor. Yield data should be treated with caution due to the variability of the site with disease control is the most accurate assessment of treatment efficacy.

Figure 1: Daily rainfall 2015 growing season (273 mm) - Dandaragan



RESULTS – Disease control

Figure 2: Loose smut % control (~2.2% infection), Bass barley, Dandaragan, WA 2015

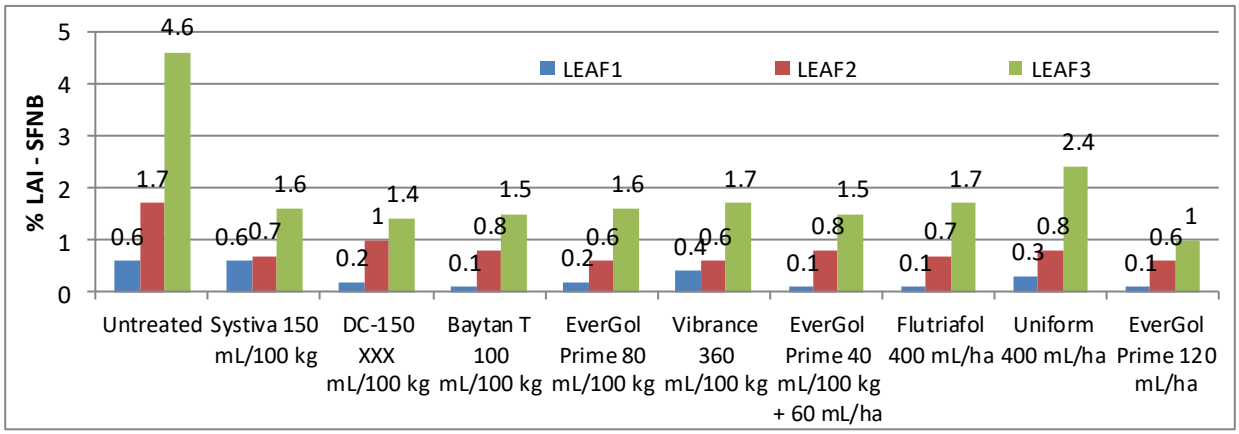


DC- 150 is an experimental Bayer CropScience product.

Systiva and Baytan T did not provide acceptable control of loose smut in this trial.

EverGol Prime at 40 or 80 mL/100 kg on seed provided excellent disease control along with Vibrance and DC-150. Infurrow application of EverGol prime 120 mL/ha did not record acceptable control of loose smut as the fungicide was not in contact with the seed wall which is required for uptake of the active ingredient inside the seed to control the infection effectively.

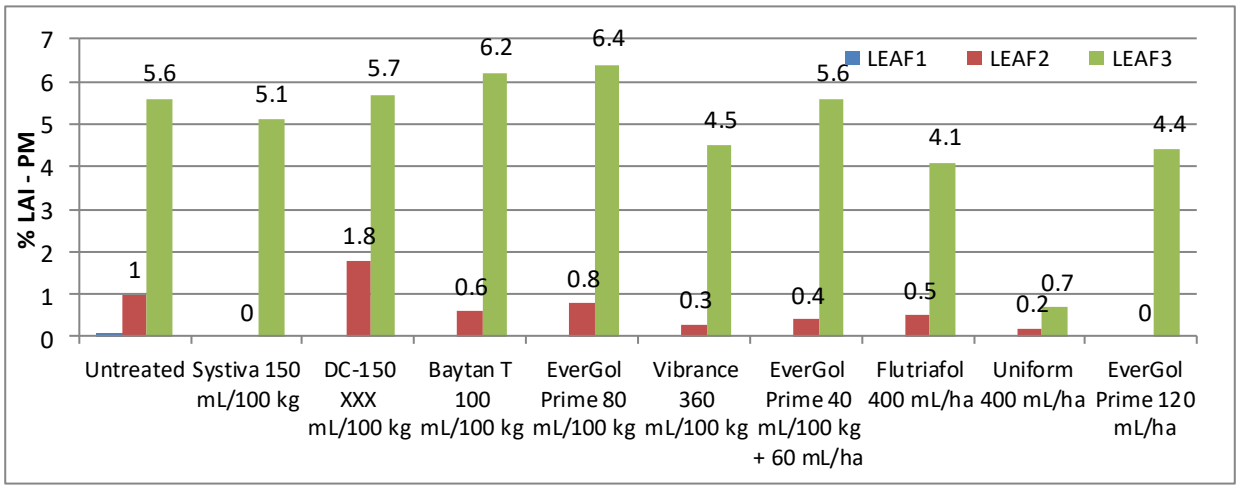
Figure 3: Impact of seed treatments and infurrow fungicides on, spot form net blotch % Leaf area infected (LAI) in Bass barley 71 days after application (DAA/B), pre Z31 foliar application, 4/8/15



