# Integrated disease management in field crops with emphasis on sclerotinia stem rot in canola

## PROJECT DETAILS

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<tr>
<th>PROJECT CODE:</th>
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<td>PROJECT TITLE:</td>
<td>INTEGRATED DISEASE MANAGEMENT IN FIELD CROPS WITH EMPHASIS ON SCLEROTINIA STEM ROT IN CANOLA</td>
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<tr>
<td>START DATE:</td>
<td>31.12.2004</td>
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<td>END DATE:</td>
<td>30.06.2007</td>
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## Summary

Stripe rust of wheat and sclerotinia stem rot of canola are important diseases in southern Australia. This project updated controls for these diseases, responded to the emerging problem of wheat streak mosaic virus (WSMV), and provided a diagnostic and advisory service for field crops.

Drought conditions affected field trials on sclerotinia. Fungicides controlled stem rot but there were no yield benefits at low levels of disease.

Stripe rust was assessed in district trials with fungicides effective but economic only in high yields of susceptible wheats.

WSMV increased with grazing intensity and duration. Viruliferous mites from nearby grasses and volunteer wheat were the major source of outbreaks.

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Conclusions

1. Sclerotinia stem rot is a major potential threat to canola production but is highly sporadic in central and southern New South Wales (NSW) and northern Victoria (VIC). It has not been a problem in the drier seasons prevailing since 2000. Fungicides applied during early flowering will control the disease but these fungicides are costly. This project and the previous one found that long periods of soil and stem wetness in spring leading up to and during flowering are needed for severe disease to occur. Some years can now be defined as ones when the disease will not develop but further work is needed to improve decisions on spraying fungicides in other years. However, the high cost of fungicides means they are an economically risky option.

2. The control guidelines for stripe rust of wheat using foliar sprays developed in the 1980s continue to be effective. They need to be combined with efforts to reduce the green bridge, growing of more resistant varieties and seed and in-furrow fungicides to provide full control. The high cost of fungicides and unreliability of rainfall mean that fungicides are unlikely to be cost effective in much of the lower yielding, low rainfall wheat belt. They are cost effective in irrigation and higher rainfall areas.

3. Wheat streak mosaic virus (WSMV) is an emerging disease of early sown long season wheats, particularly when these are grazed in late autumn and in winter. The severe damage threatens the future of graze/grain wheat. Outbreaks are associated with sources of disease inoculum and mite vectors adjoining or within cropping paddocks. There is the potential to breed for resistance.

The project developed the following control advice:

- Destroy all cereal volunteers (especially wheat) and grass weeds at least two weeks before sowing wheat in autumn including adjacent paddocks, borders of paddocks and around grain storage areas. This will reduce mite populations by removing the green bridge needed for the mites to survive and spread the wheat streak mosaic virus.
- Avoid planting cereals early in autumn to assist in providing a host-free period for the mite and WSMV between green summer cereals, especially maize. This will also reduce the time that wheat seedlings are exposed to temperatures in autumn that favour rapid build-up of mite populations.
- Sow seed from crops that were not affected by WSMV. If no other seed is available, use the above methods to reduce numbers of wheat curl mites entering the crop that can spread the virus from infected seedlings resulting from seed transmission.
- Consider sowing oats, triticale and possibly barley rather than dual-purpose wheat varieties in high risk situations.

Recommendations
1. The sclerotinia guidelines have potential for application in the emerging canola growing areas in the high rainfall areas of western Victoria and south-western Western Australia. Other forms of control need to be studied for southern New South Wales because the high cost of fungicides makes them uneconomic in most situations. In particular, the potential for selecting for resistance should be pursued, as there are reports of resistance from Canada and China. More information is needed on the distance that ascospores of sclerotinia can travel.

2. Fungicides are a high risk option for controlling stripe rust in wheat, particularly in the low yielding/low rainfall wheat belt. They are cost effective in higher yielding crops in high rainfall areas or irrigation. Methods to control stripe rust on crops before flag leaf emergence require development.

3. Wheat streak mosaic virus threatens the viability of graze/grain wheat. Integrated control by paddock management and improved resistance needs to be developed. Reasons for the variability in rates of seed borne transmission require investigation. Respective roles of seed-borne versus mite-borne virus from local grasses and volunteers need further study.

Outcomes

Economic outcomes

There will be a better return on the high input cost of fungicides to control sclerotinia stem rot in canola, with guidelines for using this control only recommended in high yield and high disease risk situations. Updated management of the other major canola diseases, blackleg and western beet yellows, will provide more consistent and higher yields.

