Monitoring air-borne spores as an early disease warning

Kazue Tanaka[1] and Kithsiri Jayasena[1],

[1]Department of Agriculture and Food, Western Australia, Albany

Contact: Kithsiri Jayasena, Ph (08) 9892 8477, email: kithsiri. jayasena@agric.wa.gov.au

Key Messages

- Passive spore traps more reliably detected spores of barley powdery mildew, leaf rust, net blotch and canola blackleg ascospores and *Alternaria* spp which are a prime cause for grain discoloration.
- Spore traps detected powdery mildew, leaf rust and net blotch spores well before the unprotected crops started to show disease symptoms.
- One of the pathogens (*Bipolaris sorokiniana*) which causes common root rot and seedling blight was detected at two locations near South Stirling and close to Wellstead (Pallinup River). This is the first report of detection this pathogen in the region.

Background and Aims

Fungal diseases are mainly spread by airborne spores. These spores can travel either for a short distance or long distance before they land on a suitable host to initiate the disease. The distance these spore travel is mainly determine by their size. For example, spores such as rusts and mildew can travel long distance and spores of net blotch and scald of barley only travel a short distance (usually in the same or adjacent field). Before diseases symptoms to manifest in a host, spores have to be release from the infected source, become airborne and land on a suitable host, establish and finally appear as the symptoms of a particular disease. It takes some time from when the spores land to when symptoms appear and this depends mainly on the host susceptibility, the abundance of spores and environmental conditions.

The current farmer practice in disease management is to routinely examine their crops for diseases after seeding which is a time consuming procedure. This burden can be reduced to a certain extent if the farmer knows in advance what fungal spores are present in the air. This provides an early opportunity to protect the crop. The airborne particles including fungal spores can be easily detected by using spore traps.

The aim of the present study is to continue monitoring airborne fungal spores in the lower great southern during the cropping season and advise farmers accordingly.

Method

At nine locations across Lower Great Southern passive spore traps were placed to monitor air-borne spores so that growers can be alerted earlier of foliar diseases of barley (Table 1). At weekly intervals slides were collected from the spore traps and brought back to laboratory to identify the spores under a compound microscope.

Results

At all sites, spore traps successfully sampled particles from the air, including fungal spores, pollen grains, insects, dust and sand. The range of fungal airborne spores such as *Alternaria* spp., blackleg ascospores, leaf rust urediniospores, net blotch conidia, powdery mildew conidia, wheat yellow spot conidia, stem rust urediniospores, oat crown rust and ryegrass leaf rust were detected across the sites.

It is interesting to note that at three spore trap sites (near Pallinup, Gnowellen and South Stirling), spot blotch conidia were detected (not shown in the Table 1). This is the first detection of the pathogen spores around South Stirling.

Net blotch conidia were first detected on the 15th of April pre-sowing; subsequently, at six other locations it was also detected from the 22nd of April to 6th of May (Table 1). After sowing the initial detection of net blotch conidia was on the 20th of May in one location; subsequently the disease was observed at all other locations from the 27th of May to the 5th of August (Table 1).

Barley leaf rust urediniospores were detected prior to sowing at two locations with the disease being first detected on the 22nd of April. After -sowing leaf rust spores were trapped at all nine locations with spores first being detection on the 3rd of June at Mark Wood's site (Table 1).

At seven locations, the spore traps detected powdery mildew conidia spores well before sowing, and the first detection was on the 29th of April. These spores were coming from infected barley regrowth in the paddocks surrounding the trapping sites. This gave a strong indication of disease risk before sowing (Table 1). After sowing powdery mildew spores were first observed on the 27th of May and subsequently at various time periods from the 3rd of June to the 5th of August.

Table 1. The spore trap locations and the dates when the spores were first detected by the spore trap (pre-sowing & post-sowing) and the first visible symptoms on trap crops in 2014.

