INFECTION TO PROTECTION

NET FORM NET BLOTCH

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This page expands on the key concepts introduced in the 'Infection to Protection- net form net blotch' information sheet, providing further detail on net form net blotch (NFNB), including what it is, what the risk factors are, a detailed explanation of the disease cycle and further information on fungicide resistance.

We've provided these additional explanations and supporting information to provide more detail on NFNB, highlighting its relevance to barley production and resources which may be useful in the pre-seeding stage.

What is it?

Net form net blotch (NFNB) is one of the two blotch diseases of barley, with the other being spot form net blotch (SFNB) which is closely related but a separate disease.

Net form net blotch is caused by the pathogen *Pyrenophora teres* f. *teres* (Ptt). As the name suggests NFNB has characteristic netting symptoms resulting from lesions along the leaf veins (Ellwood & Wallwork, 2019). Symptoms start as pinpoint brown lesions which elongate and produce fine, dark brown streaks along the leaf creating the net-like pattern (Martin , et al., 2021). It is one of the major damaging diseases of barley with reported yield losses of over 30% (Ellwood & Wallwork, 2019), from lesions which can cause leaves to completely drop off and weaken stems.

The pathogen Ptt can persist in the field on stubble from previous crops, spread through wind and rain splash throughout the growing season and is readily dispersed on infected seed material. The main reproductive process throughout the growing season is through asexual spores which reproduce rapidly and spread easily due to the virulent nature of the pathogen (Ellwood & Wallwork, 2019). The diverse nature of NFNB population enables a wide range of virulence's and rapid adaptation to selection pressures, increasing resistance breakdown in barley varieties (Ellwood & Wallwork, 2019).

Risk factors

Risk factors of NFNB primarily include the environmental conditions that favour infection, crop management practices increasing risk of infection, host factors and pathogen factors which influence the development of the infection (Snyman, 2022).

Table 1: An overview of the risk factors related to NFNB.

Category	*Risk factor*	*Risk level*	*Explanation*
Environment	Mild weather (15°C – 25°C)	High	Infection is favoured by mild weather.
	Frequent rainfall (leaf wetness)	High	Disease development is favoured by frequent rainfall which cause leaf wetness.
Crop management	Continuous barley cropping	High	Continuous barley cropping increases selection pressure of the pathogen.
	Stubble retention	High	Primary infection is derived from infected barley crop stubble or residue.
	Early sowing	Moderate	Early sowing can increase the risk of infection as crops are more exposed to favourable weather conditions.
	Diverse crop rotation	Low	Incorporating diversity into the crop rotation with break crops such as lentils and canola decreases risk.
Host factors	Susceptible varieties	High	Growing varieties rated as susceptible (S) or very susceptible (VS) are highly vulnerable. Growing varieties with some level of resistance improves crop protection.
	Infected seed	High	NFNB can be seed-borne which can result in seedling infections if using seed from disease crops.
Pathogen factors	High virulence	High	NFNB pathogen is diverse and able to overcome resistance in barley. Virulence changes as a result of increased selection pressure.

Disease cycle

A comprehensive summary of the NFNB disease cycle is shown in Figure 1. Primary infection occurs when conidia or ascospores settle on the surface of the leaves or sheath under cool, wet conditions. Infection can occur in temperatures ranging from 5°C-25°C with optimum temperatures being 15°C-22°C (Martin , et al., 2021). The infection process begins when fungal spores germinate, forming appressoria which are structures fungi use to attach to the surface of the host plant, along with penetration pegs that penetrate the epidermal cell layer and subsequently colonise the plant (Martin , et al., 2021). Symptoms appear within 24-48 hours of infection.

Secondary infection occurs 14 days to 22 days after primary infection. This develops from existing lesions with severe necrosis and chlorosis spread through strong winds and splash caused by heavy rain. Secondary infection can occur multiple times throughout the growing season, when cool, wet conditions are present, which can infect the plant head, resulting in grain damage.

Pyrenophora teres f. *teres* can survive from one season to the next on crop stubble or residue, with fungal growth colonising the surface during wet conditions and remaining viable as long as barley stubble is present on the soil surface (Martin , et al., 2021). Other cereals such as barley grass, wheat and oats can act as a green bridge between seasons, especially when there is higher than average summer rainfall (Martin , et al., 2021). Diseases on these volunteers' plants can elevate inoculum levels early in the season, leading to an increase in spore concentrations across a region (PIRSA- SARDI, 2022).

