



# Radial Overview

Radial<sup>®</sup> is a broad spectrum foliar fungicide for use in Wheat and Barley, combining market leading strobilurin and triazole active ingredients. Radial<sup>®</sup> is highly effective against all the key cereal diseases, and with dual modes of action provides persistent systemic control of major foliar diseases in Wheat and Barley.

Applied to key yield determining leaves, Radial® keeps crops greener for longer and improves photosynthetic efficiency maximising yield potential and grain quality.

# The Impact of Foliar Diseases in Cereals

Foliar diseases are responsible for significant production losses throughout Australian cereal growing regions. The value of lost production from leaf diseases in Wheat alone is currently estimated at \$470M per annum, with potential losses of several billion dollars a year if not managed appropriately.

Diseases in cereal crops rob the plant of valuable photosynthetic surface area at critical stages of the plant's life cycle where yield and quality are determined.

### Radial® at a Glance

Radial®			
Registered Crops	Wheat and Barley		
Disease Spectrum	Wheat - Leaf Rust, Yellow Spot, Septoria Nodorum Blotch, Stem Rust, Stripe Rust, Powdery Mildew		
	Barley - Leaf Rust, Leaf Scald, Net Form of Net Blotch, Powdery Mildew		
Formulation Type	Emulsifiable Concentrate (EC)		
Application Rate Range	420 mL – 840 mL/Ha		
Water Rates	<ul> <li>Apply in a water volume of between 50 and 100 L/Ha by ground application</li> <li>Apply in a water volume of</li> </ul>		
	between 20 and 30L L/Ha by aerial application		
	Apply with a Medium spray droplet size category		

### **Key Features**

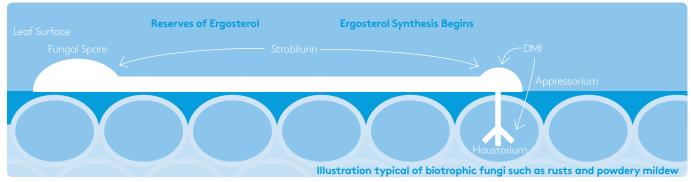
- Broad-spectrum, long lasting preventative control
- Highly effective EC formulation
- Dual mode of action for resistance management
- Highly compatible and with excellent crop safety
- Registered for use in Wheat and Barley.

### Mode of Action

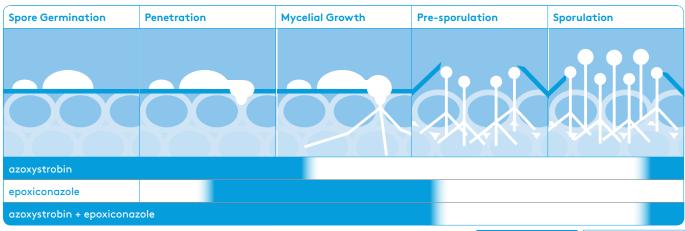
### GROUP 311 FUNGICIDE

Radial® is a combination of demethylation-inhibitors (DMI) and strobilurin (Quinone outside Inhibitors - Qols) group of fungicides and incorporates the strength of both of these key fungicide groups. Epoxiconazole acts to inhibit ergosterol production, an essential component of the membranes of a wide range of fungi.

Epoxiconazole has a strong inhibitory effect on fungal hyphae and mycelia and has the ability to interrupt fungal growth in plant tissue. Azoxystrobin inhibits the respiration of fungi by binding to the mitochondrial cytochrome and blocking electron transfer. When applied prior to disease infection, azoxystrobin provides excellent protection and has long residual activity.



The DMI's (epoxiconazole) inhibitory effects start at the formation of infection structures - appressorium and penetration peg. The strobilurin (azoxystrobin) component acts preventatively by inhibiting spore germination and early stages of growth in the plant tissue.



Radial® is a robust fungicide combination effective across multiple stages of the disease life cycle as illustrated in the diagram above.

