Integrated approach needed to manage emerging threats

By Dr Rohan Rainbow

SEVERAL SIGNIFICANT CROP protection issues have emerged in the past few years to challenge crop production – from mouse plagues through to increasing herbicide and insecticide resistance and the evolution of new rust pathotypes.

The GRDC has commissioned independent peer-reviewed research to understand how these crop pests, weeds and diseases have changed over time and to quantify their impact on crop production.

Weeds continue to have the largest impact on grain production, with a 2005 study estimating that weeds cost Australian growers $1.5 billion per year in lost productivity and control costs. In 2013 the GRDC will commission a new study to better understand the effects of particular weeds on crop productivity.

After weeds, the impact of diseases on crop production comes a close second with a series of reports on wheat, barley, pulses and oilseeds by Murray and Brennan (2009, 2012) estimating the combined control costs and lost productivity associated with crop diseases to be about $1.4 billion per year. However, if it was not for the adoption by growers of GRDC-funded development of new crop varieties, cultural controls and pesticides, these yield losses could potentially be much higher.

A study commissioned by the GRDC on the impact of invertebrate pests on crop production was released in December 2012. This study by Murray, Clarke and Ronning (2012) indicates that invertebrate pests cost Australian grain growers $360 million per year.

These GRDC-funded studies provide significant insight into the impact of crop protection issues on the Australian grain industry.

GRDC investment into research on the biology of emerging crop protection issues will help determine the best strategies for their control. In some instances, cultural control or vector management is more cost effective and sustainable than pesticide use.

Unfortunately, growers are facing increasing pesticide resistance and this, combined with fewer available pesticides, is creating real issues on-farm. With the commercial delivery of new pesticides costing in excess of $250 million and increasing global regulation of old chemical actives, growers need to conserve useful chemical options by implementing strategies to slow the development of pesticide resistance.

The GRDC has invested significant resources in monitoring herbicide, insecticide and fungicide resistance to enable growers to manage these emerging risks. GRDC-funded resistance surveys coupled with the availability of testing services for herbicide resistance are defining the extent of the resistance problem.

By understanding crop protection threats more clearly, the GRDC and its stakeholders can focus on the most effective management approaches such as monitoring and surveillance for timely control, breeding, cultural management or pesticide solutions (Figure 1).

This Ground Cover supplement on emerging issues with diseases, weeds and pests provides details of what is being done to manage these threats while also acting as an alert for regions where the threats are emerging.

While several of the threats such as wild radish and snails are unfortunately already established in some areas, other regions are experiencing an emergence of these pests.

The GRDC is focused on increasing the intelligence available to growers and advisers on where these threats are occurring and providing systems and alerts to
enable growers to manage these threats with improved identification, resistance status and timely controls.

With the support of the Australian Pesticides and Veterinary Medicines Authority minor and emergency pesticide use program, the GRDC continues to manage many of these emerging threats by better understanding pesticide efficacy and crop residues and providing growers with emergency pesticide permits. The GRDC has recently supported the release of several permits – for example, controls for insecticide-resistant diamondback moth and fungicide-resistant barley powdery mildew.

Through the ‘Protecting your Crop’ theme, the GRDC will continue to provide growers with the very best information on established and emerging crop protection issues and support the delivery of the most sustainable and cost-effective solutions to manage these threats.

More information: Dr Rohan Rainbow, GRDC, 02 6166 4500, rohan.rainbow@grdc.com.au

Figure 1  Key external and internal drivers of integrated management approaches for crop pests, weeds and disease.

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White grain rejection spreading

An occasional problem in Queensland and northern New South Wales, white grain of wheat, is now emerging as a disease in the southern cropping region.

By Dr Margaret Evans and Dr Hugh Wallwork

WHITE GRAIN

WHITE GRAIN CAUSED serious problems in South Australia in 2010 and 2011, with many loads downgraded or rejected at receival points.

It is a minor issue in Victoria and southern New South Wales, but wheat crops in SA in the north-eastern Eyre Peninsula and in the Upper North were particularly affected.

The western side of Eyre Peninsula and Western Australia remain free of the disease.

In the northern region, the fungus responsible for white grain has been identified as Botryosphaeria zeae, which is usually associated with stem rot in maize. Until its discovery in Queensland in 1999, B. zeae had not been reported on wheat anywhere else in the world.

Little is known about white grain and its management, but GRDC-funded research at the SA Research and Development Institute (SARDI) is unravelling how the fungus operates and investigating the best way to manage the emerging disease.

In SA, two fungi are causing white grain; one is B. zeae while the second is similar but has still to be identified and may not have been previously described.

The SA white grain fungi do not appear to produce toxins harmful to stock or humans, but ‘white’ grain is also a symptom of Fusarium head blight/head scab, which is associated with harmful toxins.

Fusarium head blight is present in the northern region, where it causes rejection of wheat deliveries in some seasons, but has never been detected in cereals in the southern region.

The similarity of white grain to Fusarium head blight has led to the downgrading or rejection of wheat affected by the disease, due to concerns that Australia’s export markets could be affected.

DISEASE RESEARCH

Two spore traps at Buckleboo, SA, will quantify the production and mobility of white grain fungal spores. The research will provide a better understanding of the biology of the disease and the role of infected stubbles as a spore source.

White grain only affects bread wheat in SA and does not produce obvious plant symptoms other than bleached grain.

The best way to assess whether a crop is infected is to rub grain out of wheat head samples before harvest. The disease can be patchy in its distribution across paddocks, sample the heads from several areas to assess white grain status.

Adjusting harvester settings can reduce the amount of white grain (which is lighter than normal grain) going into the bin. Harvesting badly affected areas separately could help maximise returns from wheat deliveries.

