Pest Management in Grains - Research, Coordination and Industry Engagement

Summary
As part of the National Invertebrate Pest Initiative (NIPI) network, this project comprised a range of extension and research investments to advance best practice in grains pest management. The activities have contributed to filling knowledge gaps, and improved understanding of barriers to the adoption of integrated pest management (IPM).

Highlights include more than 157 editions of PestFacts and PestFax, training workshops, websites, interviews, articles, economic evaluation and comparison of IPM and conventional pest control, assessment of pest damage thresholds, insight into predator gut contents, a tool to improved monitoring and control of mites, and an evaluation of future risk of increased pest problems due to a changing climate.

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The information contained in these older reports is now several years old, and may have been wholly or partially superseded or built upon in subsequent work funded by GRDC or others. Readers should be aware that more recent research may be more useful for their needs. Findings related to agricultural chemical use are also potentially out of date and are not to be taken as a recommendation for their use.

Conclusions
As a result of more than nine years of NIPI, and 3.5 years of NIPI3, the grains pest management resource network has been strengthened and is an increasingly well connected resource to support the grain growing community. Knowledge gaps are starting to be filled, tools to support pest control decision making are being developed, and web-based and hard copy materials to support best management practice using problem solving approaches are now available.

The insights from workshops exploring the barriers and constraints to IPM adoption have been formulated, and used for targeted research investment (e.g. Grains Pest Advisory Committee (CPAC), National Insecticide Resistance Management (NIRM), and IPM Training workshops). A case study has demonstrated that IPM is economically viable, especially in circumstances where more than a single spray is required.

Research results have demonstrated that predators commonly found in grain crops are consuming a range of pest species, and that different stubble management practices can influence pest and beneficial populations. The climate models suggest that major grain pests are likely to experience more favourable conditions in the southern regions in the future, and the high rainfall zone of Victoria (VIC) and Tasmania (TAS) may experience more outbreaks. However, some regions may experience lower risk, but this change is likely to occur slowly.

More tools are available to support adoption and practice of sustainable pest management. Schematics of life-cycles of major arthropod pests can guide monitoring and application of spray timing; the available pest damage thresholds have been summarised and significant gaps have been identified; a tool has been developed to predict emergence of autumn pest populations, again facilitating monitoring and application of spray timing; on-line resources, such as IPM Guidelines, are now available and rather than being prescriptive, the guidelines pages use a problem solving approach, drawing on the available pest management tools within a specific crop at various stages of crop development, and in different regions.

The NIPI Adoption Group and collaborating researchers continued to strengthen the network by developing resources, training growers and advisers in pest identification and biology, and IPM practices, and exchanging information across the communications network. Through these activities, an integrated approach to pest management is being built, and stakeholders are being supported to adopt best practice.

Recommendations
The adoption of IPM will require an integrated program of research, development and extension (RD&E). Additional investment will be required in socio-economic research, the development of tools and communication products aimed at the needs of specific audiences. Continued investment in preventative pest management tactics is strongly recommended. The prophylactic chemical use is highly likely to cost the industry dollars, rather than save the industry dollars (as indicated in the whole farm economic study).
If pest management practices are to change, and move away from heavy reliance on chemicals, then there is a very strong need to fund and develop viable, demonstrated alternatives to pesticide control. This should be tightly integrated with changing agronomic practices such as no-till and low-till, and implications of stubble management and prophylactic broad-spectrum chemical control. More base-line information is needed on beneficial insects and the factors that contribute to sustained population levels, and pest suppression. Action plans are needed to develop clear thresholds and decision guides, clear, easy to implement IPM programs, guidelines to avoid and delay resistance, tools and education for advisers, arguably the most important, yet weakest link in progressing best management practice for the grains industry.

The NiPI network needs to be supported and maintained, and continually move towards rapid responses of information on pest alerts and practices that minimise disruption to beneficials. Most importantly is that the NiPI network and GRDC need to commit to the further building of IPM capability and capacity in crop advisers who can support the transition to best pest management practices.