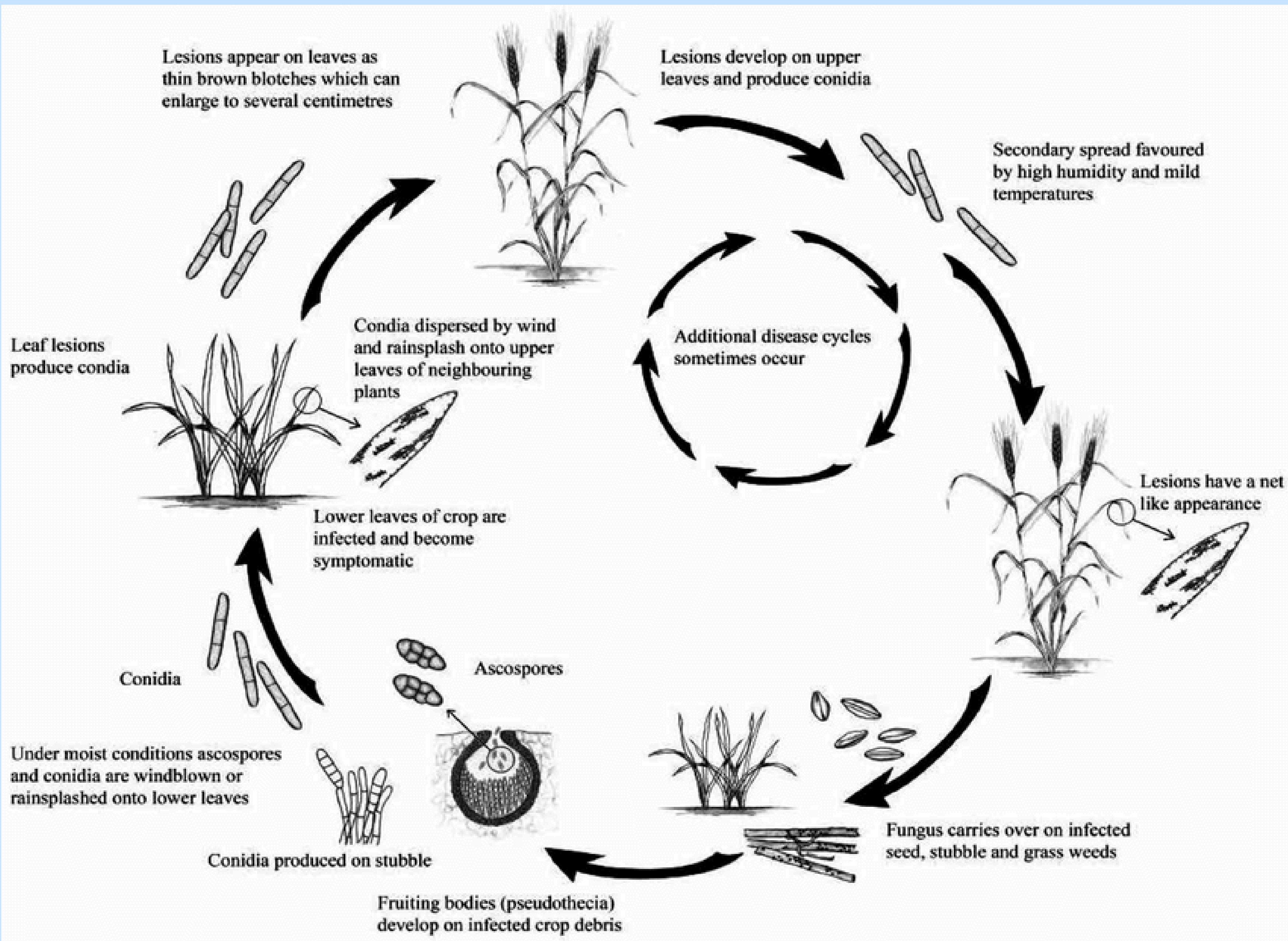

Figure 1: Disease cycle of net form net blotch of barley (Martin , et al., 2021).

Fungicide resistance

Decreased fungicide sensitivity in Ptt populations adds another level of difficulty to disease control. The effectiveness of fungicides is a crucial part of disease management and when a pathogen begins to develop resistance or tolerance towards recommended fungicides, their effectiveness becomes less reliable. Ptt has been characterised for reduced sensitivity to demethylation inhibitor (DMI, Group 3) and resistance to succinate dehydrogenase inhibitor (SDHI, Group 7) fungicides (Knight, et al., 2026).

The development of fungicide resistance is an evolutionary process which occurs in the pathogen population (Yin, et al., 2023). Fungicide resistance develops through the process of selection pressure when a fungicide is continually applied to the pathogen population. The main driver of fungicide resistance is the repeated use of fungicides with the same biochemical mode of action (MoA). Continued use of the same fungicide or fungicides with the same MoA can result in a significant increase in resistant individuals in a pathogen population (Ireland, 2021).

To manage fungicide resistance effectively there is ongoing research in MoAs and resistance mechanisms of pathogens. Different fungicide groups have varying risk levels of resistance development; therefore, rotating and mixing fungicide groups is essential (D'Souza, et al., 2026). Reducing disease pressure and minimising fungicide applications is important to reduce the risk of developing fungicide resistance. This can be achieved by having an integrated disease management (IDM) strategy, such as crop rotation, use of less susceptible varieties and strategic fungicide application (D'Souza, et al., 2026), reducing reliance on fungicides for control.

Additional resources

Net blotch symptoms and management in barley
https://ahdb.org.uk/knowledge-library/net-blotch-symptoms-and-management-in-barley

Net blotches of barley
https://agriculture.vic.gov.au/biosecurity/plant-diseases/grain-pulses-and-cereal-diseases/net-blotches-of-barley

Management of net form net blotch (NFNB) of barley in the low and medium rainfall zones of South Australia
https://www.hartfieldsite.org.au/media/2025%20Trial%20Results/HTR25_webL.pdf

How does fungicide resistance develop?
https://afren.com.au/how-does-fungicide-resistance-develop/

Fungicide resistance management in Australian grain crops
https://afren.com.au/wp-content/uploads/2026/02/fungicide-resistance-management-in-australian-grain-crops-afren-grdc-20260101-web.pdf

Managing fungicide resistance: Net form net blotch of barley
https://afren.com.au/wp-content/uploads/2022/06/AFREN-Net-form-net-blotch-Fact-Sheet_Jun22_FA_online.pdf

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I would like to acknowledge the South Australian Drought Resilience Adoption and Innovation Hub (SA Drought Hub), and South Australian Grain Industry Trust (SAGIT) for their financial contribution to the Hart research internship, South Australian Research and Development Institute (SARDI) pathology group and the Hart team for their ongoing support with this project.

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