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Protecting WA Crops

Contents

The 2025 GRDC Grains Research Updates, showcases the latest research and results from across the grains industry.

Several Crop Protection researchers from the Department of Primary Industries and Regional Development (DPIRD) were among the industry experts presenting on a variety of topical issues.

In this issue of Protecting WA Crops, we spotlight the presentations delivered by DPIRD Senior Research Scientist Ciara Beard and Research Scientist Jason Bradley.

Managing lupin sclerotinia: know your risk and how to respond

At a glance:

- Sclerotinia prevalence, particularly basal sclerotinia (ground level infection) has increased significantly in Western Australia in the last five years. Since 2020, commercial crop surveys have found basal sclerotinia is more common in lupins than in canola, and it is difficult to manage.
- A collaborative research project has found sclerotinia infects narrow-leaf lupin via two pathways: canopy and basal. Basal infection (which occurs at ground level) is more damaging, causing around 60% yield loss on infected plants, while canopy infection can cause up to 25% yield loss, mainly by infecting the main spike pods.

- A lupin sclerotinia disease risk assessment guide has been developed from field data which allows for yield loss estimation based on disease incidence.
- An integrated disease management strategy for sclerotinia canopy infection is being developed using data from 2021–2024 field trials.
- Effective options for reducing basal sclerotinia infection in lupins are currently limited, as foliar fungicide applied during crop flowering is often ineffective. Ongoing research aims to identify the drivers for basal infection and potential management strategies.

WA lupin crops are increasingly affected by sclerotinia stem rot, caused by *Sclerotinia sclerotiorum*. This disease can significantly reduce yields in conducive growing seasons (regular rainfall, temperatures 16–25°C). The inoculum (sclerotia) is widespread across the Western Australian (WA) grainbelt, and due to the long-term survival of sclerotia, paddocks sown in the past six years to canola or lupins should be assumed to be at risk of infection. Managing the disease is challenging due to the lack of resistant lupin varieties, its sporadic nature, the need to apply foliar fungicide before symptoms appear and challenges in fungicide application reaching the soil level to manage basal infection.

A collaborative project involving research partners—Department of Primary Industries and Regional Development (DPIRD), the Centre for Crop Disease Management (CCDM), Mingenew Irwin Group (MIG), and lupin growers—conducted extensive laboratory, glasshouse, and field research between 2021 and 2025 to better understand sclerotinia infection in lupins, its infection process, and potential management strategies.

Sclerotinia sclerotiorum is the dominant sclerotinia species affecting WA lupin crops, with DPIRD annual commercial crop surveys from 2021–2024 finding the pathogen widely distributed across the WA grainbelt, with few cases of *Sclerotinia minor* observed. Surveys found a higher prevalence of crop infection within the Geraldton port zone (GPZ) and Kwinana North port zone (KNPZ), especially in wet seasons, compared to the Albany port zone (APZ). Sclerotinia infection occurred via two pathways: canopy and ground level infection (basal). CCDM screening of lupin varieties using local WA sclerotinia isolates revealed disease outcome was highly variable, with several isolates more aggressive than others, leading to higher yield loss or production of greater sclerotia numbers. However, no geographical pattern was found for aggressive isolates, and lupin variety responses varied significantly, although all varieties tested were susceptible. Genetic resistance is not yet available; all lupin varieties currently available in WA are susceptible to sclerotinia infection, as observed in pot experiments, field trials, and a National Variety Testing Trial (NVT) at Mingenew in 2024.

Risk factors for sclerotinia infection

To identify which lupin crops need managing for sclerotinia, it is crucial to understand the risk factors. Field trials and monitoring sites have confirmed that sclerotinia risk is higher in lupin crops grown in paddocks with a history of sclerotinia disease, high plant density, loamy soil type, early canopy closure and good yield potential, especially in seasons with ongoing moisture during winter and spring. More information is available in the Grain Research and Development Corporation's (GRDC) Lupin sclerotinia disease risk assessment guide.