**Outcomes**

**Economic**

Ultimately, grains pest management needs to be effective, efficient and environmentally sustainable. All NiPI3 activities contribute to this goal in a variety of ways. Several activities of NiPI3 were directly related to economic benefits. The whole farm economic assessment of IPM for a case study farm at Winchelsea, VIC, demonstrated that IPM is cost effective. Chemical control costs more as soon as a second spray is applied. The use of broad-spectrum chemistry can create additional costs through flaring of pests as the season progresses. The Identification (ID) workshops held across the country have trained advisers and growers in pest ID, which is essential for targeted, effective control. Increased knowledge of egg hatch of mites has provided the evidence that a major knowledge gap exists, which is a barrier for cost effective decisions.

**Environmental**

Given the extreme dependency on chemical pest control for grain, and the direct and indirect environmental implications of these practices, innovative solutions are needed. Funding in NiPI3 has contributed to outcomes with a focus on pest control options that are working towards reduced environmental harm. Significant knowledge gaps exist about the role of natural enemies suppressing pests in grain systems, but gaps are slowly being filled, as demonstrated by work on predators eating grain pests.

**Social**

One of the greatest and most significant changes brought about by all NiPI activities more generally, and NiPI3 specifically, is the information exchange and communication flow across the NiPI network. The outcome is that industry broadly has many points of contact for regular information flow and exchange. Grains researchers share knowledge, collaborate on projects and work together to build capacity in grain entomology. The well connected and acknowledged network also allows for rapid responses and communication with key researchers. An explicit component of this project is the strengthening and maintenance of the network.

**Achievement/Benefit**

The NiPI network of approx. 60 research and extension staff were drawn from five state agencies - the Department of Employment, Economic Development & Innovation (DEEDI), New South Wales Department of Primary Industries (NSW DPI), VIC DPI, the South Australian Research and Development Institute (SARDI) and Department of Agriculture and Food, Western Australia (DAFWA), five University groups (University of Queensland (UQ), University of New England (UNE), Charles Sturt University (CSU), University of Melbourne ((UM) CESAR), University of Adelaide (UA) and University of Western Australia (UWA) and CSIRO. Actual project investments were made in extension and research with CESAR, UM, DEEDI, SARDI, DAFWA and CSIRO. The activities that have taken place over the four years of this project have continued to fill knowledge and capability gaps associated with grains pest management, and improved the understanding of barriers and limits to the adoption of IPM across Australia. Below is an overview of the major achievements of the project and how these achievements will benefit the industry.
1. Enhanced knowledge base to support a more integrated approach to pest management.

A range of activities were undertaken to gauge the baseline knowledge of growers and advisers, and to identify barriers and opportunities for IPM adoption, and research knowledge prioritisation. Workshops with growers, advisers, knowledge adoption specialists, and scientists spanning agronomy, entomology and ecology were conducted. The workshops focused on 'IPM Constraints and Adoption'.

The conclusions are that if left entirely to market forces, the adoption of IPM may be limited within the grains industry. However, IPM has much to offer the industry and growers in the long term, and fits well with insecticide resistance and natural resource management policies that affect future landscapes. The adoption of IPM will require an integrated program of RD&E. Additional investment will be required in socio-economic research, the development of tools and communication products aimed at the needs of specific audiences.

A survey was conducted to identify key pests that growers are concerned about, assess current pest management practice in grain crops, explore specific practices related to insecticide use and assess the comprehension and attitudes towards IPM. From approx. 500 responses, the issues of major concern were resistance, spray applications, timing of application, pest ID, thresholds for spraying, and monitoring before spraying. They identified six pests of major concern, and if pest management practices are to change, then there is a very strong need to fund and develop viable, demonstrated alternatives to pesticide application, develop clear thresholds and decision guides, develop clear, easy to implement IPM programs, and develop tools and education for advisers.

Research gaps have been filled with new knowledge on using agronomic and weather to predict emergence of autumn pest populations. From this, a tool has been developed that can identify the time of season when growers need to be alert to the emergence of mite problems in their field. Furthermore, predators commonly found in grain crops have now been shown to consume a range of pest species in their diet including a number of pest aphids, mites, helicoverpa, and armyworm. Demonstrating the potential control of pests by predators fills the knowledge gaps, and facilitates progress towards integrated pest control. Stubble management might also facilitate pests and beneficials. A short term trial has demonstrated that small alterations to stubble management (e.g. burning, mulching, or leave standing) support higher populations of some pests in comparison to conventionally cultivated fields early in the season in canola. All of the above activities are contributing to the knowledge base to advance best management practices.