The white grain fungus survives on cereal stubble, so moving infected residues to uninfected areas such as the western districts of the Eyre Peninsula or WA should be avoided. Infected stubble can produce spores for at least two years, so white grain is likely to remain a concern – especially during wet springs, which will favour infection during flowering and grain-fill.

Seed infected with white grain will not germinate and seeding rates may need to be increased in severe cases. While the amount of visibly white grain will give an indication of germination rate, some infected seed will not show visual symptoms and on-farm seed should be tested for germination rate.

Reducing stubble load in paddocks is likely to lower the amount of white grain inoculum, but fungicides are unlikely to provide useful control. Trial data from 2011 did not find any fungicide treatments that effectively reduced white grain infection. In addition, commercial paddocks developed white grain despite having been treated with fungicide for rust control. This suggests fungicidal control of white grain will be difficult.

There is no clear evidence at this stage that wheat varieties vary in their susceptibility to white grain, but any infection found in the 2012 National Variety Trials will help to clarify this.

More information: Dr Margaret Evans, research scientist, SARDI, 08 8303 9379, margaret.evans@sa.gov.au
Emerging diseases

Net blotch on rise in south

New virulent forms of the net form of net blotch have been emerging to challenge popular malting barley varieties in South Australia.

NET FORM OF NET BLOTCH (BARLEY)

By Dr Hugh Wallwork

HOT SPOTS of a costly fungal disease, net form of net blotch (NFNB), were found in 2012 on popular malting barley varieties Fleet Australia and Oxford in South Australia.

The plant pathology team from the SA Research and Development Institute (SARDI) has been isolating the new NFNB strains and testing them on a range of barley varieties to determine their full range of virulence on commercial varieties and breeding lines.

NFNB is not a new disease in Australia, but until the early 1990s it was kept under control through the use of resistant barley varieties. The disease came to prominence after 1993, with the introduction of the susceptible barley variety Franklin from Tasmania.

By 1996, a virulent NFNB strain was found on another popular malting barley variety, Skiff.

This was followed by scattered cases of the same strain in 1997 and then heavy damage to the Skiff barley crop in 1998, resulting in 100 per cent screenings in many areas where Skiff was grown. As a result, Skiff went out of production the following year.

The disease lingered for several years on the feed barley Barque, which was moderately susceptible.

In 2007, a new virulent strain of NFNB was found on the widely grown malting variety Keel, which became moderately susceptible to the disease.

Maritime was the next variety to suffer, with a new virulent strain of the disease discovered on the west coast of the Eyre Peninsula in 2008. Within two weeks, the disease had spread right down the west coast and across the southern Yorke Peninsula. Most crops were sprayed effectively, but where crops were not sprayed losses in grain yield were up to 70 per cent.

While fungicides can provide good control against the disease, two or three sprays may be required for adequate control where the disease infects early. Without adequate control, the spore load of the disease will continue to escalate – increasing the likelihood of more mutations and new virulent strains emerging.

The team at SARDI is working closely with barley breeders to screen upcoming material against the emerging NFNB isolates. Ultimately, the best way to keep the disease in check will be the release and widespread uptake of resistant varieties leading to reduced opportunities for new virulent strains to emerge.

GRDC Research Code DAS00099

More information: Dr Hugh Wallwork, leader, Wheat and Barley Improvement, SARDI, 08 8303 9382, hugh.wallwork@sa.gov.au
Combating powdery mildew

Barley powdery mildew has emerged as a costly disease in Western Australia and growers in the east need to be on alert for outbreaks of the disease

By Professor Richard Oliver

BARLEY POWDERY MILDEW is worsening in the western region, reflecting the diminished capacity of fungicides to control the disease.

The resistance of powdery mildew populations to some triazole fungicides was established in 2009. In 2010 and 2011, every sample tested in surveys of barley powdery mildew infection across the Western Australian wheatbelt carried the genetic mutation that provides resistance to some triazoles such as tebuconazole.

The use of susceptible barley varieties, such as the widely sown Baudin®, and the ability of the powdery mildew fungus to overcome plant resistance mechanisms have contributed to the disease blowout.

A complicating factor in the fungicide resistance story is that the powdery mildew fungus has not developed complete resistance to the triazole chemistry. If growers increase application rates of the fungicide, they will control the disease, but they will also increase the rate at which full resistance to the fungicide will develop.

To extend the life of foliar fungicides, growers are urged to apply an effective seed dressing when sowing barley, as their efficacy against the disease remains high.

GRDC-funded research is unravelling how the disease operates genetically, and is also developing more effective fungicides against powdery mildew. To manage the resistance threat of barley powdery mildew an emergency permit (PER13482) for the fungicide spiroxamine (Prosper®) has been approved for use in WA until 31 March 2013. The GRDC is seeking to have the emergency permit extended for use of Prosper® throughout the 2013 growing season. More resistant barley varieties are also in the pipeline.

Additional new fungicides and resistant malting barley varieties are expected to become available within the next few years.

Only a marginal improvement in the resistance level of barley varieties to powdery mildew would be needed to lessen the impact of the disease by reducing the amount of inoculum carried over in stubble. This is highlighted by the much lower incidence of the disease in southern regions, where more resistant barley varieties are on offer.

In eastern Australia triazole-resistant barley powdery mildew pathotypes were found in 2012 and growers should be on alert for powdery mildew outbreaks.

POWDERY MILDEW RESISTANCE

Established
Emerging

By Janet Paterson

INTENSE LENTIL CROPPING on the Yorke Peninsula in South Australia over the past decade has caused a rise in ascochyta inoculum loads and a possible breakdown in blight resistance in a popular and previously resistant variety, Nipper®.

