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Yellow spot of wheat

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Yellow spot is a serious leaf disease of wheat in Western Australia. It also occurs in Queensland, New South Wales and South Australia. Yellow spot can appear as a severe leaf blight but generally the disease does not have the rapid epidemic development of wheat rust diseases. It builds up more slowly and is not as obvious in a crop, while causing appreciable yield loss.

In Western Australia, yellow spot was first recorded by Department of Agriculture plant pathologist, T. N. Khan in 1971. It was also recognised then for the first time in South Australia.

The recent increase in the disease was first observed in Queensland in the early 1970s and has become increasingly prevalent there as more farmers have adopted stubble conservation techniques. The increase appears to result from the survival of the fungus over summer in wheat stubbles. From these infested wheat stubbles wind-blown spores carry the disease into following wheat crops.

In Western Australia, yellow spot remained an unimportant wheat disease until 1979 when it was observed on crops in the northern wheatbelt. Since then, it has caused damage throughout the wheatbelt but it is still most common in the northern areas (see map). As in the eastern States, the increased occurrence of the disease can be attributed to wheat monoculture and increased stubble retention.



Symptoms

Yellow spot may be seen in the crop at any stage. Early symptoms are small oval spots, a few millimetres across, with a distinct yellow edge and a dead brown centre. In their early stages these spots can easily be distinguished as yellow spot, but as the disease develops the spots enlarge and often merge, producing irregular shaped dead areas. Leaf tips will often die first. Lower leaves usually show more symptoms than upper leaves because they have carried the disease longer. Mild infections of yellow spot can be masked by nitrogen deficiency, or mistaken for it. The disease is also known as tan spot in the USA and Canada.

Disease cycle

Yellow spot is caused by two stages of the same fungus. The over-summering stage (also called the sexual stage) develops on stubble remaining from an infected crop. Disease is started by spores (ascospores) which are released into the air and are carried by wind and rain to the leaves of the new wheat crop. This is called the primary infection cycle. The ascospores are released from raised black oval fruiting bodies about the size of a pin head. The ascospores have a limited range and only affect the crop in the same paddock. Paddock to paddock movement of ascospores does not appear to be significant.

After the disease has established, the second (or asexual) stage takes over. The fungus grows in the leaf and these areas die. Spores (conidia) are produced on the dead areas and are blown away on the wind. In this way the

☐ The fungus survives on infested wheat straw as small fruiting bodies visible before the break of season.

fungus spreads to new leaves further up the canopy. This is called the secondary infection cycle. Conidia are very light and can be blown long distances, unlike ascospores, thereby infecting nearby crops. The fungus needs rain to stimulate spore production and to infect leaves. Because of this, the disease causes more damage in seasons of regular rainfall.

Host range

The fungus has a wide host range which includes barley, oats, rye, durum wheat, triticale and wheat grass. The fungus grows less vigorously on these hosts than on wheat and is unlikely to be a problem, with the possible exception of triticale. It rarely infects barley, making this a useful rotation crop.

Association with other diseases

The disease cycle of yellow spot is similar in many respects to septoria nodorum blotch (*Leptosphaeria nodorum*) and septoria tritici blotch (*Mycosphaerella graminicola*). The symptoms of the diseases are similar and it is difficult to distinguish between them without laboratory facilities.

Yellow spot is seldom the only leaf-spotting disease found on affected plants. The causal pathogens of yellow spot, septoria nodorum

blotch and septoria tritici blotch compete for 'space' on the leaf and frequently the proportions of each pathogen will change during the life of the crop in response to temperature changes and wet periods. In this situation, plant resistance to a single disease may be of marginal benefit because competing pathogens will simply increase their share of the leaf area.

Yield losses

The influences of yellow spot on yield have only been partly researched in Western Australia but it is very probable that they are the same as those of septoria nodorum blotch or other leaf-spotting pathogens: reduced grain weight resulting from light infections, and reduced number of grains per ear and reduced biological yield from severe infections.

In experimental plots on the Geraldton sandplain, wheat yield reductions averaging 23 per cent were measured in 1985, with some plot yields reduced by up to half. In 1983, fungicide spray trials conducted on farms in the State's higher rainfall areas resulted in an average 13 per cent yield reduction from leaf diseases. Disease complexes occurred in all of the trials but control of yellow spot was a major factor contributing to the improved yield (Table 1).

Estimates of yield reduction in badly affected Queensland crops have ranged as high as 30 per cent, while 10 to 15 per cent is considered average. Research in that State has shown that severe disease early in the crop, before stem elongation, can reduce tillering and delay flowering. High disease levels at later stages can cause premature leaf senescence and hasten maturity, resulting in a shorter grain filling period.

