Yellow Leaf Spot management

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Key words

Yellow spot, yellow leaf spot, fungicides, stubble management

Take home messages

1. Initial levels of yellow spot infection are directly proportional to the quantity of infected stubble. Control of the disease should focus on reducing the amount of infected stubble, rotating paddocks to resistant crops, timely application of fungicides and sowing resistant varieties.

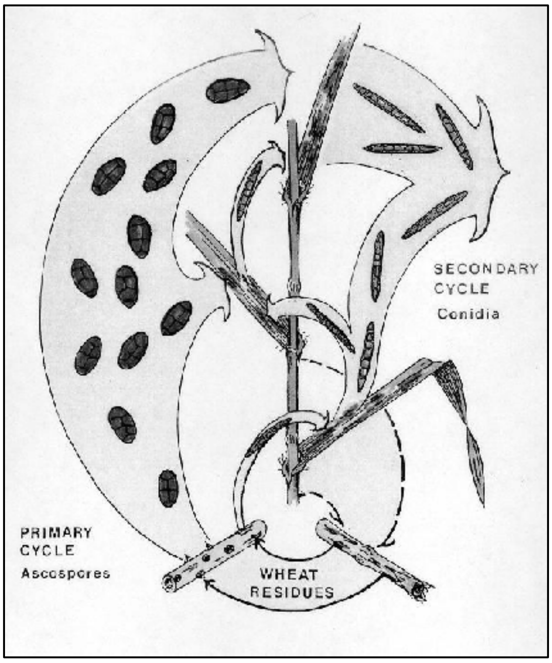
2. Maintaining rust resistance under current farming practices is difficult but it provides reliability of production and gives greater flexibility to disease management. Resistant varieties avoid the boom and bust of growing high yielding susceptible varieties and our dependence on fungicides for disease management.

Introduction

Epidemics of yellow spot develop when susceptible varieties are sown into infected stubble where frequent and extended periods of wet weather prevail at temperatures between 10 and 30ºC. Optimum temperatures are between 15 and 25ºC.

Yellow spot *Pyrenophora tritici-repentis* is a classical stubble-borne disease. The fungus survives as mycelium in stubbles from infected crops. Under **wet** conditions small black fruiting bodies (pseudothecia) develop which produce the sexual stage of the fungus (ascospores). These spores are primary inoculum for initiating infection in the new season. Wheat stubble can remain infective for several years.

Figure 1. Life cycle of *Pyrenophora tritici-repentis*



When the new crop is sown into infected stubble and **wet** conditions prevail mature ascospores are ejected onto the new crop and infection occurs. Lesions first appear as small, dark brown to black spots which expand over time, forming lesions with a necrotic tan centre surrounded by a ring of yellow chlorotic tissue. As lesions coalesce, leaves are killed. Under **wet** conditions asexual spores (conidia) are produced on dead and dying tissue and these are responsible for subsequent infection from leaf to leaf, plant to plant and paddock to paddock.

In our current farming systems where the emphasis is on maximum retention of surface stubble, it is a matter of when and not if yellow spot will become a problem. Continuous cultivation of wheat on wheat will lead to losses from yellow spot whenever favourable environmental conditions occur.

Control

There are several control options available and none is likely to be 100% effective in wheat on wheat systems; however the introduction of a number of them will minimize the effects of the disease.

1. Sow a resistant variety (if available)
2. Sow a non host crop eg barley, chickpea, canola
3. Reduce surface stubble and
4. Apply fungicides.

Resistant varieties do not deliver immunity but will result in lower disease levels than a susceptible variety. They may still suffer leaf death, particularly at juvenile stages, where inoculum levels are high. Current resistant varieties will reduce potential losses but may still require intervention with a fungicide if the season is particularly favourable or the level of resistance is inadequate.

The variety Leichhardt was released as a yellow spot resistant Hartog type and in the absence of yellow spot has yields similar to the parent variety. In 1998, epidemics of yellow spot were widespread in southern Queensland and over 13 sites Leichhardt out-yielded Hartog by over 50%. Most of this was attributed to resistance to yellow spot.

Even low levels of resistance can produce a yield benefit. Yield loss trials (See Table 1) comparing Hartog (S) and Banks (VS) showed that under similar epidemic conditions sprayed plots of Hartog yielded 57% higher than the unsprayed control while the sprayed Banks increased yield by 146%.