Disease control from seed applied (A) and in furrow (B) treatments:
At 71DAA there was a reduction recorded in %LAI of SFNB from all seed and in furrow treatments compared to the untreated on leaves 2 and 3 (Fig. 3).

*Only Systiva has a registered label claim for suppression of SFNB.

Figure 4: Impact of seed treatments and infurrow fungicides on, powdery mildew % Leaf area infected (LAI) in Bass barley 71 DAA/B, pre Z31 foliar application, 4/8/15



At 71DAA only Uniform recorded a reduction in PM control on leaf 3 compared to the untreated. It is not a registered label claim. Systiva is registered for PM control up to Z37.

Table 1: Severity (%LAI) and incidence of spot form net blotch (SFNB) 28 DAD (Z39) application

Date	17/09/2015	Spot form net blotch						
Days after application A (sowing)	115 DAA	Flag	Flag	Flag-1	Flag-1	Flag-2	Flag-2	Top 3 leaves
Days after final	28 DAD	Severit	Incidenc	Severit	Incidenc	Severit	Incidenc	Severi
Seed treatment	Foliar fungicide (C + D)	% LAI	%	% LAI	%	% LAI	%	Mean %LAI
Untreated		2.5 a	90 a	7.8 a	100 a	9 a	100 a	6.4
Untreated	Aviator Xpro 300	**0.6 b**	**33.3 c-f**	**1.7 cd**	76.7 a-d	**2 de**	93.3 ab	1.4
Systiva 150 mL/100 kg	Aviator Xpro 300	**0.4 c**	**30 c-f**	**1.5 cd**	73.3 a-d	**2 de**	86.7 ab	1.3
DC-150 XXX mL/100 kg	Aviator Xpro 300	**0.5 b**	**30 c-f**	**1.2 cd**	83.3 ab	**2 de**	80 ab	1.2
Baytan T 100 mL/100 kg	Aviator Xpro 300	**0.6 b**	**40 c-f**	**1.6 cd**	83.3 a-d	**2.4 de**	86.7 ab	1.1
EverGol Prime 80 mL/100	Aviator Xpro 300	**0.8 b**	**38.9 c-f**	**2.4 bc**	86.7 ab	**1.8 de**	79.2 ab	1.5
Vibrance 360 mL/100 kg	Aviator Xpro 300	**0.2 c**	**16.7 f**	**1.4 cd**	63.3 **c-f**	**2.3 de**	93.3 ab	1.7
EverGol Prime 40 mL/100 kg + 60 mL/ha	Aviator Xpro 300 mL/ha	**0.2 c**	**20 ef**	**1.6 cd**	80 a-e	**1.6 de**	90 abc	1.3
Flutriafol 400 mL/ha	Aviator Xpro 300	**0.7 b**	**46.7 cd**	**1.7 cd**	70 **b-f**	**2 de**	86.7 ab	1.1
Uniform 400 mL/ha	Aviator Xpro 300	**0.5 c**	**20 ef**	**0.8 d**	53.3 **ef**	**1.4 e**	76.7 ab	1.5
EverGol Prime 120 mL/ha	Aviator Xpro 300	**1 b**	**26.7 de**	**1 cd**	50 **f**	**1.8 de**	96.7 ab	0.9
EverGol Prime 80 mL/100	Aviator Xpro 500	**0.4 c**	**20 ef**	**1.4 cd**	70 **b-f**	**1.8 de**	**66.7 c**	1.3
EverGol Prime 80 mL/100 kg	Prosaro 150 mL/ha + Hasten 1%	**0.5 bc**	**20 ef**	**1.8 bcd**	80 a-e	**2.3 de**	**73.3 bc**	1.2
EverGol Prime 80 mL/100	Tilt 500 mL/ha	**1.6 b**	73.3 ab	**2.9 bc**	96.7 ab	**3.6 cd**	100 a	1.5
EverGol Prime 80 mL/100	Amistar Xtra 400	**0.4 c**	**27.4 de**	**1.6 cd**	75.6 a-f	**2.8 cd**	96.3 ab	2.7
EverGol Prime 80 mL/100	Cogito 250 mL/ha	**1.1 b**	**56.7 bc**	**3.2 bc**	86.7 ab	**6.1 b**	100 a	1.6
EverGol Prime 80 mL/100	Radial 420 mL/ha	**0.9 b**	**50 bc**	**4 b**	96.7 ab	**4.6 bc**	100 a	3.5
	LSD P=.05	0.93	24.1	1.9	25.3	1.8	21.8	
	CV	75.6	38.6	55.	19.8	38	14.9	