Highly effective

Little or no effect

Mode of Action Summary				
Parameter	epoxiconazole	azoxystrobin		
Concentration (g/L)	75 g/L	75 g/L		
FRAC Group	3	11		
Group common name	DMI	Strobilurin		
Mode of Action	Demethylation inhibitors, ergosterol biosynthesis inhibitors	Inhibitor of mitochondrial respiration		
Effect on fungi	Disrupts cell wall production and mycelial/hyphal development	Disrupts energy production, particularly in germinating spores		
Activity type	Systemic protectant + curative	Systemic protectant with some eradicant activity		
Translocation	Translaminar, systemic (acropetal)	Translaminar, systemic		
Residual activity	Up to 6 weeks			

## Target Diseases and Use Rates

#### Wheat

Leaf Rust, Yellow Spot, Septoria Nodorum Blotch, Stem Rust, Stripe Rust and Powdery Mildew: 420 to 840 mL/Ha.

Apply when conditions favour disease development and prior to incidence of high levels of disease in the crop. Aim to apply between stem elongation and complete ear emergence (Z32-59).

### **Barley**

Leaf Rust, Leaf Scald, Net Form of Net Blotch and Powdery Mildew: 420 to 840 mL/Ha.

Apply when conditions favour disease development and prior to the incidence of high levels of disease in the crop. Aim to apply from jointing (Z30).

Repeat spraying may be required, particularly if infection pressure persists. Use the higher rate when disease pressure is high.

#### Rate selection

Selection of an appropriate application rate depends on the disease pressure, weather conditions and the length of residual control required. If higher rates are to be used to achieve greater efficacy and longer length of protection, growers must not exceed a maximum of two applications at the high rate per season. This is to ensure that there are not excessive residues in the grain or hay, as well as ensuring that fungicide resistance management is considered.

Higher rates have been shown to increase yield, see charts 3 and 6.

Please consult the product label for detailed information on diseases controlled, and rates required.

# **Application**

### **Spray Application Recommendations**

Ground Application: Apply in a water volume of between 50 and 100 L/Ha using a medium quality spray. Use the higher water volume in crops with heavier canopies.

Aerial Application: Apply with suitable aircraft, set up and operated to apply fungicides to cereal crops in a water volume of between 20 and 30 L/Ha using a medium quality spray. Use the higher water volume in crops with heavier canopies.

#### **Rainfast Period**

Rainfast period for efficacy is 2 hours or when the spray has dried, whichever comes first.

### Withholding Periods

Grazing: Do not graze or cut for stock feed for 6 weeks after application.

Harvest: Do not harvest for 6 weeks after application.

### Restraints when applying Radial®

DO NOT apply more than two applications of Radial® Fungicide per season.

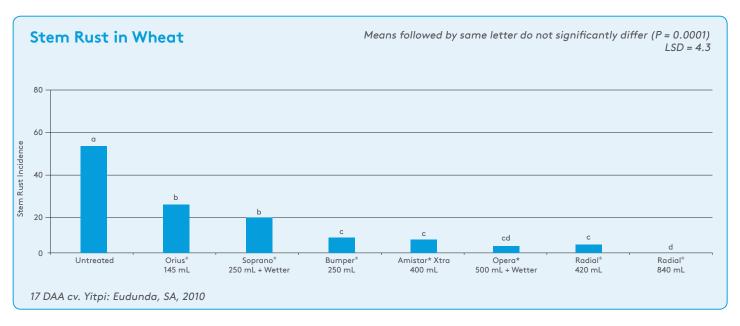
DO NOT apply if heavy rains or storms that are likely to cause runoff are forecast within 48 hours of application.

DO NOT apply when wind speed is less than 3 or more than 20 kilometres per hour at the application site.

DO NOT apply with spray droplets smaller than a MEDIUM spray droplet size category according to nozzle manufacturer specifications that refer to the ASAE S572 Standard or the BCPC Guideline.

