Management of mungbean powdery mildew

Lisa Kelly[1,2], Kirsty Owen[2], Neil Robinson[2], and Levente Kiss[2]

[1] Department of Agriculture and Fisheries, Toowoomba, Qld
[2] University of Southern Queensland, Centre for Crop Health, Toowoomba, Qld

Key words

disease, powdery mildew, mungbean, fungicide, pathogen

GRDC code

USQ2022-001RTX – Improving powdery mildew management in mungbean

Take home message

- Early sowing, variety choice and timely fungicide applications are crucial for powdery mildew management in mungbean
- Apply fungicide at the first sign of disease, and then 14 days later, to reduce disease severity
- Applying fungicides prior to disease establishment is not economical
- Using fungicides with two modes of action (MOA) is more effective than relying on a single active with one MOA.

Mungbean powdery mildew

Podosphaera xanthii and *Erysiphe vignae* are the causal agents of powdery mildew in mungbean throughout Australia (Kelly *et al.,* 2021). The fungal disease is commonly seen in all regions where mungbeans are grown in Australia, occurring each cropping season. In Queensland, disease outbreaks are commonly seen in summer planted crops during autumn. In historical field trials, the disease was reported to reduce yields in susceptible varieties by up to 40% when crops are infected prior to flowering, weather conditions are conducive for disease, and fungicides are not applied to manage disease.

Disease symptoms, survival and spread

Plants are susceptible to powdery mildew infection at all stages of growth. Initial signs of infection appear as small, circular, white powdery patches on the surface of leaves in the lower canopy. Symptoms can rapidly spread to the upper canopy during conducive weather conditions, covering the entire upper and lower leaf surfaces, petioles, stems, and occasionally pods. Fungal spores produced from these white patches become airborne and spread in the wind. These airborne spores eventually land on the leaf surface of a susceptible host, germinate, and infect the upper leaf layer and fungal hyphae begin to grow across the leaf surface. The cycle of infection from spore germination to later spore production can take as little as four days under conducive weather conditions. Mild temperatures and high relative humidity, but not free water, are ideal for infection and spread.

The fungal pathogens that cause powdery mildew require a living host to survive. Volunteer mungbean, black gram, and other Fabaceae weeds are a source of infection. The pathogens will not survive between cropping seasons in soil, crop residue, or in seed.

Disease management

Management of powdery mildew in mungbean crops relies heavily on using varieties with host resistance, sowing early to avoid infection, and on the strategic application of fungicides. The most common cultivar, Jade-AU$^{\phi}$ is considered moderately susceptible to powdery mildew

infection. Currently, Opal-AU(ϕ) offers the best source of host resistance, though fungicide application is still required.

Impact of temperature on pathogen growth

Disease outbreaks are frequently reported during autumn in crops growing across Queensland and northern New South Wales. A series of laboratory experiments were undertaken to establish the impact of temperature on the germination, infection, and early growth of the two pathogens causing powdery mildew in mungbean. Mungbean seedlings were inoculated with either *P. xanthii* or *E. vignae* and maintained at a constant temperature and 70% relative humidity until disease symptoms became apparent. Seven temperatures were assessed, ranging from 8˚C to 32˚C. Seedlings were checked daily to assess spore germination and symptom development.

The results revealed that the spores of both fungal species germinated within 24 hours of inoculation across all temperatures. The number of days between inoculation and beginning of sporulation was defined as the latent period. Despite germination, no infection occurred for both species maintained at 8 and 32˚C. Both species caused infection from 12–28˚C, though the latent period was shortest for *P. xanthii* at 20–28˚C, and 20–24˚C for *E. vignae*, occurring four days after inoculation in both species. These results provide an explanation why the disease frequently occurs in autumn in summer planted crops. Based on these findings, daily temperatures in summer would be too high for infection to occur in most regions. However, mungbeans growing in the cooler temperatures of autumn, are at a high risk of infection and will likely require fungicide management.

Fungicide management

Currently, tebuconazole and Veritas® Opti (a mixture of tebuconazole and azoxystrobin) fungicides are registered for the control of powdery mildew in mungbean. Tebuconazole is a demethylase inhibitor, DMI, (Group 3 mode of action) fungicide. Veritas® Opti has two modes of action, tebuconazole belonging to Group 3 and azoxystrobin belonging to the quinone outside inhibitor, QoI, (Group 11 mode of action) fungicide group. Information on fungicide modes of actions and resistance can be found at https://afren.com.au/understanding/#fungicides-moa. A powdery mildew management App, PowderyMildewMBM, is available to assist growers and advisors make fungicide management decisions.