In the medium/high rainfall regions of GPZ and KNPZ, sclerotinia infection in lupins is more likely to occur early in the growing season and reach high incidence and severity due to close rotation with previously infected canola, and favourable weather conditions (milder winter temperatures, i.e. more days >16°C). Consequently, the greatest yield impact occurs in these port zones. Research from 2021–2024 found that for cooler southern regions, sclerotinia incidence within crops was low and occurred later in the season, resulting in minor or negligible yield losses.

Canopy infection process and yield impact

In the field, sclerotinia canopy infection can develop rapidly under favourable warm and wet conditions (relative humidity >80% and temperature 20–25°C), with sclerotinia disease producing visible symptoms in lupins within seven days. In laboratory experiments, CCDM determined, by using confocal microscopy, that ascospore germination can occur within 24 hours under optimal conditions, with visible symptoms observed within 2–5 days. Both glasshouse and laboratory experiments revealed lupin pods developed necrosis before leaves, usually commencing at the pod base where senescing petals are located. This correlates with DPIRD field observations where the main spike pods are the most commonly infected plant part (rather than stems, as occurs in canola), causing significant yield loss in lupin. Infected lupin petals often remain *in situ*, directly infecting emerging pods, however infected petals can also drop onto leaves, which then wrap around stems and pods, causing further infection. In 2024, commercial crops in KNPZ and GPZ showed an average dry seed weight loss of 26% in plants infected with canopy sclerotinia. A model has been developed from field trials that allows yield loss estimation from disease incidence. Grain quality can be affected by sclerotia contaminating the grain at harvest necessitating grading to meet delivery standards. Research has found the source is often sclerotia formed in and outside pods and branches.

Basal infection process and yield impact

CCDM laboratory research found that myceliogenic germination of sclerotia can occur on relatively dry soil, (e.g. 40% water holding capacity), but nearly saturated soil is needed for it to persist, expand and cause basal sclerotinia in lupins. Basal sclerotinia is usually first identified by wilting plants and fungal mycelium at the plant base, typically seen during crop flowering when leaf drop is underway (about three months after emergence in northern port zones). It can cause early maturation/death of plants or reduce pod formation and grain fill. The disease often spreads to nearby plants, leading to patchy infection areas. Crops that lodge are more susceptible to infection spread. In 2024, KNPZ and GPZ crops showed an average 57% dry seed weight loss in infected plants.

Basal sclerotinia in lupin may be caused by one of two infection routes – direct myceliogenic germination of sclerotia in the soil or canopy infection spreading to the ground (through dropping infected plant parts). CCDM pot experiments found fallen petals and pods can initiate stem base infection, also observed by DPIRD in the field along with fallen infected leaves.

Basal infection at high disease pressure can potentially reduce root and shoot growth in lupins. DPIRD Northam pot experiments conducted under wet humid conditions showed basal infection (induced by adding sclerotinia mycelium to soil) significantly reduced fresh shoot and root weight, dry root weight, total root length, root surface area, and average root diameter.

Agronomic/cultural management strategies

Non-chemical strategies include crop rotation (reducing frequency of broad leaf crops in high-risk paddocks), using clean seed (grading out sclerotia), delaying time of sowing, and reducing crop density through wider row spacing and/or lower seed rate. Three out of four time of sowing trials conducted annually near Geraldton from 2021–2024 found the earlier sown lupins (April/May) developed infection earlier and had significantly higher incidence of canopy sclerotinia and yield impact than the later sown (May/June) lupins. In three out of five density trials conducted in the GPZ from 2022–2024, a high seed rate significantly increased canopy infection. One trial also showed higher basal infection at high seed rates (160 kg/ha ~ 60 plants/m²) compared to medium (80 kg/ha ~ 40 plants/m²) and low (40 kg/ha ~ 20 plants/m²) seed rates. Analysis of relative humidity under the crop canopy found lowering the seed rate allowed for better airflow (interrupting prolonged periods of high humidity) compared to higher seed rates. In two out of the five trials the highest seed rate (125–160 kg/ha) had significantly more sclerotia contamination in the grain than the lower seed rates. These findings suggest that using the standard seed rate of 90-100 kg/ha, or even reducing it, could be beneficial in paddock areas with high sclerotinia risk. Although further research is needed to assess the economic and agronomic impacts, five out of seven density trials showed no yield penalty from significantly reducing the seeding rate, (e.g. to 60 kg/ha ~ 30 plants/m²). In fact, in one GPZ 2024 trial (decile 9 winter), the lowest seed rate outperformed higher seed rates. This trial, which is the only one to date providing valuable results on row spacing and seed rate, found that low seed rate combined with wide row spacing significantly reduced canopy infection compared to denser and narrower plots. Additionally, wide row spacing improved the effectiveness of fungicide in reducing canopy infection. Further research is needed to confirm the broader applicability of these findings.