Research

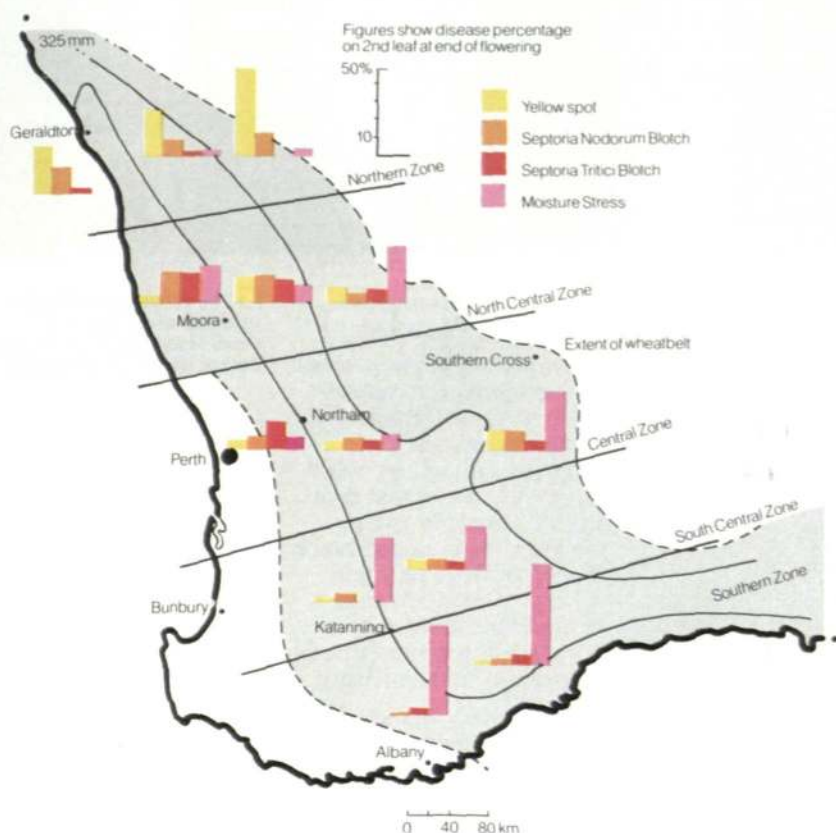
Research is concentrated on breeding wheat for resistance to yellow spot and agronomic interactions with yellow spot in the field.

Breeding for resistance

Sources of resistance to yellow spot are available overseas and these include the wheat cultivars Veery 'S' and Vicam 71 (both from Mexico), Norin 26 (Japan) and Veranopolis (Brazil). Many of these cultivars are red grained and ill adapted to Western Australian conditions. Veery 'S' has good resistance but it also has a quality problem which can not be broken.

Some of the yellow spot sources of resistance are also better than average in their resistance to septoria nodorum blotch. This is fortuitous, and these varieties are used in crosses with adapted Western Australian varieties. Because the recovery rate of

Wheat leaf disease survey data from 1982 and 1983 indicate that yellow spot was mainly located in the north of the State in those seasons.





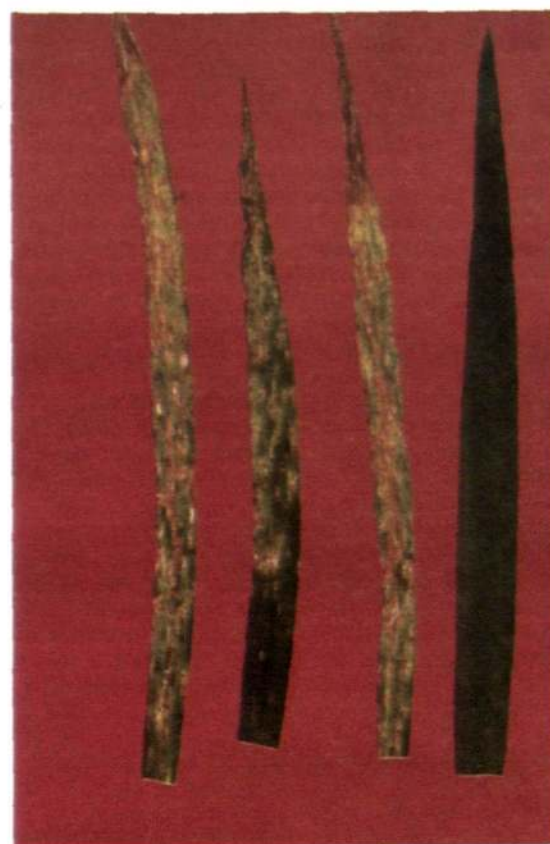
□ Early symptoms of yellow spot showing brown lesions with distinct yellow edges. Leaf on left is least affected.

□ BELOW LEFT: Late symptoms of yellow spot showing leaf blotching. Leaf on right is not affected.

Table 1. The effect of fungicide applications to control leaf diseases on the yield of wheat in the Geraldton, Three Springs and Moora regions in 1983

Area	Yield (t/ha)		Yield response to fungicide (2)	Relative proportion of diseases present (as %) (3)		
	Fungicide applied	No fungicide		Yellow spot	Septoria nodorum blotch	Septoria tritici blotch
Geraldton	2.6	2.3	11%	60	33	7
Three Springs	2.1	1.9	11%	75	25	0
Moora	2.4	2.0	17%	36	45	19

1. The fungicide Tilt (R) was applied as a foliar spray three times during the season. Control plots received no fungicide.
2. Yield responses will vary from year to year and from location to location according to seasonal and rotational conditions.
3. Disease complexes occurred in all situations. Leaf damage caused by water stress was also common. Pathogen data are for non-sprayed plots.



resistance to both yellow spot and septoria nodorum blotch is less frequent than the recovery of resistance to just one of these diseases, large numbers of progeny need to be tested.