2. Accelerated practice change in pest management leading to wider adoption of more sustainable IPM systems.

The key activities that were conducted to facilitate accelerated practice change in pest management include assessing the value proposition for IPM, providing easily accessible IPM resource material through the IPM Guidelines website and NIPI website, surveying growers to gauge their interest in trialling IPM, and conducting extension and adoption activities to achieve IPM.

The value proposition was formalised using a whole-farm economic approach for a case study farm at Winchelsea, VIC (led by Mike Krause). The results indicated the significant economic losses caused by invertebrate pests, and why they need to be managed. In addition, when allowing for the incidence of pest outbreaks, there appeared to be no significant economic difference between the non-IPM and IPM treatments. However, when the increased probabilities of related pest outbreaks were considered, the IPM approach gave the best economic result.

New and updated websites are available to help grain growers manage pests. The IPM Guidelines website uses a problem solving approach, drawing on the available pest management tools within a specific crop at various stages of crop development. Relevant regional differences are also included. The content has been kept simple and easy to navigate. Each crop page highlights the relative risk of pest attack as the crop grows, and provides a list of pests that are potentially damaging. Pest pages focus on management tactics for each crop stage, including 'off season' operations and planning. Images are included to assist with identification of pests and beneficials. An extensive collection of supporting material is available both on the site and through external links. The website is a comprehensive source of information about IPM in grains, including both traditional and novel methods of pest management. It is also a valuable decision making tool for pest management in grains throughout Australia. New content continues to be added to the NIPI website (http://www.nipi.com.au/) including research findings and the packaging of those findings in NIPI Notes (http://www.nipi.com.au/services/nipi-notes/), links to resources, contacts, and tips and tricks for achieving best management practice.
Surveys were conducted in three regions to investigate interest in grower trialling of IPM tactics, involving grower groups, advisers and suppliers. Overwhelmingly, the response was that there was considerable interest, but the trials would have to be funded in full, staffed and conducted by experts (including the monitoring and evaluation), and support provided to growers throughout the season.

3. Maintenance of the NIPI network.

Many activities were conducted to achieve an active, functional and collaborative network of researchers and extension specialists. Four annual NIPI workshops were held focusing on a range of themes (e.g. communication, novel tools and technologies). One of the highlights was at the Adelaide workshop in 2012, and the Q&A session with a panel of growers, advisers, researchers, GRDC Board members, and questions being asked by the audience. The Brisbane 2013 workshop focused on ‘Pest surveillance and monitoring: Breaking down a barrier to pest management decision making’. Key topics included new methods for identifying pest outbreaks, using automated approaches for pest monitoring, and achieving better capture and long term storage of data. A paper on this topic has been prepared by Gary McDonald. All four workshops included regular updates, special guests, and also provided an opportunity for the NIPI participants to reflect on past achievements and failures, and discuss how the momentum built over the previous years would be sustained in the future. These discussions have provided the basis of future investment, e.g. CPAC, NIRM.

The hallmark of NIPI is the Adoption Group which led workshops and training, insect identification and NIPI Notes - fact sheets of summarised research findings, and pest alert services in the form of PestFacts and PestFax in WA, SA, VIC and NSW. Over the past four years, the Group produced 157 editions, more than 860 articles on a range of pest and beneficial topics, identified 533 specimens sent by growers and agronomists, conducted 27 training workshops, produced new modules in the ‘I-Spy’ training manual, gave 52 presentations, 40 radio and television interviews, launched PestFacts podcasts, which received 833 downloads, drew PestFacts maps, PestFacts subscription surveys, and provided 259 communication activities including popular press articles, technical and media interviews.

Intellectual Property Summary
All work is public good and has been communicated widely through the NIPI network, websites, NIPI notes, workshops and seminars.

Additional Information

Publications