Decision support for stripe rust provides more economic use of fungicides, as trial work showed that economic returns are only likely in higher yielding, disease prone sites with susceptible varieties.

Preliminary studies of wheat streak mosaic highlight the economic importance of this disease for early sown wheats and lead the way to guide further research on control.

Environmental outcomes

The disease management guides for canola and wheat mean that pesticides will be used responsibly. Research has also shown that stubble burning has no major role for managing canola diseases. This should lead to less burning of stubbles, a valuable environmental outcome.

Social outcomes

Sclerotinia stem rot can severely affect canola yields but costs of control are very high, causing stress to growers when deciding whether to apply controls. Similarly, decisions on fungicide use to control stripe rust in wheat mean growers need to consider potential disease losses versus costs of control. The guidelines for managing these two diseases reduce this grower stress. The general guidelines provided for improved management of field crop diseases give higher and more stable yields in these crops, more certainty for marketing.

Achievements/Benefits

Introduction

The aims of this project were to develop improved control of two major crop diseases, sclerotinia stem rot of canola and stripe rust of wheat, to provide a crop disease advisory service and to respond to emerging disease situations. These aims provided flexibility in the project. When drought conditions meant that significant sclerotinia stem rot was unlikely to occur, pathologists were able to concentrate on wheat streak mosaic, which became the major constraint to early sown graze and grain wheat crops over a wide area of New South Wales.

Canola research and extension

Sclerotinia stem rot is occasionally a severe problem in canola. When it occurs, losses are high. While fungicide sprays can control it, they are expensive and economic only on high yielding crops at high levels of disease. This makes decisions about spraying difficult. The high cost of applying controls must be balanced against the high but relatively rare losses from the disease. The project aimed to define the conditions when fungicide application would be warranted and examine other means of reducing the disease. Fungicide trials were established with co-operators at four sites in 2005 and seven sites in 2006. Sites were from Greenethorpe to Wallendbeen. However, because of drought the 2006 sites had to be abandoned.
Overall disease checks were done at 4-6 leaf, 20-30% flowering (petal test for sclerotinia, presence of other diseases), and windrowing (stem rot, canker, root rot). Rainfall, temperature and crop yield were recorded. Although only trace to low amounts of sclerotinia stem rot developed in 2005, all fungicide treatments had significantly less disease than the unsprayed treatment at Dirnaseer, Galong and Wallendbeen but no disease developed at Greenethorpe. Yields of the fungicide treatments were not significantly different at any site except Dirnaseer, where some Rovral® treatments had higher yields. Because disease levels were low, the data were not useful for further developing the models of the relationships between weather, disease and yield, although the fungicide treatments controlled sclerotinia as expected.

Laboratory tests confirmed that sclerotia exposed to triazine herbicide failed to produce spores. Field observations were carried out to study whether there was less development of sclerotinia in TT canola crops treated with triazine compared with untreated crops. The scope of this work had to be reduced as the main site was found to be contaminated with GM canola and thus the crop had to be destroyed. The late start to the growing season of 2005 and the drought of 2006 meant that disease pressure from sclerotinia was very low in both years. This meant that no useful data were added to develop the models for sclerotinia development. The previous project developed a satisfactory model for petal infection, which means that 50% of years can be eliminated for spraying based on the model.

Blackleg remains the major threat to canola production. Resistant varieties enable the crop to be grown but losses still occur to canker and root rot. Seed treatment may have some effect in reducing the effects of blackleg therefore the disease was monitored in trials and crops. Latest results of these observations and those by others working on blackleg were incorporated in the disease section of the Best Management Practices Canola Guide.

Emerging canola diseases. A severe case of club root occurred in a mustard crop. This disease is not normally a problem in canola because the strain present in Australia only develops in warm soils and clubroot is a disease of summer-grown crucifers. However, it is possible that the case in mustard is a new introduction of a cooler temperature strain. Samples were sent for testing but no results became available. A warning was issued to farm advisers and growers to watch out for the disease and report any instances.

Wheat research and extension

Plant Health Diagnostic Service (PHDS)

Field crop diseases were monitored by surveys, from reports and samples from public and private advisers and growers, enabling a rapid response to emerging problems. The main diseases of concern during this project were stripe rust and wheat streak mosaic virus. The PHDS provided diagnosis and advice on received samples. The pathology diagnostic laboratory received ISO9001:2000 certified (NATA Certification System International) in September 2006.