SA Research and Development Institute (SARDI) pulse pathologist Jenny Davidson is monitoring a suspected breakdown in lentil resistance to the ascochyta fungus.

During a severe outbreak of ascochyta in 2010, Nipper® lentils needed fungicide sprays during podding ahead of rain fronts to prevent pod and seed infection. Such infection levels had not been seen before and could indicate that the fungus has broken the variety’s resistance.

SARDI research funded by the GRDC and the SA Grains Industry Trust identified isolates of *Ascochyta lentis* collected from Yorke Peninsula in 2010 that can separately overcome each of three sources of resistance used in the lentil breeding program.

Under high selection pressure, such as occurs on Yorke Peninsula, these might develop a single resistance type capable of overcoming all three sources of plant resistance.

It is important that growers monitor all lentil crops for ascochyta infection.

Preliminary research indicates that ascochyta can survive in lentil paddocks much longer than previously thought, with 2012 surveys showing inoculum persists for at least three years. This may mean a broader rotation is required to adequately control serious inoculum levels.

Ms Davidson says a seed fungicide dressing is critical to controlling springtime levels of the disease.

GRDC Research Code DAS00099

More information: Jenny Davidson, senior pulse pathologist, SARDI, 08 8303 9389, jenny.davidson@sai.gov.au
Fleabane now a national challenge

Integrated weed management is the key to managing flaxleaf fleabane, which is emerging as a problem weed across southern Australia

By Dr Michael Widderick

FLAXLEAF FLEABANE IS a major weed in dryland crops in southern Queensland and northern New South Wales, and is emerging as a problem weed across the entire cereal-cropping belt of southern Australia.

Previously, fleabane was found mainly on roadsides, particularly where council use of glyphosate created bare ground on which the weed could flourish without competition. However, the weed is highly mobile and soon found its way into adjacent cropping systems.

With the move to minimum tillage and the increasing use of glyphosate, the scene was set for an expansion of the troublesome weed. Wet summers in southern grain regions over the past two years have aided the weed’s spread.

Fallow weed control costs have increased markedly because of fleabane, with some zero-till growers having to reintroduce cultivation as a last-resort control tactic.

Disturbingly, populations of fleabane have recently been confirmed as resistant to eight times the normal rate of glyphosate – earning fleabane the title of Australia’s first glyphosate-resistant broadleaf weed.

The resistant populations were found in zero-tilled or minimum-tilled paddocks in southern Queensland and northern NSW. In addition, glyphosate-resistant populations were identified along roadsides near these cropping paddocks.

On the other side of the continent, a survey in Western Australia initially found fleabane following the typical pattern of occupying roadsides and fencelines, except for some incursion into crops in the Esperance district. But now, GRDC-funded researcher Dr Sally Pelzter, from the Department of Agriculture and Food, WA, says fleabane is becoming an increasing problem across the wheatbelt.

In other countries, fleabane has developed resistance to herbicides from Groups B, C, L and M, with some populations resistant to multiple chemicals.

Herbicide resistance has the potential to spread due to the weed’s highly mobile seed. Research in WA found that fleabane seed could travel on the wind up to 800 metres from its parent plant.

CONTROL STRATEGY

While fleabane presents a serious and costly weed challenge, GRDC-funded research has shown that a strategic approach using integrated weed management (IWM) can significantly reduce the weed’s impact on crop production.

University of Queensland researcher Dr Steve Walker says the key to getting on top of fleabane is to attack all parts of the weed’s life cycle to keep the seedbank low. Adopting an IWM strategy, which includes chemical and non-chemical tactics, will result in substantially fewer fleabane problems and resistant populations in subsequent seasons (www.qaafi.uq.edu.au/content/Documents/weeds/IWM-Fleabane-guide.pdf).

With the capacity to produce two or three generations each year and 110,000 seeds per plant, controlling fleabane before it sets seed is critical.

In southern and western Australia, fleabane often germinates under crops during spring or at harvest. Following harvest, a lack of crop competition combined with summer rain can cause rapid weed growth. By the time there is a window for control, the fleabane plants are often mature, with a large root system, a reduced leaf area and a high tolerance to most herbicides.

In northern NSW and southern Queensland, fleabane is a major weed of winter and summer cropping. It germinates either just before or after the crop is sown, competing strongly if left uncontrolled.

Research across Australia indicates that hitting the weed with herbicide while it is young and actively growing is the best approach. Conversely, delaying herbicide application until the weed is mature and water-stressed can result in poor control.

The ‘double-knock’ approach, with glyphosate followed by paraquat, has proved a critical component of a fleabane IWM program.

This approach, coupled with the use of competitive crops and pastures and strategic cultivations to bury ‘blow-outs’ of seed production, can reduce the weed’s seedbank to manageable levels within a few seasons. It is also important to target fencelines and roadsides.

New GRDC-funded research in NSW, led by Dr Hanwen Wu, from the NSW Department of Primary Industries, aims to identify residual herbicides for fleabane control in wheat and canola to overcome the common problem of growers tackling mature fleabane plants during the fallow.

Alternative herbicide chemistries for controlling fleabane in fallows are also being investigated to allow more options for a double-knock approach (www.qaafi.uq.edu.au/content/Documents/weeds/Controlling-flaxleaf-fleabane-2.pdf).

This would reduce the pressure on the current approach, which heavily relies on glyphosate and paraquat.