Farmer	**Coordinates**	**Trap crop**	**Spore trap**						**Trap Crop**		
(the day spore trap installed)	of new locations	sown on	Pre-sowing			Post- sowing					
			PM	BLR	NB	PM	BLR	NB	PM	BLR	NB
Chris Tomlinson (6 May)	50H 0558462E; 6193036N	25-May	27-May	None	6-May	24-Jun	10-Jun	27-May	15-Jul	**None	None
Mark Adams (8 April)	50H 0578891E; 6183064N	17-Jun	29-Apr	22-Apr	22-Apr	24-Jun	26-Aug	24-Jun	12-Aug	None	3-Sep
Derek Curwen (8 April)	50H 059999E; 6169572E	10-May	6-May	29-Apr	6-May	3-Jun	1-Jul	20-May	24-Jun	26-Aug	3-Sep
John Howard (17 June)	50H 0605209E; 61688645N	28-May	*NA	NA	NA	1-Jul	5-Aug	17-Jun	None	None	29-Jul
Greg Baum (15 April)	50H 0638210E; 6198635N	27-May	6-May	NA	15-Apr	3-Jun	21-Jul	3-Jun	15-Jul	3-Sep	12-Aug
Mark Wood (8 April)	50H 0629265E; 6173465N	21-May	29-Apr	NA	29-Apr	3-Jun	3-Jun	27-May	15-Jul	15-Jul	None
Mick Moir (8 April)	50H 644842E; 6197069N	23-May	29-Apr	NA	29-Apr	27-May	5-Aug	27-May	None	None	12-Aug
Mark Slattery (8 April)	50H 0631979E; 6185743N	3-Jun	6-May	NA	22-Apr	10-Jun	5-Aug	10-Jun	12-Aug	3-Sep	29-Jul
Matt Campbell (29 July)	50H 0638343E; 6216189N	23-May	NA	NA	NA	5-Aug	19-Aug	5-Aug	***-	-	-

Note: *NA = not observed in the spore trap slides; **None = diseases listed in the table not observed in the trap plants. *** - = no trap plants of barley at this site. Abbreviations: PM = Powdery Mildew; BLR = Barley Leaf Rust; NB = Net Blotch (Spot type & Net type).

At six locations the “trap plants” started to show net type net blotch symptoms from the 29th of July to the 3rd of September. Net type net blotch symptoms were first detected on the 29th of July, 8 weeks after sowing, on untreated (no seed dressing) Baudin barley. At two locations (Chris Tomlinson and Mark Wood sites), net blotch was not observed on the “trap plants” (Table 1); this may be due to at least one location (Chris Tomlinson) spraying herbicides on the trap plants to prevent the powdery mildew from spreading to nearby barley crop. At the second site (Mark Wood), the new barley crop (Baudin) was mainly affected by powdery mildew and leaf rust. The crop was on a previous season canola stubble and no barley was grown close to the site. Of note is the detection of net blotch symptoms on “trap plants” observed 6 to 15 weeks after the detection of net blotch spores in the spore traps.

Barley leaf rust symptoms on “trap plants” were observed only at four locations and initially detected on the 15th of July (Table 1). At the other three locations, symptoms were observed from the 26th of August to the 3rd of September. The “trap plants” observed symptoms 6 to 8 weeks after the detection of rust spores in the spore traps.

Barley powdery mildew conidia were trapped at all sites post sowing. The first visible powdery mildew symptom on the “trap plants” were observed at six sites from the 24th of June to the 12th of August and three sites were unaffected (Table 1). At these sites the first powdery mildew symptoms on “trap plants” were observed from 3 to 9 weeks after detection in the spore traps.

Most of the leaf rust, powdery mildew and net blotch spores were trapped from the 3rd of June to the 28th of October, from the 29th of April to the 9th of September and from the 22nd of April to the 28th of October respectively (Table 2). The weather data analysis revealed that the average temperature and the optimum temperature requirements for the three diseases were similar. Compared to 2013, barley leaf rust urediniospores, net blotch conidia and *Alternaria* spores germinating on the slides of spore traps were not observed in 2014.

The most notable detection by spore trapping was spot blotch disease caused by the pathogenic *Bipolaris sorokiniana* conidia from the South Stirling to Wellstead sites.

Table 2. Rainfall and the temperature conditions during the period when the spores were trapped.

Spores	Pathogen Trapped	Rainfall (mm)	No of Rainy Days	av Temp* ℃	Optimum Temp ℃
Barley Leaf Rust	3 June to 28 Oct	218.5	37	7 - 22	14 - 17
Powdery Mildew	29 April to 9 Sept	222	42	7 - 20	12 - 16
Net Blotch	22 April to 28 Oct	300	52	7 - 22	12 -1 8

Note: *average temperature (daily minimum + daily maximum temperature)

Conclusion

The detection of fungal spores in the spore traps before detection of the respective disease/s in the unprotected crops provides an early warning in the particular environment for farmers to make decisions about crop protection and provide greater peace of mind.

Key words

barley, airborne plant pathogens, spore trapping

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