The Plant Disease Notes were distributed to over 200 public and private advisers and other users of the PHDS before and during the growing season, providing the current situation, warnings of diseases and control advice. We polled users for their comments and suggestions on the PHDS. A wide view was the importance of timely advice on problems through the Plant Disease Notes. Many agronomists reproduced articles from the Plant Disease Notes in local media or distributed them electronically to growers.

The diseases sections in the Winter Crops Variety Sowing Guide were updated each year.

Stripe rust

Stripe rust had been well controlled in eastern Australia with resistant varieties since the mid 1980s. The situation changed from 2000, first with the widespread growing of H45, which was susceptible to an existing race of stripe rust, and then the arrival of a new race, probably from North America, first in Western Australia and then its rapid spread east in 2003. Many current varieties were damaged by the new race and also provided abundant suitable volunteers to build up the disease in the late summer and autumn, causing much earlier epidemics than had occurred in the past. These early epidemics developed before adult plant resistance and so damaged many varieties that depended on this resistance.

We responded with advice on the importance of breaking the green bridge, changing where possible to varieties with less susceptibility, and the strategic use of seed and in-furrow fungicides to provide early control. Modelling with temperatures showed that stripe rust develops most rapidly in autumn and spring throughout most of the NSW wheat growing areas, and thus the importance of minimising volunteer wheat in autumn to reduce inoculum entering new crops. Our work on
fungicide spraying and epidemiology carried out in the 1980s was used to create the RustMan spreadsheet. This enabled growers and farm advisers to estimate the likely losses from stripe rust in their crop and the likely benefit from spraying. Subsequent field trials demonstrated that the information gained in the detailed experiments in the 1980s remained valid for the epidemics of the last decade, showing the value of robust comprehensive experiments. The advice was given through summer and autumn planning meetings, the Plant Disease Notes, press releases, seasonal grower meetings and in many telephone calls from advisers and growers during epidemics.

We participated in planning and then assessed stripe rust development in district fungicide trials in southern and central NSW. These trials demonstrated that seed and in-furrow treatments provide useful early control and that timely application of foliar sprays, particularly combined with the earlier treatments, could give very good control. However, economic benefits only occurred reliably in higher yielding sites on susceptible varieties when stripe rust began early, as is predicted by RustMan. The fungicide strategy is uneconomic for much of the wheat belt, particularly in low rainfall years.

Updated versions of RustMan were distributed to public and private agronomists in 2005, 2006 and 2007 and were widely used. A particular use was to run scenarios of the typical crops to develop local rules for fungicide application. Information on variety reaction in southern NSW was given to national telephone conferences which decided on the rating of varieties to stripe rust.

A new problem for controlling stripe rust has emerged. Epidemics are now occurring earlier in crops than before, causing growers to consider applying fungicides before flag leaf emergence. These early applications will protect the leaves that the fungicide covers but leaves emerging later are unprotected, regardless of the fungicide used. Strategies to cope with early epidemics need to be developed.

The other problem is the reliance on fungicides to control stripe rust on susceptible varieties. This management is not economic over much of the low yielding western areas of NSW where profits are higher in unsprayed crops than in sprayed ones. This leads to a huge build up of spores from the west blowing into the later maturing eastern crops, causing greater losses.

Wheat streak mosaic virus

The first widespread occurrence of wheat streak mosaic virus (WSMV) occurred in eastern Australia in 2003. None was reported in 2004 but a severe outbreak occurred in 2005, mainly on the Central Western Slopes, Central Tablelands and South Western Slopes of NSW. It affected early sown wheats, particularly those that were grazed. A graze/grain wheat experiment at Wallendbeen allowed us to find a relationship between grazing intensity and duration, which agreed with survey data from crops. An estimated 7,000ha was affected, with 1000 ha severely affected (total grain loss), and losses were about $2,000,000. However, losses are potentially much greater, in the order of $20,000,000, as the concern over the disease caused many growers to consider growing other less profitable winter cereals for graze and grain.

In 2005, the distribution of the disease in some crops was related to presence of grass hosts of WSMV and the wheat curl mite vector on the perimeter of the crop. In one case, the infection had come from volunteer wheat that the crop had been sown into. Other cases of entire crop damage with no discernible source of inoculum or vectors remain unexplained.