GRDC Research Codes UA00134, UG00055, UG00062

More information: Dr Michael Widderick, senior research scientist weeds, Agri-Science Queensland, 07 4639 8856, michael.widderick@daff.qld.gov.au
Feathertop heads south
Feathertop Rhodes grass has jumped the fence in southern Queensland to emerge as a major weed of the region’s summer crops

A SHIFT TO MINIMUM tillage and increasing glyphosate use across southern Queensland and northern New South Wales has created the perfect environment for feathertop Rhodes grass (FTR) to flourish.

A problem weed in Central Queensland for many years, FTR has only become an issue further south recently. Previously it was only a roadside weed in these areas.

GRDC-funded research has shown that no single management strategy will effectively control FTR. A variety of tactics across rotations is required to keep on top of the troublesome weed.

As with all problem weeds, the aim is to deplete the seedbank, control seedlings and small plants, stop seed set and prevent new seeds entering from outside the system.

Central Queensland research has been determining the most effective herbicide and cultural controls for managing FTR in fallow and cropping systems. A newly funded GRDC project, ‘Improving IWM practices in the Northern Region’, is investigating FTR ecology and other control options suitable for southern-Queensland and northern-NSW cropping systems.

FALLOW CONTROL
FTR is not listed on the labels of any fallow-registered knockdown herbicide. However, a minor use permit to 31 August 2016 (PER12941) initiated by the Northern Grower Alliance allows a double-knock of a Group A herbicide followed by paraquat (Group L), but only in fallows that will be planted to mungbeans. This permit is specific to Queensland.

Annual grasses can rapidly develop resistance to ‘fop’ chemistry. To reduce the rate at which this occurs in FTR, the PER12941 permit limits Verdict® 520 use to one application per season in fallow, and this must be followed by a double-knock application of at least 1.6 litres per hectare of a 250 grams/L paraquat product.

Research in Central Queensland shows that once FTR is past early tillering, a Group M (glycine) herbicide used alone becomes ineffective, but if a Group L bipyridyl herbicide is applied sequentially FTR control approaches 100 per cent. This double-knock tactic has proved the most consistent and effective approach across a range of growth stages and plant stress conditions. The same research shows that adding residuals (particularly Group B) to the second knock enhances the effect of the Group L herbicide (Figure 1).

The interval between knocks is

FIGURE 1 Impact of the residual herbicides (Groups K, C and B) with Group L in the second knock of a double-knock tactic on the knockdown control of FTR. The first knock was a robust rate of a Group M herbicide.

FIGURE 2 Effect of time interval between the first (Group M herbicide) and second (Group L herbicide) knocks of the double-knock tactic on control of FTR in a southern Queensland trial.

PHOTOS: STEVEN WALKER
important to overall efficacy. For many weeds, the interval required is short (three to four days), but FTR research by the GRDC-supported Northern Grower Alliance found that a minimum of seven days is necessary when using a Group M as the first knock (Figure 2). This is probably due to an antagonism that occurs inside the plant and is specific to FTR. The ‘Improving IWM practices in the Northern Region’ project will investigate this further.

The double-knock tactic works best when applied to small, actively growing weeds, and rates for both knocks are robust. Applying the second knock as a spot spray, or using weed-detection technology (if available), can cut herbicide costs. Spot tillage is also an option and, in some instances, the second knock can be a ‘spot’ tillage operation instead of herbicide.

**IN-CROP CONTROL**

In-crop control of FTR will be limited by the herbicides that can be safely used within specific crops. For post-emergence control, shielded sprayers might be required (Group L and M herbicides in most crops, and Group A herbicides in some grass and cereal crops). Queensland research has shown that several of the grass-selective Group A herbicides control FTR well, however, butoxydim and cloethodim are the only Group A herbicides registered for in-crop FTR control. Research is examining other Group A herbicides, which may perform better.

Grass-selective knockdown herbicides are widely used in broadleaf crops such as mungbeans, chickpeas, cotton and sunflowers. Growing these crops in the rotation will help manage FTR. In addition, certain Group A herbicides used in wheat and barley provide effective post-emergence control of FTR, so winter cereals are a good option in an FTR-integrated weed management plan.

Most weed control tactics rarely achieve 100 per cent control, so monitoring for and controlling survivors is important. Controlling survivors as soon as possible by spot tillage, spot spraying (including weed sensor spray technology) or manual removal will avoid further seed set and minimise future problems.

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**HERBICIDE RESISTANCE IN SUMMER GRASSES**

**By Tony Cook**

WINDMILL GRASS,AWNLESS barnyard grass and liverseed grass have all been confirmed as glyphosate resistant in the GRDC northern grains region.

Summer grasses that are resistant to glyphosate pose huge threats to no-till farming systems in summer-rainfall areas of Australia, according to Dr Chris Preston from the University of Adelaide, who chairs the GRDC-funded Australian Glyphosate Sustainability Working Group.

Summer grasses are among the weed species with the highest potential to develop resistance to glyphosate due to their high seed production, limited options for fallow control other than glyphosate and reliance on glyphosate in no-till cropping systems.

In addition, there are limited post-emergent control options.

GRDC-funded research across Australia has sought to better understand the biology and ecology of the summer grasses, and to develop and promote integrated weed management systems to control these costly weeds. Research is ongoing to look at other Group A herbicides that may perform better.

**AWNLESS BARNYARD GRASS**

Awnless barnyard grass populations with resistance to glyphosate have trebled since 2011 in the northern grains region, according to a recent GRDC-funded survey led by the New South Wales Department of Primary Industries with assistance from the Northern Grower Alliance.

The survey tested awnless barnyard grass samples that had survived spraying from zero-till fallow paddocks across southern Queensland and northern NSW.

Of the 64 populations tested, 40 were resistant to seven times the normal rate of glyphosate; a further five populations were deemed marginally resistant. All resistant cases came from areas in which there had been sustained glyphosate use, often for more than 15 years, with few other weed control measures.