Since 2022, plant pathology teams from the University of Southern Queensland (UniSQ) and the Queensland Department of Agriculture and Fisheries (QDAF) have conducted replicated field trials across southern Qld to assess the efficacy of the two registered fungicides, tebuconazole and Veritas® Opti, in controlling mungbean powdery mildew. In 2022, one field trial was conducted at UniSQ in Toowoomba. A second trial sown in 2022 in southern Qld was destroyed by floods. In 2023, field trials were undertaken at UniSQ (Toowoomba), Tosari Crop Research Station (Tummaville), and Kingaroy Research Station (Kingaroy). An additional three field trials have been conducted in 2024 and are currently being evaluated. The mung bean cv. Jade-AU(ϕ) was sown between late December and mid-February for all trials. Each trial was naturally infected with powdery mildew. Table 1 details the treatments assessed in replicated field trials.

Table 1. Fungicide treatments applied to replicated field trials, 2022–2024

Treatment No.	Fungicide details	Code	No. fungicide sprays
1	One spray of tebuconazole at the first sign of disease	Teb x1	1
2	One spray of Veritas® Opti, low rate (250 mL/ha), at the first sign of disease	Veritas x1	1
3	Two sprays of tebuconazole, the first applied at the first sign of disease and then a second two weeks later	Teb x2	2
4	Two sprays of Veritas® Opti, low rate (250 mL/ha), the first applied at the first sign of disease and then a second two weeks later	Veritas x2	2
5	Common Industry Practice #1: One spray with tebuconazole (mixed with an insecticide) at the first sign of disease and a second spray with tebuconazole (mixed with an insecticide) two weeks later	Teb x2 insect	2
6	No fungicide applications	Control	0
7	Common Industry Practice #2: One preventative spray with tebuconazole (mixed with an insecticide), a second spray of tebuconazole (mixed with an insecticide) at the first sign of disease, and a third spray with tebuconazole (mixed with an insecticide). Each fungicide application was two weeks apart	Teb x3	3
8	One spray of Veritas® Opti, HIGH rate (320 mL/ha), at the first sign of disease	Veritas HIGH x1	1
9	Two sprays of Veritas® Opti, HIGH rate (320 mL/ha), the first applied at the first sign of disease and then a second two weeks later	Veritas HIGH x2	2

Plots were rated for disease incidence according to a 1–9 scale where 1 = no disease, and 9 = colonies of powdery mildew throughout the plant canopy, to the top leaves of every plant with defoliation. Disease severity was rated on the 1–5 scale, where 1 = no powdery mildew colonies observed, and 5 = severe infection covering more than 75% of leaf area. Biomass and yield was determined. Unfortunately, the 2022 trials were unable to be harvested due to weather conditions.

The 2023 mungbean cropping season was warmer than average and less conducive for early development of powdery mildew disease. Consequently, infection was delayed until late flowering/early podding, and although disease incidence and severity was moderate to high by plant maturity, the impact of disease on yield was minor. As a result of these warmer conditions, there was no significant difference in yield between the untreated control and fungicide treatments in 2023.

In all trials in 2023, disease incidence and severity were lower in the fungicide treatments compared to the untreated control. Figure 1 displays the disease severity for each treatment in the 2023 field trial at the Tosari Crop Research Station. Disease severity was significantly reduced by the fungicide treatments compared to the control ($P<0.001$). Disease severity was

similar across all fungicide treatments. Severity was greatest in the control (rating: 3.5) and least in tebuconazole applied three times (Teb x3) and the Veritas® Opti applied once or applied twice (rating: 2).