Chemical management strategies

DPIRD field research found that application of a foliar fungicide at late flower/early pod emergence on the main spike was consistently the best timing to reduce canopy sclerotinia infection and yield loss. Fungicide application in lupin should focus on protecting the emerging main spike pods (rather than the main stem as in canola), which is a vulnerable stage in lupin development.

While fungicide can be effective for reducing canopy infection, it does not always result in a yield response or a positive economic return. In all the field trials conducted from 2021–2024 by DPIRD, MIG and lupin growers, yield response in lupin was highly variable. In the 24 trials conducted in years conducive to disease (2021, 2022, and 2024), where a single foliar fungicide was applied and sclerotinia was the dominant disease, 42% (10 trials) showed a statistically significant yield gain from the fungicide application during crop flowering/early pod emergence (Table 1). Of those 10 trials, nine were in the GPZ and one in the KNPZ. The average yield gain was 10% (0.3 t/ha), resulting in a profit of $20 to $75/ha. This assumes a lupin price of $375/t and fungicide application costs ranging from $38 to $93/ha, depending on the product used. Site specific weather and canopy conditions significantly influence disease development, with a higher chance of significant disease levels and yield gain from fungicide application in the GPZ followed by the high rainfall KNPZ.

Table 1. Field trials conducted from 2021–2024 where sclerotinia was the dominant disease present and application of a foliar fungicide provided a significant yield response.

All trials to meet these criteria were on narrow-leaf lupin (SSP= sown small plot, GS = grower paddock, O = opportunistic small plot in grower crop).

Port zone	Location	Year	Type of trial	Canopy Sclerotinia incidence (%)	Yield of untreated (t/ha)	Yield gain from fungicide (t/ha)	Yield response to fungicide (% above untreated)	Sig. reduction in canopy inf from fungicide?	Sclerotia in grain at harvest?	Sig. reduction in sclerotia contamination from fungicide?
GPZ	Woorree	2021	SSP	59	3.0	0.6	20	Yes	Yes	Yes
GPZ	Nanson	2021	O	7	2.8	0.3	9	No	No	Not applicable
GPZ	Merkanooka	2021	GS	70	2.5	0.1	4	No	Yes	Yes
GPZ	Moonyoonooka	2022	O	39	2.8	0.3	11	Yes	Yes	No
GPZ	Bootenal	2022	GS	30	2.8	0.2	7	Not assessed	Yes	No
GPZ	Merkanooka	2022	GS	60	4.0	0.2	5	Not assessed	Yes	No
KPZ	Bolgart	2022	GS	18	3.5	0.2	5	yes	Yes	Yes
GPZ	Moonyoonooka	2024	SSP	50	2.2	0.4	15	Yes	Yes	No
GPZ	Mount Horner	2024	GS	11	0.8	0.2	25	Yes	No	Not applicable
GPZ	Merkanooka	2024	GS	5	2.5	0.06	3	No	Yes	No
Average across all trials:				35	2.7	0.25	10.5			

Observations from the field research were that:

- To determine whether a management strategy is likely to be profitable, it is first important to carefully assess if crops meet the high-risk criteria (history of sclerotinia, loamy soil type, early canopy closure and dense crop) and also that the outlook is for favourable (wet) weather conditions. If the crop is considered at high risk, it could be valuable to apply a foliar fungicide when pods are first emerging on the main spike.
- A significant yield response to foliar fungicide is more likely when canopy sclerotinia incidence at crop maturity reaches at least 30%. While this threshold may not be useful for the current growing season (as a fungicide treatment should be applied before significant infection), it indicates that moderate infection is required for cost-effective fungicide use. This infection level was mainly observed in the GPZ (six out of 10 trials had greater than 30% infection, Table 1). In contrast, in 20 trials across GPZ, KNPZ, and APZ with no significant yield response, 16 trials had an average infection of less than 30%.
- Foliar fungicides are most effective when applied as protectants before infection occurs. In an unusually wet winter, such as GPZ in 2024, fungicides may need to be applied earlier than the late flower/early pod emergence stage. This is because the infection can start earlier, be more intense, and may already be present within plant tissues even if not visible.
- Yield gain from foliar fungicide is more likely in growing seasons with a wet spring when other diseases like anthracnose and phomopsis are also present. In anthracnose risk areas such as the GPZ, a registered foliar fungicide applied during crop flowering/early pod to albus lupin variety Amira can be particularly advantageous, as it may help reduce the impact of both anthracnose and sclerotinia. In two trials conducted

in grower crops (both in GPZ, one in 2021 and one in 2022), sclerotinia incidence in the untreated control was 40–60% of plants, anthracnose incidence was 90%, and the yield response from a foliar fungicide application was 0.4t/ha (50-100% yield gain above the untreated control).

- In most cases basal sclerotinia will not be reduced by foliar fungicide applied during crop flowering, as the fungicide struggles to reach infection at or below ground level. Only five out of 24 field trials that had basal infection present, had a significant reduction in basal infection from a foliar fungicide applied at late flowering or early pod emergence on the main spike.
- Sclerotia contamination of harvested grain is highly variable and is not consistently reduced by a foliar fungicide application during crop flowering. Of 21 foliar fungicide field trials conducted from 2021-2024 that had sclerotia contamination in grain at harvest, foliar fungicide significantly reduced contamination in only five trials (24%).

Pot experiments at DPIRD Northam are investigating whether impact of basal infection on lupin plants can be reduced through fungicide seed treatments and soil application of foliar fungicides, although no products are currently registered for this use. Laboratory experiments by CCDM found mycelium growth of 11 diverse WA sclerotinia isolates grown on agar plates was completely inhibited when amended with the active ingredients of some registered foliar fungicides at commercial rates.

Future research

Novel methods were developed at CCDM for producing consistent sclerotinia infection in lupin (canopy and basal) and canola which has enabled high-throughput phenotyping for Sclerotinia resistance. Using this phenotyping method, over 500 lupin wild-type and breeding lines will be assessed in glasshouse and field experiments within a new Western Australia Agricultural Research Collaboration (WAARC)/GRDC-invested project (DAW2305-006RTX Increasing stable lupin productivity through enhanced disease resistances). In the future there are plans for a lupin sclerotinia decision support tool (app) to be developed by the DPIRD disease modelling team. Further research is required to determine potential management options for basal sclerotinia in lupin which may include innovative fungicide application techniques, use of biological agents and development of resistant varieties.

Further Information

For more information on sclerotinia refer to DPIRD's Sclerotinia stem rot and its management in lupins and Registered Foliar and in-furrow/seeding fungicides webpages.

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Hamersley and Ben Webb) and agronomists, consultants, chemical representatives who have assisted. Thank you to Kanch Wickramarachchi, DPIRD Research Scientist, for providing equipment and assisting with the root scanning work at DPIRD Northam. We gratefully acknowledge use of the CCDM Sclerotinia reference isolate collection.

Outcomes from 5 years researching spot form net blotch management in low rainfall areas

Severe lesions of spot type net blotch. Image: DPIRD.