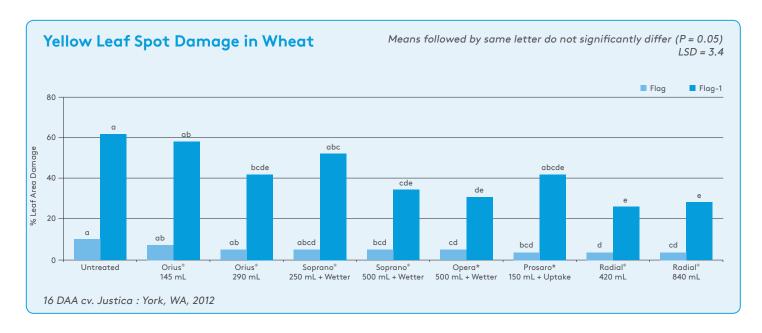


### **Trial Results Wheat**



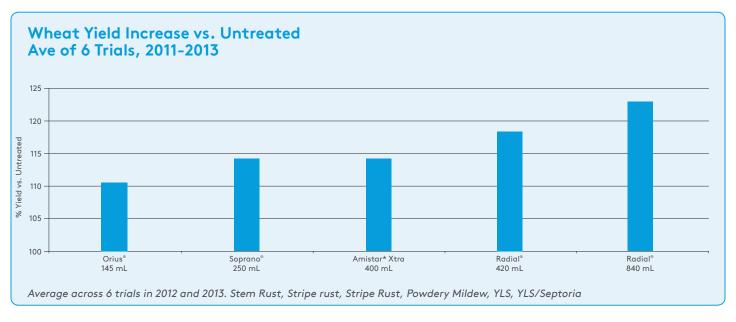
#### Chart 1.

This Stem Rust trial at Eudunda, SA in 2010 demonstrates the effectiveness of Radial® against Stem Rust in Wheat. The analysis shows Radial® has performed significantly better than all other treatments at the 840 mL rate with the only exception being Opera\* and at the 420 mL rate performs at least as good as Amistar\* Xtra.



### Chart 2.

This trial at York, WA demonstrates the robust control of Radial® against Yellow Leaf Spot (YLS) in Wheat and highlights the reduced level of leaf damage that can be achieved when using Radial® versus other fungicide formulations. Radial® has consistently performed well against YLS over a number of trials.



#### Chart 3.

This analysis of the average yield improvement achieved by Radial® in Wheat across a range of diseases and conditions shows that Radial® is an excellent wheat fungicide and provides yield increases above those seen with alternative fungicides.



This photo was taken at a Septoria trial at Colac, Vic, 2013.

The photo illustrates the robust control that can be achieved on Septoria sp. with Radial®. At time of printing Radial® is only registered on Septoria nodurum however Adama are undertaking further trial work with the aim of registering Radial® against Septoria tritici also.

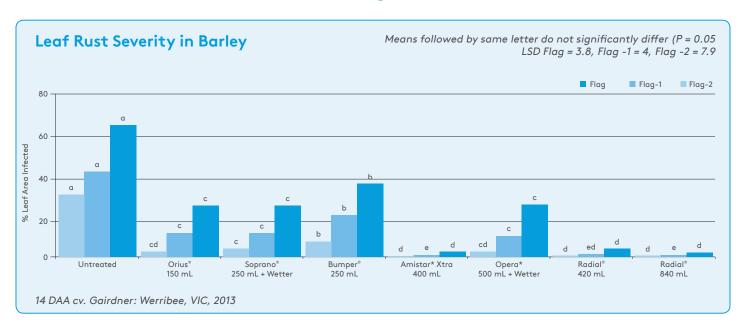


Orius® 145 mL/Ha

This photo was taken at a Stripe Rust demonstration trial at Arthur River, approximately 2 hours South of Perth, WA in 2013.

The crop was Mace wheat and it can clearly be seen where the Radial® has extended the green leaf of the crop beyond that achieved with Orius®. The Radial® plot in this trial yielded 4.6 t/Ha versus Orius® at 4.2 t/Ha.

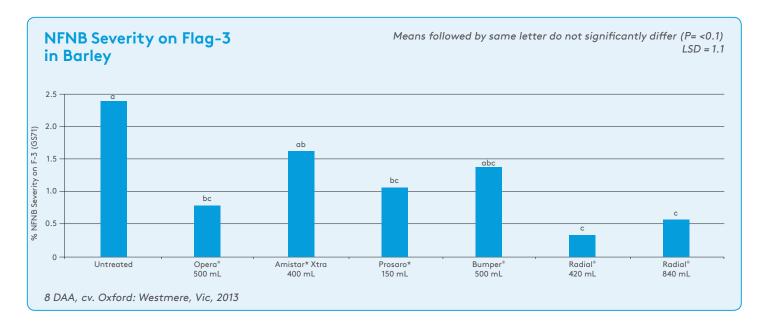
# Trial Results Barley



#### Chart 4.

The results in Chart 1 above highlight the strength of Radial® on Barley Leaf Rust at both registered label rates. Both Radial® and the Amistar\* Xtra treatments show significantly improved control versus all other treatments.