Table 1. Results of Yield loss trials (Colson et al 2003)

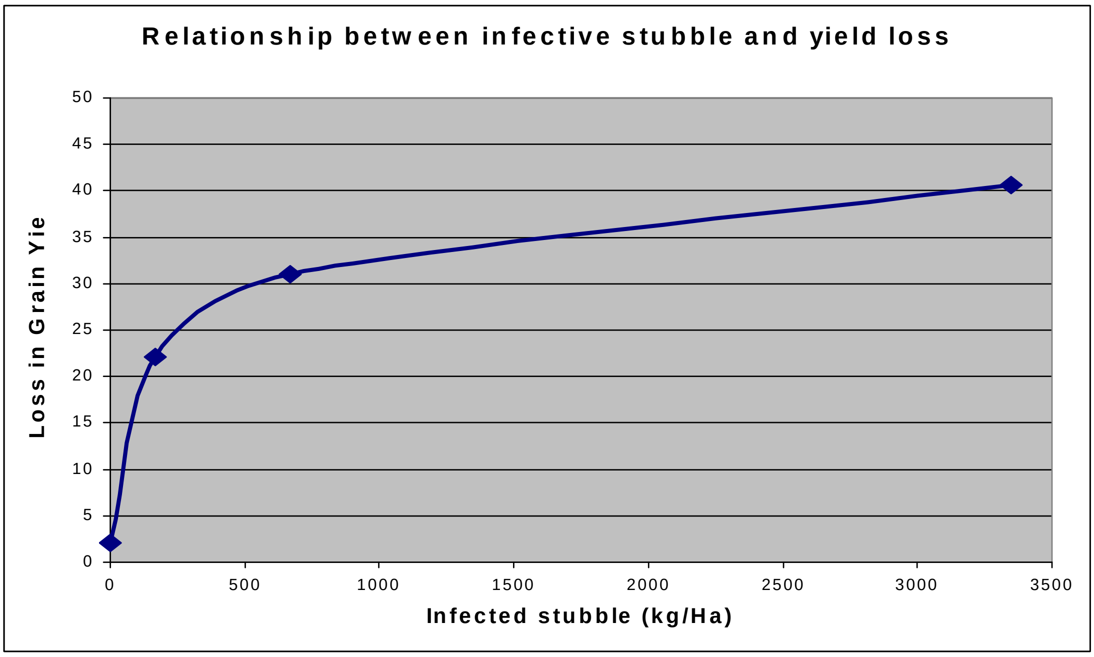
Treatment	% flag leaf infected GS 78-81	Yield	% increase in yield	1000 grain wt.
	%	kg/Ha		g
Hartog				
Unsprayed	85.9b	4163c		29.58c
Sprayed	1.14a	6570f	57.8	36.76e
Propiconazole	2.44a	5367e	28.9	34.18d
Banks				
Unsprayed	82.9b	1865a		21.14a
Sprayed	1.64a	4586d	145.9	29.30c
Propiconazole	2.73a	2820b	51.2	25.14b
LSD P=0.05	7.79	280		1.51

Sowing a non host crop is the recommended approach. Barley, chickpea and canola are resistant and can be grown in wheat stubbles without the risk of infection. Yellow spot will infect barley but lesions remain constrained and leaf death is negligible.

While yellow spot inoculum is carried by air movement, it is nowhere near as transportable as the rusts or powdery mildews. Therefore stubble management within a paddock is the main determinant of epidemic development in that paddock. The amount of surface stubble can be reduced by cultivation, grazing, baling and burning. While burning is not encouraged it could be used to reduce stubble prior to planting. Harrows may be required to effect a good burn.

While stubble removal will reduce epidemics, relatively little infective stubble can result in high levels of yellow spot in later stages of crop growth with subsequent losses in yield. Under conditions favourable for infection, Rees and Platz (1982) demonstrated the effect of varying amounts of infective stubble on disease levels and grain yield. Figure 2 below is a summary of the loss in yield relative to the amount of infective straw applied after sowing.

Figure 2. Relationship between amount of infective stubble and percentage yield loss.



Chemical control

It is important to understand that fungicides are best applied as protectants and that they are not translocated from leaf to leaf. Therefore the level of control will depend on the number and timeliness of applications. More than two applications of the same fungicide in any season is against label recommendations.

Yellow spot can infect crops at any growth stage after emergence and often crops can be severely diseased at early tillering; however losses caused prior to GS31 are minor when compared to losses from heavy infection at later growth stages.
Rees and Platz (1983) demonstrated that heavy infection in Banks wheat prior to GS31 caused 13% loss in yield while infection after that growth stage resulted in 35% yield loss. This has important implications for disease control. Regular rain events are required to ensure continued development of an epidemic. Therefore early season spraying needs to be carefully evaluated on the basis of potential economic return and anticipated in-crop rainfall.

The most important application is the one to protect the Flag (F), F-1 and F-2 leaves. Maximum yield and quality benefits are obtained by keeping the upper leaves free from disease during grain fill. For convenience this usually coincides with 90% flag leaf emergence but may be delayed if epidemic progress is delayed. it must be remembered that one application will provide only 21 to 30 days protection, depending on the rate of application.