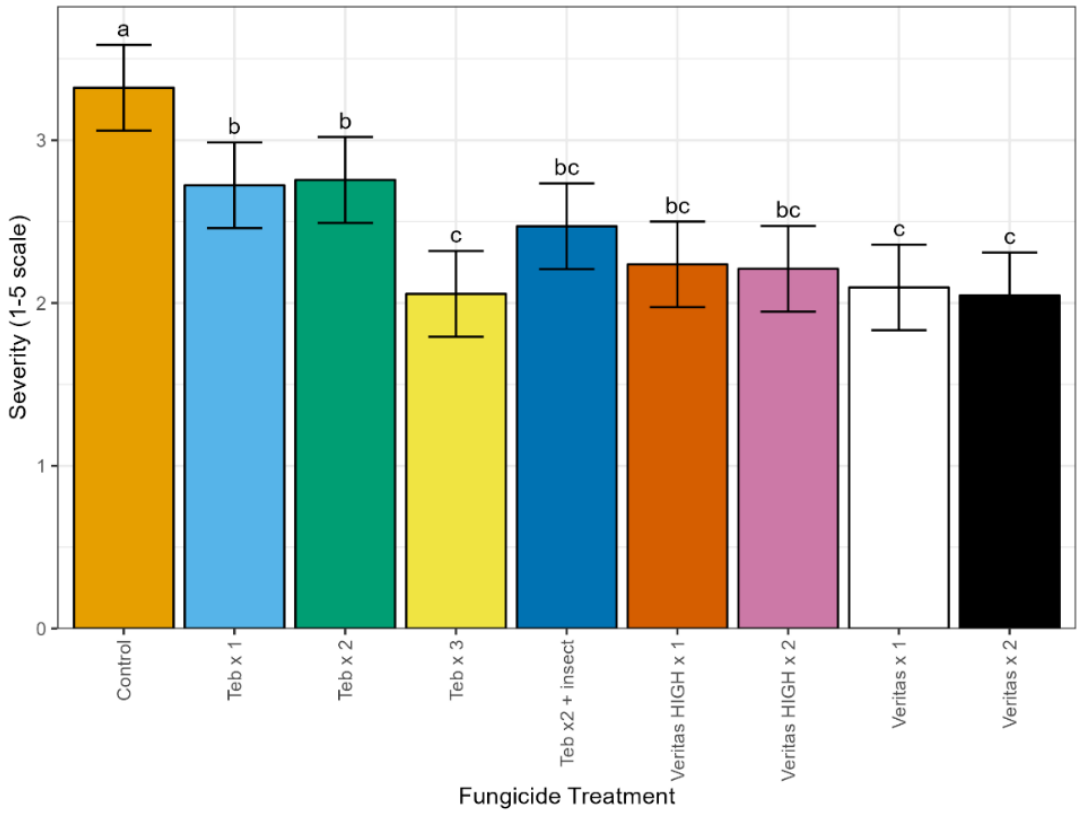

Figure 1. The severity of powdery mildew on mungbean cv. Jade-AU(b) at the Tosari Crop Research Station (treatment main effect, *P*=0.0179). The crop was sown on 20 December 2022 and powdery mildew first appeared on 10 February 2023. The fungicide applications and codes are detailed in Table 1.

Conclusions

Powdery mildew in mungbean is currently managed by sowing early to avoid infection in crops prior to flowering, and through the strategic use of fungicides. Historical field trials revealed the disease can reduce yields by more than 40% without management. It is not known whether one, or both, species caused that yield loss. Future research should investigate the yield impact caused by individual species. Growers have reported that the effectiveness of their herbicide application to desiccate plants prior to harvest has been less effective in mungbean crops infected with powdery mildew. Further research should investigate this interaction.

The results of these field trials revealed that fungicides with two modes of action were more effective than one. In field trials, no fungicide controlled powdery mildew completely. Fungicides with other modes of actions registered in other crops against powdery mildew should be investigated as an option in mungbean. The risk of fungicide resistance is a significant threat to the mungbean industry, and the unnecessary application of fungicides should be avoided. Further information on minimising the risk of fungicide resistance can be found at https://afren.com.au/understanding/. Breeding for host resistance to the powdery mildew pathogens should also remain a priority for the mungbean industry.

Links to websites

Fungicide modes of action (ARFEN)

Fungicide resistance (AFREN)

PowderyMildewMBM app information (DPIRD)

References

Kelly LA, Vaghefi N, Bransgrove K, Fechner NA, Stuart K, Pandey AK Sharma M, Zemeth MZ, Liu SY, Tang, SR, Nair RM, Douglas CA and Kiss L (2021) One crop disease, how many pathogens? *Podosphaera xanthii* and *Erysiphe vignae* sp. nov. identified as the two species that cause powdery mildew of mungbean (*Vigna radiata*) and black gram (*V. mungo*) in Australia. *Phytopathology*, 111 (7), 1193-1206

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the author would like to thank them for their continued support.

Contact details

Lisa Kelly
Department of Agriculture and Fisheries
Toowoomba, Queensland
Email: lisa.kelly@daf.qld.gov.au

Date published

July 2024