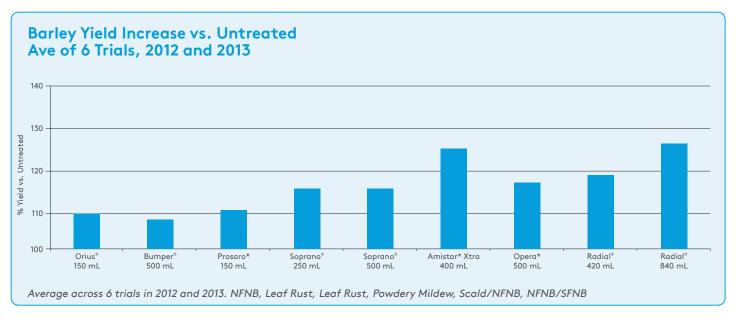
Soprano® (epoxiconazole) is excellent on most rust strains as a stand-alone treatment but the Radial® formulation with azoxystrobin significantly improves control of Barley Leaf Rust.



### Chart 5.

All fungicide treatments in this FAR trial at Westmere in Victoria significantly decreased the disease level versus the untreated, except Amistar\* Xtra which gave significantly lower control of NFNB (Net Form of Net Blotch) compared to Radial®.

The trend seen in this trial illustrates the strength Radial® has against *pyrenophora* spp diseases such as NFNB when compared to some other fungicides.



#### Chart 6.

This analysis of the average yield improvement achieved by Radial® in Barley across a range of diseases and conditions shows that Radial® is an excellent Barley fungicide and provides yield increases above those seen with the majority of alternative fungicides.









Barley Leaf Rust trial. Werribee, Victoria, 2011: Barley cv. Gairdner. Peracto, Trial No. FAR09235#5

# Summary of Trial Results

The trial results shown in charts 1 through to 6 demonstrate that when compared in the field against other market standards, Radial® has robust performance across a range of key cereal diseases and demonstrates an ability to improve cereal yields above that seen from alternative products. Trial results also indicate that Radial® has excellent crop safety having been tested across multiple wheat and barley varieties with no negative effects observed.