Integrated weed management is critical to staying on top of the glyphosate-resistant populations. It needs to include: targeting young plants; monitoring for and removing spray survivors; and using a double-knock in fallows, with a residual herbicide early in the fallow.

Modifying the rotation to include competitive, short-season broadleaf crops over summer, such as mungbeans, should be considered. This will allow other herbicide groups to be used while reducing the weed seedbank.

Growing sorghum in these high-risk paddocks should be delayed until awnless barnyard grass has been significantly reduced, as weed numbers are likely to increase if pre-emergent herbicides are compromised by dry weather during crop establishment.

**FIGURE 1** Biomass and yield of Wyalkatchem wheat in 2009 following control or no control of windmill grass from spring 2008 to autumn 2009.

*Wheat biomass (g/m²) Wheat yield (t/ha)*
SOUTH FACES WILD RADISH RESISTANCE

BY JANET PATRSON

GROWERS IN THE GRDC’s southern cropping region should be able to draw on the experience of their western counterparts for developing and implementing proactive control strategies for herbicide-resistant wild radish.

Herbicide-resistant wild radish is becoming a serious threat in the southern region, but western growers have considerable experience in keeping this difficult weed in check. Although wild radish has been present in both regions, the use of a sheep/wheat rotation in the south – southern New South Wales, Victoria, South Australia and Tasmania – has helped keep the weed under control.

In contrast, Western Australia’s intensive cropping system has led to wild radish becoming the number-one weed issue, with 60 per cent of wild radish populations developing resistance to some herbicide. Some populations are now resistant to multiple herbicide groups. While the level of resistant wild radish populations in the southern region is still significantly lower than in the west, enterprise changes are beginning to replicate what has happened in WA. Growers in the southern region are moving towards a more intensive cropping system, with fewer sheep and more herbicide applications.

According to University of Adelaide weed scientist Dr Christopher Preston, there are more than 20 paddocks across Victoria and SA with wild radish resistant to herbicides. Of these, five wild radish populations are resistant to Group I herbicides (three in Victoria and two in SA) and one is resistant to Group B, Group I and Group F.

Dr Peter Boutsalis is director of Plant Science Consulting, which carries out annual herbicide-resistance testing on wild radish from paddocks where herbicides have failed. Since 2009, half the 60 wild radish samples received from growers across south-eastern Australia have been verified as resistant to Group B and Group I herbicides.

When poor herbicide control of wild radish is identified, it is critical that the weed seed is tested for herbicide resistance.

GRDC-funded research across the western and southern regions is quantifying the extent of the wild radish problem and developing management systems to lower the weed’s on-farm seedbank.

Over the past decade, research by Professor Stephen Powles and his team at the Australian Herbicide Resistance Initiative has unravelled the biology of wild radish and has developed innovative control strategies.

An underlying principle of wild radish management is to keep the weed seedbank in check. More than 90 per cent of seed can be captured at harvest. As long as this seed is destroyed or removed via chaff carts, baling systems, windrow and subsequent burning, crushing (via the newly commercialised Harrington Seed Destructor) or feeding to livestock, then radish seedbank numbers can be reduced to manageable levels.

When weed seed is not destroyed it remains in the chaff to be spread back onto the paddock or – worse still – to be transported to another paddock, where wild radish or herbicide-resistant wild radish may not be present.

FROM PAGE 9 RESISTANT SUMMER GRASSES POSE BIG THREAT

Department of Agriculture and Food, Western Australia, suggests subsequent wheat yields can be reduced by as much as 25 per cent (Figure 1).

In central NSW, yield potential of canola crops has been reduced by as much as 80 per cent in paddocks with serious windmill grass infestations.

As a shallow-rooted perennial favouring lighter soils, windmill grass easily becomes moisture-stressed, making it less responsive to herbicide control. Herbicide efficacy against windmill grass can drop by as much as 50 per cent during hot, dry weather.

The secret, as with all summer weeds, is to control plants early (while they are still small and actively growing) using a double-knock of glyphosate followed by paraquat. In some paddocks, cultivation may be the only way to control mature plants and get on top of a serious infestation.

LIVERSEED GRASS

Resistance to glyphosate-based herbicides in liverseed grass was first confirmed in 2008. The resistant population was restricted to a small part of a paddock, totalling about one hectare.

No other cases of resistance have since been confirmed, and the resistant patch has nearly been eradicated. After three years of persistent control measures, the grower now weeds by hand the occasional liverseed plant.

Liverseed can be controlled using a double-knock of either a high legal rate of glyphosate or a Group A herbicide first (via a WeedSeeker® boom), followed by a bipyridyl herbicide.

Incorporating the fallow residual herbicide (Flame®, Group B) into a liverseed chemical-control program enables rotation of herbicides with different modes of action.

An effective non-chemical control measure is to use the mulch layer of brown-manured winter cereals as a preventive barrier against liverseed grass establishment.

GRDC Reseach Code UQ00062

More information: Tony Cook, technical specialist – weeds, NSW DPI, 0447 651 607, tony.cook@dpi.nsw.gov.au
Emerging pests
Southern and western snail snapshot

Reports of snail damage are on the rise in the western region, while a new survey will determine the extent of the snail issue across southern Australia.

SURVEY WORK IN the western and southern grains regions will help identify the extent of the snail problem in these areas. Results of the GRDC-funded research will be available in mid-2013 and will help determine if the cropping pest has reached its ecological potential or is still on the move.

South Australian Research and Development Institute (SARDI) entomologist Greg Baker is leading the research project, in collaboration with Dr Michael Nash from the University of Melbourne and Svetlana Micic and Peter Mangano from the Department of Agriculture and Food, Western Australia.