Means followed by same letter do not significantly differ (Duncan's New Multiple Range at 5% significance level).

Treatments in bold were significantly different to the untreated.

At 28 DAD all treatments significantly (≥5%) reduced SFNB %LAI on all three leaves compared to the untreated.

At 28 DAD the lowest mean %LAI from the top 3 leaves was recorded from EverGol Prime 120 mL/ha with Aviator Xpro applied foliar (0.9%) with the highest recorded %LAI from Radial applied foliar (3.5%).

At 28 DAD all treatments recorded a significant reduction to the incidence of SFNB on the flag leaf compared to the untreated (90%) apart from Tilt (73.3%). On flag-1 and flag-2 only treatments in bold were significantly lower than the untreated.

Table 2: Severity (%LAI) and incidence of powdery mildew (PM) 28 DAD (Z39) application

Date	17/09/2015	Powdery mildew						
Days after application A (sowing)	115 DAA	Flag	Flag	Flag-1	Flag-1	Flag-2	Flag-2	Top 3 leaves
Days after final application	28 DAD	Severit	Incidenc	Severi	Incidenc	Severity	Inciden	Severi
Seed treatment	Foliar fungicide (C + D)	% LAI	%	% LAI	%	% LAI	%	Mean %LAI
Untreated		0.7 a	16.7 a	7.2 a	73.3 a	20.3 a	100 a	9.4
Untreated	Aviator Xpro 300	0 a	0 a	**0 b**	**0 c**	**0.6 b**	**13.3 cd**	0.2
Systiva 150 mL/100 kg	Aviator Xpro 300	0 a	0 a	**0.1 b**	**6.7 c**	**0.4 c**	**6.7 d**	0.2
DC-150 XXX mL/100 kg	Aviator Xpro 300	0 a	0 a	**0.2 b**	**3.3 c**	**1.2 b**	**20 cd**	0.5
Baytan T 100 mL/100 kg	Aviator Xpro 300	0 a	0 a	**0 b**	**0 c**	**0.2 c**	**3.3 d**	0.1
EverGol Prime 80 mL/100 kg	Aviator Xpro 300	0 a	0 a	**0.1 b**	**6.7 c**	**0.1 c**	**3.3 d**	0.1
Vibrance 360 mL/100 kg	Aviator Xpro 300	0 a	0 a	**0 b**	**0 c**	**0.2 c**	**6.7 d**	0.1
EverGol Prime 40 mL/100 kg	Aviator Xpro 300	0 a	0 a	**0 b**	**0 c**	**0 c**	**0 d**	0.0
Flutriafol 400 mL/ha	Aviator Xpro 300	0 a	0 a	**0.1 b**	**3.3 c**	**0 c**	**0 d**	0.0
Uniform 400 mL/ha	Aviator Xpro 300	0 a	0 a	**0 b**	**0 c**	**0 c**	**0 d**	0.0
EverGol Prime 120 mL/ha	Aviator Xpro 300	0 a	0 a	**0 b**	**0 c**	**0.1 c**	**3.3 d**	0.0
EverGol Prime 80 mL/100 kg	Aviator Xpro 500	0 a	0 a	**0.1 b**	**3.3 c**	**0.3 c**	**6.7 d**	0.1
EverGol Prime 80 mL/100 kg	Prosaro 150 mL/ha + Hasten 1%	0 a	3.3 a	**0.1 b**	**3.3 c**	**0.1 c**	**6.7 d**	0.1
EverGol Prime 80 mL/100 kg	Tilt 500 mL/ha	0 a	0 a	**0.7 b**	**16.7 c**	**2 b**	**43.3 bc**	0.9
EverGol Prime 80 mL/100 kg	Amistar Xtra 400	0.1 a	3.3 a	**0.1 b**	**6.7 c**	**2.2 b**	**33.3 bc**	0.8
EverGol Prime 80 mL/100 kg	Cogito 250 mL/ha	0.1 a	6.7 a	**1.2 b**	**40 b**	**3.3 b**	**63.3 b**	1.5
EverGol Prime 80 mL/100 kg	Radial 420 mL/ha	0.2 a	10 a	**0.9 b**	**16.7 c**	**4.9 b**	**56.7 bc**	2.0
	LSD P=.05	0.38	10.21	2.13	20.6	3.92	29.7	
	CV	317.	254.2	212.	123.5	117.	86.7	