# Tank Mixture Compatibility

Product and maximum rate tested	Formulation	Active Constituents	Company	Physically Compatible Yes/No	Crop Safety Field Tests	Recommended Adjuvant	Critical Comments
2,4-D Amine 625 1.7 L/Ha	SL	2,4-D amine 625 g/L	Adama	Yes - at ≥ 20 L/Ha	Yes x 9	Not Required	Acceptable crop safety in trials. Minor crop damage observed.
2,4-D Amine 625 1.4 L/Ha + Eclipse* 100SC 50 mL/Ha	SL SC	2,4-D amine 625 g/L + metosulam 100 g/L	Adama + Bayer CropScience	Yes - Field tested only	Yes x 2	Wetspray® 1000 0.25%	Acceptable crop safety in trials.
2,4-D LV Ester 680 800 mL/Ha	EC	2,4-D ester 680 g/L	Adama	Yes - at ≥ 30 L/Ha	Yes x 4	Not Required	Acceptable crop safety in trials. Some increase in crop effect is possible.
Alpha-Scud® Elite 240 mL/Ha	EC	alpha-cypermethrin 100 g/L	Adama	Yes - Field tested only	Commercial trials x 2	Not Required	Acceptable crop safety in trials.
Axial* 100 EC 300 mL/Ha	EC	pinoxaden 100 g/L + cloquintocet-mexyl 25 g/L	Syngenta	Yes - at ≥ 20 L/Ha	Yes x 9	Adigor* 0.5%	This mixture including oil may give unacceptable crop effects. Not recommended.
Big Red* (Copper Oxide) 375 mL/Ha	SC	copper oxide 500 g/L	Agrichem	Yes - Field tested only	Yes x 3	Not Required	Acceptable crop safety in trials. Minor crop spotting observed.
Colt® 1.0 L/Ha	EC	bromoxynil 250 g/L + diflufenican 25 g/L	Adama	Yes - at ≥ 50 L/Ha	Not Tested	Not Required	Not field tested. Use with caution at rates below 750 mL/Ha.
Conclude* 100 mL/Ha	SE	MCPA ester 357 g/L + Florasulam 7 g/L	Dow AgroSciences	Yes - at ≥ 50 L/Ha	Yes x 5	Uptake* 0.5%	Acceptable crop safety in trials.
Crusader* 300 mL/Ha	OD	pyroxsulam 30 g/L + cloquintocet-mexyl 90 g/L	Dow AgroSciences	Yes - at ≥ 50 L/Ha	Not Tested	Wetspray® 1000 0.25%	Not field tested. Not recommended.
Cutlass® 500 400 mL/Ha	SL	dicamba 500 g/L	Adama	Yes - at ≥ 25 L/Ha	Not Tested	Not Required	Not field tested. Increased crop effect is likely. Not recommended.
Cutlass® M 1.7 L/Ha	SL	MCPA 340 g/L + dicamba 80 g/L	Adama	Yes - at ≥ 25 L/Ha	Not Tested	Not Required	Not field tested. Increased crop effect is likely. Not recommended.
Cycocel* 750A 1.3 L/Ha	SL	chlormequat 582 g/L	BASF	Yes - at ≥ 20 L/Ha	Not Tested	Not Required	Not field tested. Expected to be acceptable crop safety.
Dimethoate 500 mL/Ha	EC	dimethoate 400 g/L	Adama	Yes - at ≥ 50 L/Ha	Not Tested	Not Required	Not field tested. Expected to be acceptable crop safety.
Eclipse* 100 SC 50 mL/Ha	SC	metosulam 100 g/L	Bayer CropScience	Yes - at ≥ 50 L/Ha	Field Tested as a mix with 2,4 D	Wetspray® 1000 0.25%	Acceptable crop safety in trials.
Enforcer® 242 1 L/Ha	SL	MCPA 420 g/L + Picloram Potassium Salts 26 g/L	Adama	Yes - Field tested only	Yes x 2	Not Required	Acceptable crop safety in trials. Some increase in crop effect is possible.
Enforcer® 75-D 1 L/Ha	SL	2,4-D 300 g/L + picloram 75 g/L	Adama	Yes - at ≥ 20 L/Ha	Not Tested	Not Required	Not field tested. See Enforcer 242.
Flexi N* - UAN 50 L/Ha	SL	25% nitrate + 25% ammonium + 50% urea	CSBP	Yes 50/50 Dilution	Yes x5	Not Required	Some spotting observed in trials, but no different to solo UAN. Apply below 25°C. UAN can burn in some circumstances.