The survey across the cropping regions of SA, WA, Victoria and southern New South Wales will cover the four exotic snail species (two round and two conical) and three exotic slug species that affect crops across southern Australia.

No comprehensive snail surveys have been done in the past few decades and the new distribution information will help target snail management and market access activity.

Mr Baker believes it is unlikely that the snails have reached their geographic limit.

In SA, snails are a significant economic problem and can cause tens of thousands of dollars in lost production, control costs and downgraded grain on individual farms.

Entomologist Ms Micic says there are increasing reports from WA growers of snails damaging crops and requiring control – particularly in southern coastal districts and near Geraldton in the northern wheatbelt.

Snail numbers are also increasing in western Victoria and snail populations are expanding eastwards.

Dr Nash says snails and slugs will continue to be a problem in high-rainfall cropping areas across southern Australia due to stubble retention and improved soil moisture-holding capacity.

The research will also examine the efficacy of alternative baits and unregistered chemicals in controlling snails. Chemical control of snails relies solely on baits (the majority contain metaldehyde), which often results in poor field efficacy, especially for juvenile snails.

**By Janet Paterson**

GRDC Research Code DAS00127
More information: Greg Baker, principal entomologist, SARDI, 08 8303 9544, greg.baker@sa.gov.au

Reports of snail damage are rising in Western Australia.
SEVERAL NEW CROP pests have emerged in the past 10 to 15 years as important pests of germinating crops in southern and western regions. Of particular concern are balaustium mites, earwigs, millipedes and slaters.

This shift is probably due to a complex interaction of factors, including increased use of broad-spectrum insecticides, widespread adoption of stubble retention and minimum tillage, increased plantings of vulnerable crops such as canola, and drier conditions exacerbated by climate change.

Seedling damage from pests is often more severe when seasonal factors delay seedling establishment, or lead to low plant densities through poor seedling vigour or germination rate.

Except for earwigs there are no registered insecticide products to control these pests in broadacre crops in Australia.

**BALAUSTIUM MITES**

Little is known about the biology and ecology of balaustium mites worldwide. Their economic effect in Australia is difficult to assess as balaustium are often misidentified as other mite pests. Balaustium mites survive insecticide applications aimed at other mite pests in crops and pastures. Non-chemical control methods should be implemented such as destroying early-season weed hosts before sowing crops. Other control options need to be investigated.

It is important to correctly identify the mite species before using insecticides. In addition to wasting time and money, the inappropriate use of chemicals can lead to issues with resistance and change the pest species dynamics.

**BLACK PORTUGUESE MILLIPEDES**

Black Portuguese millipedes have emerged in recent years as pests of canola in the southern region. These pests are often accidentally transported into cropping areas with the movement of plant material and agricultural machinery. Stubble retention provides a favourable habitat for the millipedes to survive and reproduce. Wetter summers in recent seasons have contributed to a build-up of millipede populations in some districts.

Most reported millipede damage has occurred in emerging canola crops on black organic soils with heavy stubble loads, although there have been problems on lighter soils. The presence of millipedes does not always result in damage; there have been many instances where no damage has occurred, despite large millipede populations.

Millipedes are difficult and expensive to control in-crop. Reducing stubble load over summer is likely to be the most effective way to reduce their numbers. A parasitic native nematode that attacks and kills millipedes was released in urban areas of South Australia in the late 1980s and millipede numbers in those areas have since declined, but it is unclear whether the parasite has spread to cropping areas.

**EUROPEAN EARWIGS**

There are several species of earwigs in Australia. Some are beneficial while others, such as the introduced European earwig, are increasingly being reported as crop pests. It is important to identify earwig species before implementing control measures.

When high populations of earwigs are found beneath stubble they are likely to be European earwigs, as native earwigs are more solitary by nature. European earwigs mainly attack canola, but will also feed on cereals, lupins and some legume crops. Where European earwigs have accidently been introduced into properties their numbers usually increase over several years, often in paddocks with high levels of stubble residue. Removing stubble by burning or other means can be an effective strategy.

**SLATERS**

Although not common, native and introduced slaters have become an increasing pest of broadacre crops and pastures in recent years.

Some growers are now proactively baiting for slaters ahead of sowing. Stubble retention is thought to have contributed to the build-up of slater populations and its removal is likely to reduce pest numbers. Slaters are relatively unaffected by most foliar applications of synthetic pyrethroids and organophosphates to control other crop-establishment pests, even when applied at very high rates.

**MANAGEMENT**

- Long-term, dense and under-grazed pastures often favour cropping pests.
- Canola following a pasture phase is usually at higher risk of pest attack than a cereal rotation.
- Planting a non-host crop, such as chickpeas, will help suppress some pest populations.
- Early sowing of high-vigour varieties with an increased seeding rate will help compensate for seeding losses from pest damage.

Further research on these emerging pests is required to better understand why certain paddock conditions result in increased pest populations.

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**By Dr Paul Umina, Kym Perry and Peter Mangano**

GRDC Research Code CSE00046

More information: Dr Paul Umina, cesar / University of Melbourne, 03 9349 4723, pumina@unimelb.edu.au; Kym Perry, entomologist, SARDI, 08 8303 9370, kym.perry@sa.gov.au; Peter Mangano, entomologist, DAFWA, 08 9368 3753, pmangano@agric.wa.gov.au
Emerging pests

New insecticides for control

Insecticide resistance in diamondback moth is on the rise, making it critical to implement integrated pest management systems

DIAMONDBACK MOTH RESISTANCE

- Established (in Western Region and South Australia only)
- Emerging (in Victoria and southern NSW)

By Janet Paterson

DIAMONDBACK MOTH (DBM) has been a pest in brassica vegetable crops in Australia for many years, but has only recently emerged as a serious problem for the canola industry.