Means followed by same letter do not significantly differ (Duncan's New Multiple Range at 5% significance level).

Treatments in bold were significantly different to the untreated.

At 28 DAD all treatments significantly (≥5%) reduced PM %LAI on flag-1 and flag-2 compared to the untreated. Low level infection was recorded on the flag leaf in the untreated (0.7%) and all treatments recorded a reduction in PM infection although none was significant.

At 28 DAD the mean PM %LAI from the top 3 leaves recorded 9.4% in the untreated with all treatments reducing disease levels although Cogito and Radial recorded higher levels than the other treatments (≥1.5%).

At 28 DAD none of the treatments recorded a significant reduction in PM incidence compared to the untreated although all treatments observed a reduction Cogito and Radial had the highest level of disease (≥6.7%). All treatments recorded a significant reduction to the incidence of PM on flag leaf -1 and flag-2 compared to the untreated.

Table 3: Severity (%LAI) and incidence of leaf rust (LR) 28 DAD (Z39) application

Date	17/09/2015	Powdery mildew						
Days after application A (sowing)	115 DAA	Flag	Flag	Flag-1	Flag-1	Flag-2	Flag-2	Top 3 leaves
Days after final	28 DAD	Severit	Inciden	Severit	Incidence	Severit	Incidenc	Severity
Seed treatment	**Foliar fungicide (C + D)**	% LAI	%	% LAI	%	% LAI	%	Mean %LAI
Untreated		3 a	83.3 a	5.2 a	83.3 a	1.5 a	46.7 a	3.2
Untreated	Aviator Xpro 300	**0.7 b**	**40 bc**	**0.6 b**	**26.7 b-**	**0.4 bc**	23.3 a-	0.6
Systiva 150 mL/100 kg	Aviator Xpro 300	**0.6 b**	**40 bc**	**0.4 b**	**23.3 b-**	**0.1 bc**	**6.7 bc**	0.4
DC-150 XXX mL/100 kg	Aviator Xpro 300	**0.4 b**	**33.3 bc**	**0.2 b**	**13.3 de**	**0.2 bc**	**16.7 bc**	0.3
Baytan T 100 mL/100 kg	Aviator Xpro 300	**0.5 b**	**36.7 bc**	**0.8 b**	**46.7 b**	**0.7 b**	26.7 a-	0.7
EverGol Prime 80 mL/100	Aviator Xpro 300	**0.4 b**	**30 bc**	**0.9 b**	**36.7 bc**	**0.3 bc**	**20 b-**	0.5
Vibrance 360 mL/100 kg	Aviator Xpro 300	**0.6 b**	**50 b**	**0.8 b**	**46.7 b**	**0.3 bc**	**20 b-**	0.6
EverGol Prime 40 mL/100 kg + 60 mL/ha	Aviator Xpro 300 mL/ha	**0.2 b**	**13.3 bc**	**0.1 b**	**13.3 de**	**0.1 bc**	**13.3 b-e**	0.1
Flutriafol 400 mL/ha	Aviator Xpro 300	**0.2 b**	**20 bc**	**0.1 b**	**13.3 de**	**0.1 c**	**6.7 cd**	0.1
Uniform 400 mL/ha	Aviator Xpro 300	**0.3 b**	**23.3 bc**	**0 b**	**3.3 e**	**0 c**	**0 e**	0.1
EverGol Prime 120 mL/ha	Aviator Xpro 300	**0.1 b**	**10 c**	**0.5 b**	**26.7 b-**	**0 c**	**3.3 de**	0.2
EverGol Prime 80 mL/100	Aviator Xpro 500	**0.1 b**	**10 c**	**0.1 b**	**6.7 e**	**0.2 bc**	**10 b-**	0.1
EverGol Prime 80 mL/100 kg	Prosaro 150 mL/ha + Hasten 1%	**0.2 b**	**23.3 bc**	**0.1 b**	**6.7 e**	**0.2 bc**	**10 b-e**	0.2
EverGol Prime 80 mL/100	Tilt 500 mL/ha	**0.5 b**	**40 bc**	**0.6 b**	**43.3 bc**	**0.4 bc**	30 ab	0.5
EverGol Prime 80 mL/100	Amistar Xtra 400	**0.3 b**	**24.1 bc**	**0.2 b**	**13.3 de**	**0 c**	**0 e**	0.2
EverGol Prime 80 mL/100	Cogito 250 mL/ha	**0.4 b**	**33.3 bc**	**0.3 b**	**23.3 b-**	**0.2 bc**	**13.3 b-**	0.3
EverGol Prime 80 mL/100	Radial 420 mL/ha	**0.1 b**	**6.7 c**	**0.2 b**	**16.7 cd**	**0.1 bc**	**6.7 cd**	0.1
	LSD P=.05	0.98	31.8	1.54	24.41	0.5	21.7	
	CV	119.1	63.5	140.4	54.91	107	84.7	