At a glance:

- In lower rainfall environments, application of fungicide for spot form net blotch (SFNB) is unlikely to have a consistent yield impact. Across 15 trials between 2021 -2024 the maximum yield response achieved from multiple fungicide sprays was 580 kg/ha with the average response across all trials being 108 kg/ha. The trials conducted within the 5-year project supports the findings from a meta-analysis of 31 DPIRD field trials (1985-2022) in the low rainfall zone in which only 4 trials had a significant yield response to fungicide application with an average response of 113 kg/ha (median 90kg/ha).
- Alternate integrated disease management approaches, including variety resistance and crop rotation, should form a larger part of SFNB management in lower rainfall environment.
- Improved variety resistance to SFNB reduces disease severity in-season and reduces stubble infectivity.
- Rotation is an effective tool for SFNB, spore production on stubble is greatest in its first year after harvest and diminishes in subsequent years as stubble residues degrade.
- Scald contamination in field trials was shown to have a greater influence on yield response to fungicide application than SFNB.

A five-year project led by the Department of Primary Industries and Regional Development (DPIRD), with co-investment from the Grains Research and Development Corporation (GRDC), is approaching completion. The project was initiated in response to spot form net blotch (SFNB) emerging as the leading foliar disease in barley across all agricultural regions of Western Australia, including the low rainfall zone (LRZ). Its objective was to analyse historical DPIRD data and generate new insights into the economic impact of SFNB and the influence of crop management practices on disease development in the LRZ.

In 2021, over 90% of sowings by area were to varieties rated as being susceptible or worse to SFNB, and over 75% of paddocks were visibly affected by SFNB. Whilst it is common for fungicide applications to be scheduled into paddock planning in medium to high rainfall areas, where there is a greater chance of disease development into upper canopies and of yield response, there is a greater need for strategic control measures in low rainfall zones, which experience variable seasonal rainfall and no guarantee of finishing rains to drive disease development and help crops achieve their yield potential. .

Spot form net blotch is a stubble-borne necrotrophic disease. It requires both rain events and temperatures between 15-25°C to produce and release spores from stubble and to infect new crops. Barley on barley rotations are more common in LRZ farming systems and can expose seedling crops to high, early disease pressure leading to SFNB development with favourable winter growing conditions. During the growing season, rain events promote production of spores from infection on lower leaves that are dispersed through the crop canopy causing secondary infection. Upfront fungicides (on seed or fertiliser) or in-crop foliar applications can protect crops, but they are a cost that may not be recouped in a dry season.

Given the epidemiology of the disease and increased stubble retention in the farming system, it is important to understand and quantify how factors such as variety, fungicide, and weathering contribute to disease carryover from the previous year's barley crops in barley-on-barley rotations.

Several newer varieties with improved resistance to SFNB have been released during the life of the project. The impact of these varieties on disease progress and yield is of interest to growers in the LRZ, where a response to fungicide is not guaranteed.

Historical and current trial metanalysis

Of the 31 DPIRD trials analysed (conducted between 1985-2022), 90% had a statistically significant reduction of SFNB severity from two foliar fungicide treatments. However, this was not necessarily coupled with yield response, only 13% of trials showed a significant increase over untreated, with an average response of 113 kg/ha (median 90kg/ha). There was, however, a potential benefit in improved grain quality from fungicide treatment with an increase in retentions in 25% of trials. Analysis of SFNB disease and yield response to management, coupled with climatic factors, failed to clearly identify a key driver of response in this environment.

Spot form net blotch disease management field trials

A total of 15 trials—including six in-crop demonstration trials in growers' barley-on-barley paddocks—were conducted across the 2021 to 2024 seasons in the eastern and south-eastern grainbelt. The trials aimed to assess various control strategies for spot form net blotch (SFNB), including varietal selection, fungicide application, time of sowing, and the resulting impacts on grain yield and quality. All trials were sown into barley stubble to replicate a barley-on-barley rotation and provide a natural source of SFNB inoculum. SFNB was the primary disease present in 12 of the trials. Three trials were excluded from the overall analysis due to the presence of barley scald as a major impact on yield.