DBM’s host range is restricted to brassica crops and it has become an increasing problem as the area planted to canola across Australia has expanded to two million hectares. Larvae damage can cause serious crop losses.

Outbreaks are seasonally driven; the most severe are generally associated with warm, dry conditions during winter and early spring.

DBM is notorious for its capacity to develop insecticide resistance. The moth was the first insect pest to develop field resistance to DDT and in the past 40 years has developed resistance to all insecticide classes used for its control.

In Australia, DBM has developed moderate resistance to the widely used synthetic pyrethroid and organophosphate groups of insecticides.

The ability of DBM to ‘out fox’ new insecticides prompted the GRDC to fund a search for new chemistries for its control.

NEW INSECTICIDES

Research by South Australian Research and Development Institute (SARDI) entomologist Greg Baker provided data to support the registration of three new insecticides for DBM control in canola.

The two registered in 2012 (Group 6 – avermectin, Affirm® and Group 5 – spinosyn, Success® NEO) are chemical types that have been used to control DBM in the vegetable industry since about 2000. Canola registration is pending for the third type (Group 28 – diamide), which has been used in the vegetable industry since 2008.

However, the SARDI team has found evidence of DBM cross-resistance to two of these new insecticides (Group 6 Affirm® and the Group 28 diamide) in DBM populations in vegetable-growing areas. The finding is a blow for the canola industry, which would ideally rotate the insecticides to prolong their useful life.

Despite the setback, Mr Baker is confident that the new insecticides can provide the canola industry with effective options to control DBM – provided they are used wisely, and resistance genes do not spread from the vegetable industry to the canola industry.

Fortunately, DBM outbreaks only occur sporadically in canola, so the chemicals will not have to be used every year.

Synthetic pyrethroids are broad-spectrum insecticides often used from pre-emergence right through to crop maturity to control a range of insect pests, including DBM. Their widespread and frequent use, coupled with DBM’s propensity to develop chemical resistance, has increased the selection pressure for resistance in DBM, even in years when DBM is not a particular problem.

Unlike synthetic pyrethroids, the Affirm®, Success® NEO and Group 28 insecticides are specific to DBM.

If the new insecticides are used only for DBM – and only in years when DBM is an economic issue – their useful lifetime will be optimised.

Whether DBM (with resistance) can migrate from brassica vegetable production areas to canola areas is unknown, but this will be important in determining longer-term DBM resistance management strategies for the grains industry.

SPRAY COVERAGE

DBM control is closely associated with adequate spray cover of canola crops. Mr Baker’s recent research across a range of aerial and on-ground spray equipment suggests insecticide coverage of canola crops for DBM control is very poor. His study indicated that insecticide rarely penetrates below the upper canopy layer of flowering canola crops. This is an issue because DBM larvae are distributed throughout the canopy.

Future research will address these spray issues with the development of more effective spray technologies to reduce drift and improve canopy penetration and product efficacy.

GRDC Research Code DAS00094
More Information: Greg Baker, principal entomologist, SARDI, 08 8303 9544, greg.baker@sa.gov.au

Research by SARDI entomologist Greg Baker has provided data to support the registration of three new insecticides for diamondback control in canola.

Diamondback moth has become an increasing problem in canola crops across southern Australia.

Photos: Peter Mangano

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Established (in Western Region and South Australia only)
Emerging (in Victoria and southern NSW)
STAYING ABOREAL OF RLEM AND APHID RESISTANCE

By Janet Paterson

INSECTICIDE RESISTANCE IN aphid and mite populations is likely to rise across southern Australia.

REDEIGNED EARTH MITE

Emerging

Screening for resistant populations of redlegged earth mite (RLEM) is underway throughout the southern and western regions. More than 20 cases of mites resistant to synthetic pyrethroids have been confirmed across 900 kilometres of Western Australia.

Dr Paul Umina, from cesar and the University of Melbourne, believes it is inevitable that RLEM with insecticide resistance will emerge in southern Australia.

Insecticide resistance in RLEM is genetic and survives several generations. This, coupled with the fact that RLEM eggs can travel long distances via wind and on farm machinery, makes biosecurity measures critical to controlling the spread of resistance.

GRDC-funded research has identified RLEM resistance across the entire pyrethroid chemical group. Pyrethroids should therefore not be used on resistant RLEM populations.

The good news is that resistant mites can still be controlled using registered chemicals such as omethoate and chlorpyrifos. However, it is critical that chemical groups are rotated to prolong their effective life span.

GREEN PEACH APHID

Emerging

With the 2010 discovery of green peach aphid (GPA) resistance to pirimicarb in WA, a national GRDC-funded project is now mapping GPA insecticide resistance across southern Australia.

Preliminary results suggest the pirimicarb resistance may not be confined to WA.

The aphid has already developed resistance to organophosphates and synthetic pyrethroid insecticides.

Survey results indicate synthetic pyrethroid resistance is more widespread than first thought in the southern grains region, with high levels of resistance detected across eastern Australia.

Resistance to organophosphates does not appear to have increased over the past five to 10 years in Australia, although further screening of field populations is underway.

The confirmation of GPA resistance to pirimicarb is a blow to pulse and oilseed growers in particular. Until now this chemical has been seen as a fallback for aphid populations resistant to other chemical groups.

Pirimicarb is aphid specific and less harmful to other invertebrates when applied to crops.

Mandalotus control: a mystery

MANDALOTUS WEEVILS

Detected

Mandalotus weevils have emerged as a serious pest of canola in the southern region.