Means followed by same letter do not significantly differ (Duncan's New Multiple Range at 5% significance level).

Treatments in bold were significantly different to the untreated.

At 28 DAD all treatments significantly (≥5%) reduced leaf rust %LAI on all three leaves compared to the untreated.

At 28 DAD the mean leaf rust %LAI recorded from the top 3 leaves was low (≤0.7%) across all treatments compared to the untreated (3.2%).

At 28 DAD all treatments recorded a significant reduction to the incidence of LR on the flag leaf and flag-1 compared to the untreated. On flag-2 all treatments reduced the level of incidence compared to the untreated although untreated or Baytan T on seed followed by Aviator or EverGol Prime followed by Tilt foliar was not significant to the untreated.

Table 3: Green leaf retention (%GLR) and incidence on flag-2 28 DAD (Z39) application

Date	17/09/2015	**Green leaf retention**	
Days after application A (sowing)	115 DAA	Flag-2	Flag-2
Days after final application	28 DAD	Green leaf	Incidence
Seed treatment	**Foliar fungicide (C + D)**	% GLR	%
Untreated		28.2 d	70 a
Untreated	Aviator Xpro 300	**70 abc**	96.7 a
Systiva 150 mL/100 kg	Aviator Xpro 300	**61.1 abc**	90 a
DC-150 XXX mL/100 kg	Aviator Xpro 300	**82.4 a**	96.7 a
Baytan T 100 mL/100 kg	Aviator Xpro 300	**67.1 ab**	93.3 a
EverGol Prime 80 mL/100 kg	Aviator Xpro 300	**62.9 ab**	95.8 a
Vibrance 360 mL/100 kg	Aviator Xpro 300	**64.7 ab**	93.3 a
EverGol Prime 40 mL/100 kg + 60	Aviator Xpro 300	**65.9 ab**	93.3 a
Flutriafol 400 mL/ha	Aviator Xpro 300	**70.4 ab**	96.7 a
Uniform 400 mL/ha	Aviator Xpro 300	**70.6 ab**	93.3 a
EverGol Prime 120 mL/ha	Aviator Xpro 300	**74.3 ab**	96.7 a
EverGol Prime 80 mL/100 kg	Aviator Xpro 500	**71.1 ab**	100 a
EverGol Prime 80 mL/100 kg	Prosaro 150 mL/ha +	**74 ab**	100 a
EverGol Prime 80 mL/100 kg	Tilt 500 mL/ha	**68.5 ab**	93.3 a
EverGol Prime 80 mL/100 kg	Amistar Xtra 400	**77.6 a**	100 a
EverGol Prime 80 mL/100 kg	Cogito 250 mL/ha	**59.3 ab**	86.7 a
EverGol Prime 80 mL/100 kg	Radial 420 mL/ha	**55 b**	83.3 a
	LSD P=.05	18.28	16.32
	CV	16.57	10.53