SFNB levels in management trials varied between site, variety and year (climate). Rainfall for the field trial sites between 1 May to 31 October ranged between 118mm (Merredin 2023) -277mm (Mt Hampton 2021).

Across all trials, SFNB (%Leaf Area Affected) on untreated Maximus CL ranged between 2-6% with an average of nearly 4%. Spartacus CL consistently had higher disease levels in management trials, ranging from 3-14% and averaging 6%. An opportunistic trial of untreated Spartacus CL reached 21%, demonstrating the potential disease level with a conducive environment. This suggests that in the lower rainfall environments, SFNB may have 100% incidence in a paddock but does not reach potentially yield limiting severity in the upper canopy due to drier spring weather not supporting disease development.

Fungicides were effective in disease control, significantly reducing SFNB severity in over 80% of the trials, although the treatment x variety interaction was only significant in 30%.

Statistically significant yield responses did not occur in any trial, however at some sites differences between varieties were evident. Untreated Maximus CL yielded higher than untreated Spartacus CL in over 80% of the trials. Susceptible varieties had a larger response to treatment and treated Spartacus CL had higher yield than treated Maximus CL in 30% of trials.

Fungicide treatment increased retentions in over 80% of trials, similar to the findings of the meta-analysis of historical trial data. Both retentions and grain weight responses were differentially affected by variety. Retentions increased by nearly 7% in Spartacus CL and only 1% in Maximus CL.

Table 1. Summary of results from 6 experimental trials (2021-2024) carried out in the project examining spot form net blotch (SFNB) severity and yield impacts. Results are average variety x treatment responses comparing Untreated and Full control (at least 2x fungicide application) for disease severity, grain yield and grain quality data.

Variety	Resistance	SFNB (%LAA)		Yield (kg/ha)		Retentions (% sample>2.5mm)		1000 seed weight (g)	
		Untreated	2 Sprays	Untreated	2 Sprays	Untreated	2 Sprays	Untreated	2 Sprays
Spartacus	SVS	6.0	2.1	2765	2918	80.9	87.7	38.7	40.4
Maximus	MSS	3.7	1.9	2960	3013	90.6	91.5	41.9	42.5

At 2 sites where barley scald had similar or greater severity than SFNB, yield responses to fungicide application were greater than in all other trials, suggesting that this disease may be an emerging concern for growers of susceptible varieties (Table 2). Both trials had relatively low SFNB levels, except for in untreated RGT Planet barley. Both Maximus CL and Spartacus CL had high scald infection, which may have reduced the SFNB development in these varieties. The varietal resistance in Neo CL was effective, with low levels of both diseases. There were significant yield increases from 2 fungicide treatments in Maximus CL and Spartacus CL ranging from 200-900kg (average 530kg), whereas in the more scald and SFNB resistant variety Neo CL, yield response averaged 132kg. Interestingly at this site high levels of SFNB (19%) in RGT Planet resulted in 285 kg/ha yield response.

Table 2. Summary of results from three project trials confounded by levels of barley scald virulent on Maximus CL and Spartacus CL. Results are average variety x treatment responses comparing Nil (untreated) and Full control (at least 2x fungicide application) for disease severity, grain yield and grain retention data.

Variety	Resistance		SFNB (%LAA)		Scald (%LAA)		Yield (kg/ha)		Retentions (% sample>2.5mm)	
	SFNB	Scald	Untreated	2 sprays	Untreated	2 sprays	Untreated	2 sprays	Untreated	2 sprays
Spartacus	SVS	MR*	3	3	24	6	3023	3620	51	71
Planet	S	MR	19	5	0	0	3480	3765	59	69
Maximus	MSS	MR*	4	3	13	2	3452	3918	56	70
Neo	MRMS	MRp	2	1	1	0	3894	4026	69	70

Spore production on stubble and degradation over time

Mesh packets with 50g of Spartacus CL stubble from Nungarin (2021) were distributed in the LRZ eastern grainbelt region, covering a transect from Northam to Merredin to Moorine Rock (a rainfall gradient on a similar longitude). The stubble packets were collected and examined on a regular basis from all three sites for the presence of conidia and mature pseudothecia (producing ascospores).