Product and maximum rate tested	Formulation	Active Constituents	Company	Physically Compatible Yes/No	Crop Safety Field Tests	Recommended Adjuvant	Critical Comments
Hussar* OD 100 mL/Ha	OD	iodosulfuron 100 g/L + mefenpyr-diethyl 300 g/L	Bayer CropScience	Yes - at ≥ 50 L/Ha	Not Tested	Wetspray® 1000 0.25%	Not field tested. Crop damage likely. Not recommended
Intervix* 750 mL/Ha	SL	imazamox 33 g/L + imazapyr 14 g/L	BASF	Yes - at ≥ 70 L/Ha	Not Tested	Supercharge* 0.5%	Not field tested. Some increase in crop effect is likely.  Not recommended.
Legacy® MA 1.0 L/Ha	EC	MCPA 250 g/L + diffufenican 25 g/L	Adama	Yes - at ≥ 50 L/Ha	Not Tested	Not Required	Use with caution at rates below 750 mL/Ha. Not field tested.
Lonestar® 750WG 15 g/Ha	WG	triasulfuron 750 g/kg	Adama	Yes - at ≥ 20 L/Ha	Yes x 5	Wetspray® 1000 0.25%	Good crop safety. This is the late post- emergent use rate for seed set reduction of Wild Radish.
Lynx® 7 g/Ha	WG	metsulfuron methyl 600 g/kg	Adama	Yes - at ≥ 20 L/Ha	Yes x 9	Wetspray® 1000 0.25%	Acceptable crop safety in trials. Some typical metsulfuron crop effects where observed in trials.
Mandate® 210 mL/Ha	EC	clodinafop-propargyl 240 g/L + cloquintocet-mexyl 60 g/L	Adama	Yes - at ≥ 20 L/Ha	Yes x 4	Uptake* 0.5%	Acceptable crop safety in trials. Use with wetting agent instead of oil.
MCPA LVE 570 1.84 L/Ha	EC	MCPA 570 g/L as iso-octyl ester	Adama	Yes - at ≥30 L/Ha Requires constant agitation	Yes x 9	Not Required	Acceptable crop safety in trials. Some increase in crop effect is possible.
MCPA 750 (Amine) 660 mL/Ha	SL	MCPA 750 g/L	Adama	Yes - at ≥ 20 L/Ha	Yes x 4	Not Required	Acceptable crop safety in trials.
Mentor® 200 g/Ha	SC	metribuzin 750 g/L	Adama	Yes - at ≥ 20 L/Ha	Not Tested	Not Required	Not field tested. This mix is likely to increase Mentor® crop damage. Not recommended
Moddus Evo* † 400 mL/Ha	EC	trinexapac-ethyl 250 g/L	Syngenta	Yes - at ≥ 20 L/Ha	Yes x 5	Not Required	Normal crop shortening is observed. Use with caution.
Pentagon® 400 g/Ha	SC	tralkoxydim 400 g/kg	Adama	Yes - at ≥ 20 L/Ha	Not Tested	Amplify® 1%	Not field tested. Not recommended
Precept* 300 EC 1.0 L/Ha	EC	MCPA 250 g/L + pyrasulfatole 50 g/L + mefenpyr-diethyl 12.5 g/L	Bayer CropScience	Yes - at ≥ 30 L/Ha	Not Tested	Hasten* 1% (tested) or can use Liase* 1.2 L/Ha	Not field tested. Not recommended.
Tackle® WG 20 g/Ha	WG	chlorsufuron 750 g/kg	Adama	Not Tested	Yes x 4	Wetspray® 1000 0.25%	Acceptable crop safety in field trials, however normal chlorsulfuron damage is expected.
Trident® 25 g/Ha	WDG	flumetsulam 800 g/kg	Adama	Yes - at ≥ 50 L/Ha	Not Tested	Uptake* 0.5%	Not field tested. Some increase in crop effect is likely. Not recommended.
Triathlon® 1L/Ha	EC	MCPA 250 g/L + diflufenican 25 g/L + bromoxynil 150 g/L	Adama	Yes - at ≥ 20 L/Ha	Yes x 5	Not Required	Acceptable crop safety in field trials. Increased crop effect is likely. Use with caution at rates below 750 mL/Ha
Velocity* 1 L/Ha	EC	bromoxynil 210 g/L + pyrasulfatole 37.5 g/L + mefenpyr-diethyl 9.4 g/L	Bayer CropScience	Yes - at ≥ 50 L/Ha	Not Tested	Uptake 0.5%	Not field tested. This mixture including oil may give unacceptable crop effects. Recommended.
Victory® SL 300 mL/Ha	SL	clopyralid 300 g/L	Adama	Yes - at ≥ 20 L/Ha	Not Tested	Not Required	Not field tested. Expected to be acceptable crop safety.
Victory® SL 50 mL/Ha + LVE MCPA 600 mL/Ha	SL	clopyralid 300 g/L + 570 LVE MCPA ester	Adama	Not Tested	Yes x 4	Not Required	Acceptable crop safety in trials. Use with caution.

<sup>†</sup> Not registered at time of printing

To see a more comprehensive compatibility chart scan the QR code on the back cover.

### **Compatibility Notes:**

- Most compatibilities were conducted with Radial® at 840 mL/Ha, the highest label rate. Crop safety and any minor mixing issues are likely to be reduced at lower rates of Radial®
- For all mixtures observe the label requirements of the mixing partner, including recommended crop stage, spray volumes etc
- The physical compatibility test conducted in the laboratory was a more complete test than that conducted in field tests. Mixtures were compared at different water hardness and under different temperatures
- Mixtures requiring the addition of crop oils will always heighten the risk of an adverse crop effect and should be avoided with Radial<sup>®</sup>

- Compatibility is limited to those specific products and product manufacturers listed unless an alternative product is clearly an equivalent formulation
- Products containing varying concentrations of active constituents to those listed may not be compatible with Radial®
- Adverse environmental conditions such as frosts, waterlogging, drought, pests or anything else that can stress the crop can compound adverse effects to the crop and should be avoided when tank mixing Radial®
- These mixes have not been tested by aerial application. Aerial application is likely to increase the potential for crop damage due to higher product concentrations.