Means followed by same letter do not significantly differ (Duncan's New Multiple Range at 5% significance level).

Treatments in bold were significantly different to the untreated.

At 28 DAD all treatments significantly (≥5%) increased green leaf area %GLR on flag-2compared to the untreated. The highest retention of %GLR was recorded from DC-150 followed by Aviator Xpro foliar (82.4%).

At 28 DAD all treatments recorded an increase in the retention of green leaves with higher incidence recorded than the untreated from all treatments although none was significant.

FINANCIAL ANALYSIS OF RESULTS

Table 4: Fungicide cost, yield (t/ha), % of untreated, grain quality and $Gross/ha

		Days after sowing/ Application		4/11/15 - 173 DAA/ 86 DAD						
Seed treatment rate/ 100 kg, infurrow treatment	Seed trt. cost $/ha at 80 kg	Foliar fungicide rate/ha	Fungicide cost $/ha per	Yield t/ha	% untreated	Moisture %	Protein %	Specific Weight (kg/hL)	Screenings (%)	Gross $/ha
Untreated	$0.00	Untreated	$0.00	2.67	100	10	14.3	59.4	12.6	$632.79
Seed/ soil applied mean treatment yield		Aviator Xpro 300 mL/ha	Not registered	**2.98**	**112**	**9.9**	**13.6**	**60.4**	**8.2**	**$707.31**
Systiva 150 mL/100 kg	$23.88									
DC-150 200 mL/100 kg	not reg.									
Baytan T 100 mL/100 kg	$1.72									
EverGol Prime 80 mL/100 kg	$9.60									
Vibrance 360 mL/100 kg	$9.49									
EverGol Prime 40 mL/100 kg + 60 mL/ha	$13.80									
Flutriafol 400 mL/ha	$9.60									
Uniform 400 mL/ha	$25.32									
EverGol Prime 120 mL/ha	$18.00									
Foliar fungicide mean treatment yield				**3.12**	**117**	**10.1**	**12.8**	**62.6**	**4.2**	**$739.44**
EverGol Prime 80 mL/100 kg	$9.60	Aviator Xpro 500 mL/ha	Not reg.							
	$9.60	Prosaro 150 mL/ha + Hasten 1%	$14.50							
	$9.60	Tilt 500 mL/ha	$6.00							
	$9.60	Amistar Xtra 400 mL/ha	$14.34							
	$9.60	Cogito 250 mL/ha	$6.25							
	$9.60	Radial 420 mL/ha	$14.20							
Price Feed 1 Kwinana 21/12/15		$237.00	**LSD P=.05**	0.76	There was no significant difference between treatments (Duncan's New Multiple Range at 5% significance level). Aviator Xpro and DC-150 are not registered products with no pricing available.					
Application Costs x 2 foliar		$12.00	**CV**	15.4						

Note: Due to yield variability results are displayed as a mean of seed treatment or foliar responses from the trial.

All treatments met Feed 1 grade. Yield across the site was variable and not an accurate reflection of treatment efficacy. A positive average yield response for either soil applied fungicides (12%) with Aviator Xpro foliar or EverGol Prime on seed with a range of and foliar fungicide treatments (17%) was recorded over the untreated. Screenings were reduced compared to the untreated.

PEER REVIEW/REVIEW

Geoff Robertson - Development Manager Broadacre and Seed Treatment.

ACKNOWLEDGEMENTS/ THANKS

Thanks to Living Farm for the application, seeding and harvest of the trial, thanks to Susie Mason from Elders Moora for assistance with assessments and the Roberts family for the site.