Conidia (asexual spores) were detected on stubble from the start of the observation period and continued to be detected throughout the 3 seasons of observation. At all sites the surface area of stubble producing conidia was greatest in year 1 (2022), reducing by 60—80% by year 2 and 3 (2023 & 2024). Conidia production (area of stubble pieces with condia present) was greatest at the Northam site.

Pseudothecia (sexual fruiting bodies) were evident at each site within 3 months of the stubble packets being deployed. The number of pseudothecia counted, and the regularity of them being detected, was greater at Northam and Merredin than at Moorine Rock. Mature pseudothecia containing ascospores were detected after 5 months exposure of stubble at Northam and Merredin, and 6 months at Moorine Rock. The key difference between sites was the sporadic nature of detection of mature fruiting bodies at Merredin and Moorine Rock compared to Northam. Following a complete growing season and summer off-season (2022-2023), pseudothecia continued to be detected at all sites at similar frequency, however the incidence of pseudothecia with mature and viable ascospores diminished. In some cases, ascospores that were immature prior to summer were desiccated and damaged and did not recover as conditions became cooler and damper in the following season. Formation of ascospores in pseudothecia following summer did not equate to the levels prior to summer.

Stubble persistence with crop rotation

Samples of barley stubble were collected from focus paddocks after seeding and harvest over a period of 4 years and assessed for the degradation of barley residue and the impact of rotation on persistence.

Whilst there was variability within and between paddocks, stubble load was significantly reduced by any rotation away from barley. Within the following growing season, barley crop residues decreased by an average of 40% across measured sites. Continued reduction was evident in the second year, in some cases minimal stubble was present after 2-years rotation way from barley. In barley-on-barley rotations the total quantity of barley stubble increased over time.

Disease carryover from stubble

In three separate field trial activities at DPIRD Merredin research station, factors that reduced SFNB infection in the previous season reduced inoculum pressure of stubble in the following season, subsequently reducing disease in seedling / tillering plants growing through the stubble.

In variety x management trials sown over stubble blocks of untreated Maximus CL (MSS) or Spartacus CL (SVS), stubble variety affected SFNB disease on tillering plants in the following crop. Disease was greater following Spartacus CL than Maximus CL.

In Spartacus CL barley bulk sown into the stubble of a variety x management trial (2023), fungicide treatment in the previous season had the greatest influence in SFNB disease level in the following crop (F pr. <0.001). Stubble variety impacted SFNB severity, however, the differences were not significant. A repeat of the experiment in the following year involved planting bulk RGT Planet (SVS) over a variety x management trial. There was a similar response, with a significant reduction in disease levels on tillering plants from fungicide treatment in the previous season (F pr. 0.014).

Pot trials at South Perth examining the effects of carryover of SFNB in stubble had SFNB infected stubble from Wialki and Merredin spread as 1m x 1m squares held under wire mesh to limit wind transport. The rate of application was 0.5kg / m^2 of straw evenly spread, corresponding to a 3 t/ha yield and a retained stubble load of 5t/ha. Seedlings of Spartacus CL (SVS) were grown in 100mm diameter pots and placed in the centre of each stubble square as 2 leaf seedlings, acting as trap plants to monitor spore release from stubble.

The trap plants placed over infected stubble were replaced after two weeks exposure and severity of infection subsequently developing on plants demonstrated the quantity of spores released in a two-week period, as well as factors which influenced spore release and disease development. Stubble exposure produced infection on trap plants throughout the growing season, from the first fortnight of exposure in April continuing till the end of October. The highest number of lesions occurred between June- August, promoted by a combination of average day temperatures between 18-20^{o}C and more frequent rain events. Warmer, drier conditions in March and September-October corresponded to lower lesion counts.

Stubble age impacted infectivity, there were higher lesion counts on trap plants over stubble in its first year of exposure compared to the same stubble in its second year of exposure.