GRDC-funded research at the South Australian Research and Development Institute (SARDI) is starting to unravel the weevil’s basic biology, but its control continues to be a challenge. One of the difficulties is the fact that the weevil spends most of its life cycle underground, emerging as an adult in autumn.

While the SARDI research has made considerable progress in better understanding Mandalotus behaviour, key questions remain about the environmental conditions that trigger weevil emergence. This makes chemical control of the pest difficult, as the most effective time to spray is unknown.

Work is underway to test the susceptibility of weevils to several broad-spectrum products registered for use in canola for a range of pests. To date there are no registered insecticides for its control.

Chemical control at the adult stage will be a key management strategy, but growers have so far had variable success. The weevils’ tendency to hide in the soil at the base of canola plants may affect spray coverage, and therefore control.

The SARDI research team members have spent many hours on their knees collecting weevils from canola crops to carry out chemical bio assay and life cycle investigations.

Preliminary results have shown an insecticide seed treatment gave 100 per cent control in a glasshouse experiment in which the weevils were fed only plants grown from treated seed. Other seed treatments were far less effective, giving less than 20 per cent weevil control in the laboratory and little activity on weevils in field trials.

In 2012 field trials of foliar insecticides applied as a bare earth treatment post-sowing, showed 53 to 68 per cent control after seven days compared with just three to 20 per cent control for other synthetic pyrethroid and organophosphate products. Work is ongoing to achieve registration of these effective products.

The SARDI research is investigating aspects of weevil reproduction and whether specific crops are connected with a build-up of the weevil. Preliminary
INTEGRATED APPROACH CRITICAL

SILVERLEAF WHITEFLY IN COASTAL PULSES

By Dr Melina Miles

DESPITE STABILISING IN numbers since its initial incursion into Queensland in the late 1990s, silverleaf whitefly (SLW) remains a potentially serious pest of coastal soybeans in the northern region.

The difficult-to-manage SLW has an international reputation for developing resistance to insecticides, and has already removed soybeans from the cropping rotation in cotton-growing areas of Central Queensland.

SLW is a much greater threat to soybeans than other whiteflies because it has a wider host range, rapidly develops pesticide resistance (within a single season) and is adapted to high temperatures. Under the right conditions, these factors can give rise to uncontrollable plagues with billions of individuals per hectare.

Once SLW numbers explode in a cropping region, there are no ‘silver bullets’ for their control. They cannot be managed with pesticides alone, even where effective products are registered.

Broad-spectrum pesticides used against other pests will encourage SLW because such insecticides kill SLW parasites and predators, enabling the pest to multiply unchallenged. Integrated pest management (IPM) is a necessity – not an option.

The SLW problem in soybeans is compounded because soybeans mature later in the season than other susceptible crops, such as cotton and cucurbits.

Queensland Department of Agriculture, Fisheries and Forestry entomologist Hugh Brier has been leading GRDC-funded research to better understand SLW, and to develop and promote an IPM system for coastal pulse crops in the northern cropping region.

NATURAL PREDATORS

The most effective way to control SLW is to ensure there are enough natural predators in the crop to suppress the pest’s population. If these predators are removed by broad-spectrum insecticides, SLW populations can increase dramatically – resulting in unmanageable pest levels and potential crop failure.

Upsetting the balance between natural predators and SLW is why soybeans are no longer produced in cotton-growing regions in Central Queensland.

Mr Brier and a team of agronomists and researchers have promoted soybean IPM widely in the northern coastal regions of New South Wales and Queensland through a series of coastal break crop IPM courses.

The courses also promote targetted use of ‘soft’ insecticides against pests other than SLW, so that the natural predators of SLW are not destroyed. The project has contributed to the registration of new products for pest management in soybeans, such as Bt (DiPel®) for soybean looper control.

Thresholds for mirid spraying in soybeans have also been established, resulting in far fewer sprayings for this pest. This has significantly improved SLW IPM, as spraying for mirids in other crops, especially cotton, is a major trigger for SLW outbreaks.

In recent years SLW populations have generally been low in the Bundaberg, Mackay and Burdekin regions of coastal Queensland. Mr Brier hopes the IPM system will be widely adopted thus preventing the soybean industry in coastal northern Queensland and northern NSW from suffering the same fate as that of Central Queensland.

GRDC Research Code DAQ00153
More information: Hugh Brier, Queensland DAFF – Kingaroy, 07 4160 0740, 0428 188 069, hugh.brier@daff.qld.gov.au

SILVERLEAF WHITEFLY

The silverleaf whitefly (SLW), introduced into Australia, came with resistance to most organophosphates, carbamates and synthetic pyrethroids. Since then, resistance has developed in some Australian regions to imidacloprid (Confidor®), endosulfan, bifenthrin (Talstar®), insect growth regulators and amitraz. SLW can develop pesticide resistance rapidly. The egg-to-adult cycle takes just 12 days in summer, resulting in billions of insects per hectare in heavily infested crops. If repeated applications of the same insecticide are used, SLW can develop resistance within a single season.

Spraying SLW in soybeans with the same products sprayed earlier in the season on cotton (or other susceptible crops) makes resistance develop more quickly.

PHOTOS: DR MELINA MILES, QUEENSLAND DAFF

Maintaining high populations of natural predators against silverleaf whitefly is the only way to manage this serious pest in northern coastal soybean crops.
GRDC LINK PAGES

For options and information on managing pests, diseases and weeds in your grain crops go to:


Annual estimated cost to industry

- Annual ryegrass: $300 million
- Blackleg in canola: $76.6 million
- Stripe rust in wheat: $127 million
- RLEM (cereals, canola, lupins): $44.7 million

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