A glasshouse-based inoculation test is necessary to successfully breed for resistance to yellow spot and septoria nodorum blotch. In the glasshouse, seedlings are grown and infected with yellow spot and disease development is assessed for severity.

A little later, the same plants are infected with septoria nodorum blotch for assessment of this disease. Information on both diseases is used as a measure of the effectiveness of particular wheat crosses, thus assessing the merits of different parents for contributing resistance to these diseases. At present the genetics of yellow spot resistance is poorly understood and improved information on the inheritance of resistance will assist future breeding strategies.

Agronomic interactions

A field programme located at Geraldton is investigating the role of crop rotation, cultivation and nitrogen on the development of yellow spot on sandplain soils. Although losses still occur in wheat on lupin rotation,



□ Technical officer Gerry Cusack assesses resistance of wheat to yellow spot.

□ In the glasshouse, yellow spot symptoms on test lines of wheat ranged from resistant (left) to susceptible (right). Current commercial cultivars respond like those on the right.



growing lupins is a highly effective way of controlling cereal diseases, including yellow spot of wheat.

In farm trials in 1984, yield reduction of wheat caused by leaf disease were estimated to be 12 per cent on wheat after wheat, compared with 5 per cent on wheat after lupins. In 1985 trials, plots of wheat after lupins were inoculated with yellow spot. The disease was still less damaging than on comparable plots of wheat after wheat (Table 2). Applying nitrogen had a negligible effect on disease incidence.

Deep tillage (ripping) of sandy soils can reduce losses due to leaf disease; in 1985 losses on ripped plots averaged 20 per cent, compared with 27 per cent on unripped plots. Leaf disease also reduced water use efficiency. This is particularly important in Western Australia where the rainfall is low and the sandy soils hold very little water. Severe leaf disease reduced root growth considerably and also reduced the number of fertile ears. As is usual with leaf spot diseases the main yield losses were reduced seed weight.

Control

Although varietal resistance provides the best long term solution to the yellow spot problem, at present there are no adapted commercial cultivars that are resistant. Some of the present cultivars such as Gamenya, Millewa and Halberd seem particularly vulnerable. The cultivars Olympic and Flinders which have some resistance to yellow spot are not suited to Western Australian growing conditions.

Fungicide sprays have proved useful for controlling the disease in experiments, but none would reliably produce economic returns if used on the farm. Farmers must rely on cultural practices which aim to reduce stubble carry-over to minimise transfer of yellow spot to the new wheat crop.

By far the best way of doing this is to rotate crops. Wheat after pasture, lupins, peas or barley will show significantly lower levels of yellow spot early in crop development than wheat after wheat. This is because there will be little or no primary inoculum in the crop to start the disease. The amount of disease occurring in a crop with a clean start will depend on the proximity of adjacent infected crops, but disease levels are unlikely to reach those of double cropped wheat. Yellow spot is able to survive on stubble remnants for one break crop, so that direct drilled, year-in-year-out rotations may still encounter some disease problems.

Where multiple wheat cropping is undertaken stubble carry-over must be reduced. Stubble can be reduced by cultivating, burning or heavy grazing. Only small amounts of infected stubble are required to initiate disease, so stubble removal must be thorough for worthwhile control. However, the advantages of stubble removal must be carefully weighed against the risk of soil erosion. Disease risks are greatest in direct drilled, multiple wheat crops.

□ Yellow spot severity at the seedling stage is worse on multiple cropped wheat (right) than it is on wheat which follows pasture (centre) or lupins (left).

Table 2. The effect of rotation with lupins, nitrogen application and fungicide treatment on the yield of wheat on the Geraldton sandplain in 1985

Rotation (1)	Nitrogen (Agran®) (2)	Fungicide (3)	Yield (t/ha)	Loss due to leaf disease (4)
Wheat after lupins	Nil	Applied	2.1	24%
	Nil	No fungicide	1.6	
	150 kg/ha	Applied	2.1	23%
	150 kg/ha	No fungicide	1.6	
Continuous wheat	Nil	Applied	0.9	31%
	Nil	No fungicide	0.6	
	150 kg/ha	Applied	1.5	27%
	150 kg/ha	No fungicide	1.1	

1. Infected wheat stubble was spread on the wheat after lupin plots, so the disease load was heavier than would usually be encountered on such a rotation.
2. The fungicide Tilt (R) was applied as a foliar spray four times during the season. This controlled leaf disease, but did not eliminate it completely.
3. Leaf diseases were caused by yellow spot (80%) and septoria nodorum blotch (20%). Septoria tritici blotch was absent.