Trap plant exposure supported field disease carryover experiments, with lower lesion counts on trap plants over crop residues from fungicide treated plots crop residues than from untreated plots.

Conclusion

- Management of spot form net blotch (SFNB) in lower rainfall environments should encompass all aspects of an integrated disease management program.
- Fungicide management of SFNB in low rainfall areas in Western Australia will consistently reduce disease severity. Significant yield responses can occur however have been rare. Additional benefit from fungicide application may include improved grain quality (even in absence of yield response) or reduced carryover of disease on stubble.
- Choosing varieties with improved resistance to SFNB will reduce disease severity in-season and reduce stubble infectivity in following seasons.
- At least a one-year break between barley crops should significantly reduce SFNB risk, because spore production on infected stubble is greatest in the first year after harvest, and both spore production and stubble residue levels diminish in subsequent seasons.
- As more resistant varieties become established in the farming system, SFNB should become less common in lower rainfall environments, which are generally less conducive to stubble- borne necrotrophic diseases.

Further Information

For more information on management of Spot form net blotch of barley refer to DPIRD's Spot type net blotch and its management in barley and Barley leaf diseases and their management webpages.

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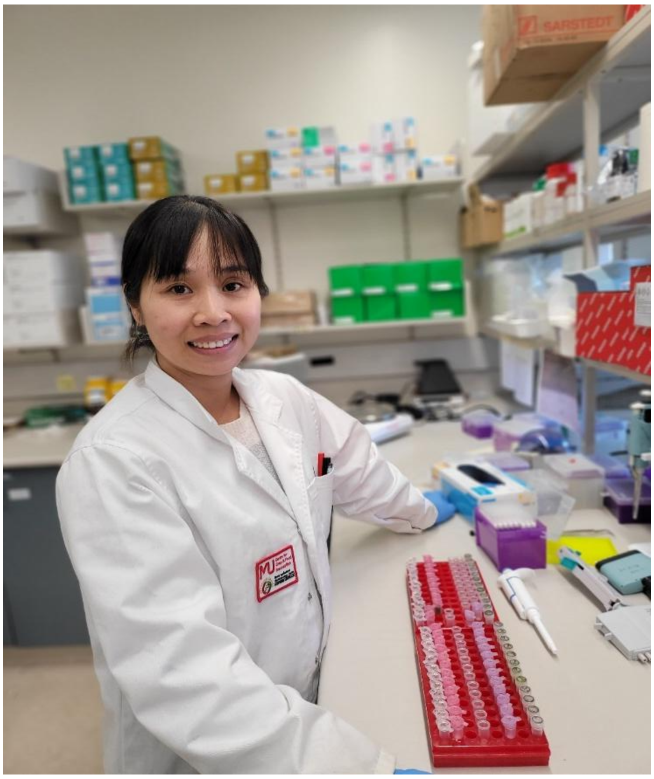
Meet Crop protection team member – Chi Cao



Chi is a research scientist in the department, working in the National Grains Diagnostic and Surveillance Initiative (NGDSI) to help develop rapid and precise diagnostic assays and procedures for detecting widespread crop viruses across Australia.

Originally from Vietnam, Chi grew up in a region where agriculture was a way of life. With both parents employed at the Vietnam Academy of Agriculture, she developed a strong connection to plant science from an early age. By the time she was 10, Chi already knew she wanted to become a "doctor of plants" — a dream that continues to drive her research today.

Chi earned a degree in Crop Protection from one of Vietnam's leading agricultural universities before pursuing a master's degree in biotechnology at Macquarie University. She later completed a PhD in plant virology at Murdoch University. Following her academic studies, Chi worked at Illumina, a global leader in sequencing technologies, where she gained extensive experience in nucleic acid sequencing and big data analysis.

In 2020, Chi joined the department as part of DPIRD's Diagnostic Laboratory Services (DDLS) team, where she responded to viral outbreaks in local crops by testing submitted plant samples for various viruses and sharing the results with growers to support more informed management decisions. She later transitioned to the Crop Protection team in 2023 where she continues to apply her expertise.