Photos taken at a Radial® compatibility trial near Badgingarra WA, Baudin Barley, 2013. These photos show the typical leaf spotting that can be seen from the application of UAN and the photos also show that the spotting is no worse where Radial® and UAN have been applied in a tank mix. Care should be used with this mix however and temperatures above 25°C avoided.

# Resistance Management

With the increasing incidence of tebuconazole resistant Barley Powdery Mildew recently, the importance of not relying on a single fungicide mode of action has been highlighted. Radial® is an ideal choice to include in disease control programs where growers are wishing to include a second mode of action to help avoid resistance and improve efficacy. It is often the case with Wheat and Barley crops that growers will apply multiple fungicides throughout the season and often the majority of these are straight DMI fungicides, such as a foliar fungicide, in addition to a seed dressing and/or in-furrow application, inclusion of another mode of action group is highly recommended.

CropLife recommends that no more than 3 DMI treatments or formulations including a DMI treatment should be used in any one growing season.

For fungicide resistance management Radial® is both a Group 3 and a Group 11 fungicide and CropLife highlight that group 3+11 mixtures like Radial® should be treated like group 11 only fungicides for resistance management purposes. CropLife also suggest that no more than two group 11 or group 3+11 fungicides be use on any one crop.

In high risk disease environments integrated management approaches should be used to reduce fungicide resistance risk including the removal of stubble, control of green bridge volunteers and the use of tolerant and resistant varieties. This is particularly important for managing Barley Powdery Mildew which has shifted in tolerance to DMI fungicides as mentioned above.

Adama encourage the responsible use of fungicides as outlined in the CropLife Fungicide Resistance Management Guidelines. CropLife guidelines can be found by visiting www.croplifeaustralia.org.au

## Frequently Asked Questions

### How does Radial® perform on Barley diseases?

Radial® provides excellent disease control in Barley and in trials it consistently outperforms solo DMI products. Unlike Radial®, solo DMI's do not prevent spore germination which is critical for controlling diseases such as Leaf Rust and NFNB. Radial® also has a dual mode of action and extended disease control versus DMI's allowing it to provide a longer length of protection and improved efficacy.

#### Will Radial® control diseases not on the label?

Radial® is an excellent broad spectrum fungicide that has been evaluated on all key diseases of Wheat and Barley with outstanding results. Adama are continuing to build data on those diseases that were not present in the initial registration phase or insufficient data was available at the time of registration submission. Adama are exploring options for label extensions for both new crops and diseases.

### How does Radial® perform on Wheat diseases?

Radial® provides excellent control of Wheat diseases and in trials it consistently outperforms solo DMI's. Epoxiconazole is an outstanding active ingredient on Wheat diseases like Stripe Rust and Septoria and when combined with the strength of azoxystrobin Radial® provides a high level of disease control across all key Wheat diseases. In addition Radial® has a dual mode of action and extended disease control.

### What are the strengths of Radial® versus straight DMI fungicides?

Radial® has a dual mode of action for improved resistance management and greater efficacy versus solo DMI fungicides. The azoxystrobin component of Radial® provides extended systemic protectant disease control and has activity against multiple stages on the fungal life cycle. The azoxystrobin component prevents spore germination and mycelial penetration. Epoxiconazole prevents appressoria formation and mycelial development on the leaf surface and acts systemically. In certain situations the azoxystrobin component of Radial® can also provide a crop enhancement effect helping keep the crop greener for longer.

### Features and Benefits

Features	Benefits		
Combination of highly effective strobilurin and DMI active ingredients	Two modes of action for resistance management and better efficacy		
EC formulation	Unlike SC and SE formulations the active ingredients are fully available for disease control		
Excellent preventative control	Provides greater disease control for longer than standalone DMI treatments		
Highly compatible	Less need to perform multiple applications		
Broad disease spectrum.	Confidence all targeted diseases will be controlled.		

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# Summary

- Broad-spectrum, long lasting preventative control
- Optimised EC formulation for Australian conditions and diseases
- Dual mode of action for resistance management
- Highly compatible and with excellent crop safety
- Registered for use in Wheat and Barley.



Radial® is available through Adama Innovation Centre retailers.

Visit adama.com for further details.

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Please note: This information is not intended to replace the product labels. Always read the complete product label appearing on the container before opening or using products.



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