The project funding enabled us to respond and funding was supplemented with a seed grant from the EH Graham Centre (NSW Department of Primary Industries/Charles Sturt University). Volunteer wheat and early sown wheat crops were surveyed in late autumn 2006 in the eastern high rainfall cropping areas of central NSW. Symptoms of WSMV were common over a wide area. Volunteer wheat showed high levels of infection and wheat curl mites were abundant on these plants. In crops, infection was mostly associated with perimeter grasses. Some cases of apparent seed-borne infection were noted, with individual infected plants among healthy plants. In crops where no mites were found, there was no subsequent spread of the virus. Later in the year, severe infection was associated with presence of the mite vector.

A trial was sown in a field containing a high incidence of WSMV and mites. The trial contained 31 wheat varieties, four durums and oats, barley and triticale. The varieties were also sown in the glasshouses at Wagga Wagga and Tamworth. Very severe symptoms (combination of direct damage by mites, WSMV and high plains virus) developed on all cereals. However, differences in reaction to inoculation with WSMV alone were obvious in the glasshouse. No symptoms developed on oats, barley and triticale, while a range of severities occurred on the wheat and durum varieties. Among the long season wheats, CurrawongP was least affected at both Tamworth and Wagga Wagga while MackellarP and WylahP were worst affected. There may be potential to select for resistance.
Because the disease is more severe with grazing, the possibility that the virus could survive in sheep saliva and thus be transmitted by grazing animals was tested. A glasshouse experiment found that while the virus survived very well in water, survival was low in saliva. Although transmission on mouth and teeth is not so likely, the possibility remains that sap from affected plants could be transferred to healthy plants on the hoofs of animals, or perhaps the animals transport the mites around the crop.

Testing of seed transmission was carried out and found to be variable, with no transmission occurring in about half the samples of grain harvested from affected crops, and ranging up to about 1% in some seed lots. We co-operated in a field trial at Calong, which was sown with seed from infected crops and from virus free crops and then grazed. In 2006 no symptoms of wheat streak mosaic were observed across the entire trial.

Work on seed transmission in NSW showed that this transmission would be important for introducing the virus to a new area, but that local sources of virus and mite vectors from grass hosts or wheat volunteers are essential to develop an epidemic.

Other research

The research will take a new direction at Wagga Wagga following the retirement of Dr Gordon Murray. Two new plant pathologists have been appointed. Dr Andrew Milgate will specialise in diseases of winter cereals and Mr Kurt Lindbeck will specialise in diseases of pulse and oilseed crops.

Potential research and development opportunities that have arisen from this project include:

1. Further investigations into the epidemiology of sclerotinia stem rot of canola in Australia. Research into this disease in Australia currently looks at genetic variation of the pathogen (Melbourne University) and identification of resistant canola germplasm (Department of Agriculture and Food Western Australia (DAFWA)). Epidemiological studies could use spore trapping experiments to determine the timing of infection events in the field and inoculum availability (e.g. are there patterns of spore release that can be exploited by growers to avoid infection?) and the use of trap plants (such as marigold) as indicators of infection periods. Also studies into the microclimate under the crop canopy (leaf wetness under the crop canopy vs actual rainfall), and the determination of environmental parameters that trigger the development of disease epidemics. The survival of sclerotia under Australian conditions is also poorly understood, especially under field crop conditions. The scope exists for further studies to be performed looking at the effect of different cropping systems, herbicide residues and climatic zones.

2. Stripe rust of wheat. New challenges for controlling stripe rust have emerged with epidemics now occurring earlier in crops than previously, causing growers to consider applying fungicides before flag leaf emergence. These early applications will protect the leaves that the fungicide covers but leaves emerging later are unprotected, regardless of the fungicide used. New advice and effective management strategies need to be developed for the management of moderately resistant/moderately susceptible (MR/MS) and MS varieties across all production zones of southern New South Wales. Such work would include the evaluation of different fungicide management regimes and new advanced breeding lines.

3. Wheat streak mosaic virus. This project indicates that WSMV could emerge as an important disease in high rainfall wheat production zones. The opportunity exists to survey a variety of cropping and rainfall zones in southern NSW (high rainfall/east of Wagga Wagga, low rainfall/west of Wagga Wagga and irrigation areas) for the disease and the vector of the disease as a measure of possible impacts on production, which may vary from year to year. In addition, industry requires pre-season indicators as a measure for the possible impact of the disease in the following growing season. Such indicators may include sampling volunteer cereals and grass weed hosts for presence of the virus, or sampling plant hosts for presence of the wheat curl mite. Management decisions could then be based upon the level of WSMV risk based upon the presence of the virus and vector.

Additional information


Conferences


Extension Publications