Cost of fungicide should not be the main driver in choice of product or rate of application. Colson et al (2003) demonstrated the economic benefit of applying 125mls of propiconazole as opposed to half that rate. In a trial situation using 2010 prices, this strategy returned an additional $260 per hectare.

The choice of product and rate of application are secondary considerations; however both can strongly influence return on investment. New vogue fungicides are typically admixtures of two chemicals having different rates of uptake and/or modes of action. They are more expensive than the single active product but may also give superior disease control and a better economic return.

Propiconazole remains the standard for control of yellow spot; yet newer improved products are available. Some trials conducted in the Dubbo area in 2010 were relatively inconclusive and further work needs to be done to quantify the efficacy of these products on current varieties. .

Fungicide application has become almost routine management in cereal production. Given that timing is the most important factor in fungicidal control, the onus is on growers and agronomists to monitor crops closely. Fungicides have declined in price in recent years making them more attractive as a control option. Ultimately economics dictate fungicide application strategy. If high levels of yellow spot are present and a good season is indicated, two applications may well be warranted.

Is breeding for rust resistance too hard and should we be focusing majorly on yield?

To answer this question adequately we have to ask "What do we require of our production systems?" Is it

- High yields with a high risk of crop failure in some seasons or
- Reliability of production where good yields are regularly obtained by virtue of rust resistance?

In the first instance, the high risk of rust epidemics demands careful crop monitoring and timely, effective fungicide application(s) to protect the yield potential. Growers and agronomists must be "on the ball" with chemical control to achieve that yield potential. There will be seasons where little chemical control is required; but there will also be seasons where several applications of fungicide may be required to realize that yield potential. There will also be situations where fungicides can not be applied on time due to weather constraints etc rendering susceptible varieties vulnerable to rust infection.

For high yielding rust susceptible varieties to be a viable option, the assumption is that chemicals to control rusts will always be available. This may not be the case. In much the same way that rusts overcome genetic resistance, rusts can develop resistance to fungicides. Unforseen or unexpected insensitivity to fungicides could lead to serious rust epidemics and crop losses.

There is also the assumption that growers do not contribute to costs of fungicide development. This is far from fact in that private companies invest millions of dollars in product development and their return on investment is through the price growers pay for that product. Growers either contribute a few dollars per tonne to a research levy for rust resistance breeding or pay a comparable amount for fungicides applied to susceptible crops. There is a cost for both options.

Varieties with useful levels of rust resistance may have inferior yields in the absence of rust; yet when rust is present they will have comparable yields and a lesser need for the application of fungicides. Where chemical intervention is required in varieties with resistance, application is not as urgent as in susceptible/very susceptible varieties and the same rate of fungicide is likely to give superior disease control over susceptible varieties.

Breeding for rust resistance is not hard; maintaining rust resistance is the difficulty that confronts us. Effective resistance breeding demands ongoing monitoring of virulences in the pathogen population and a knowledge of host resistances and their effectiveness against those virulences. This knowledge can only be gained by ongoing research and development – a form of crop insurance. It represents an enduring financial commitment akin to research and development of new fungicides.

One of the problems of resistance breeding is the perception that resistance affords protection under all conditions. There is scant regard for protecting that resistance in the greater farming community. Resistant varieties are sown alongside susceptible varieties; volunteers persist through summer and sequential sowings occur. All these practices favour development of new virulences in the pathogen population.

A major contributor to rust epidemics and the breakdown of resistances is the cultivation of very susceptible varieties. The more rust in the farming system the more likely resistance will break down. The greater the area of resistant varieties the more those resistances will be protected. Minimize rust inoculum; maximize area under resistant varieties and extend longevity of resistances.

I am unable to offer an unbiased opinion of the resistance versus yield debate. I have been involved in breeding and selecting for resistance for too long to not support this philosophy. I have witnessed the success of resistance breeding in delivering a stable wheat growing industry in northern Australia where stem rust epidemics once wreaked regular and devastating losses. However for this approach to succeed, an holistic approach must be adopted to minimize inoculum levels and protect the diminishing resistances available to us.

Yield will always be king; yet pursuit of increased yields at the expense of rust resistance, sooner or later, will lead to massive crop losses. Widespread sowing of susceptible varieties ensures a continuous supply of inoculum and seasons or a sequence of seasons, favourable for infection will result in severe epidemics. Fungicides are in effect resistance in a drum yet they are only effective when applied to the crop – an additional farming operation. Genetic resistance is delivered with the seed and usually operates throughout the life of the crop.

Higher yields in most seasons may be attractive; but I contend that good yields in all seasons is preferable.

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