A systems approach to enhance the adoption of Integrated Weed Management techniques in the Northern Agricultural Region of WA

PROJECT DETAILS

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PROJECT TITLE: A SYSTEMS APPROACH TO ENHANCE THE ADOPTION OF INTEGRATED WEED MANAGEMENT TECHNIQUES IN THE NORTHERN AGRICULTURAL REGION OF WA
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Summary
The Northern Agricultural Region (NAR) of Western Australia (WA) has amongst the world’s most significant problems with herbicide resistant weeds. Both annual ryegrass and wild radish have demonstrated high levels of multiple resistance to herbicides in a high percentage of paddocks in this area.

During the course of this project, focus paddock case studies and surveys have shown that crop area grown in this region has increased while weed management has improved. Research during this project developed and refined key integrated weed management (IWM) techniques as well as delivered specific information on best practice use of these techniques. Computer simulation, case studies and grower workshops have demonstrated the long term benefits of IWM.

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Conclusions

The Northern Agricultural Region of Western Australia has recently undergone a major shift in farming systems away from a crop and livestock system to a continuous crop based system with some chemical fallow. It is very clear that in order for growers to maintain this cropping system they need to include non-herbicide weed management in their farming systems.

It is very encouraging to see growers who participated in this project embrace integrated weed management and adopt a range of practices to manage resistant weeds. The final survey demonstrated that an increasing number of growers are adopting the double knockdown technique, crop topping, windrow burning, and chemical fallow. The survey also revealed increasing interest in weed seed management at harvest with many growers considering buying chaff carts and/or a Harrington Seed Destructor when it becomes available on the market.

Herbicide resistant weeds are now considered just another aspect of farming life for grain growers in the Northern Agricultural Region of WA. The focus has shifted from having herbicide resistant weeds to the management of resistant weeds. Growers, agronomists and researchers are now less focused on preventing development of herbicide resistance and more focused on managing populations of resistant weeds. Now that most growers have experienced and accepted the problem, they will be in a better position to implement effective management of resistant weeds in the future.

Recommendations

Wild radish management is viewed as a significant future challenge. Many of the IWM practices that have been successful for annual ryegrass will apply to wild radish with some fine-tuning. It is recommended that grain growers in the Northern Agricultural Region of Western Australia focus on IWM of wild radish first and foremost. IWM practised to manage wild radish is likely to be sufficient to successfully manage annual ryegrass.

The main IWM tool not widely adopted is crop competition, the major reason being that growers are locked into wide row spacing with their current seeding machinery. With advances in auto steer technology, harvest machinery and stubble handling of seeding machinery, there is scope for growers to improve crop competition with weeds by decreasing row spacing. This will facilitate the adoption of higher crop seeding rates to further enhance crop competition.
The area of chemical fallow is increasing in the Northern Agricultural Region of WA. This system is likely to discover several populations of glyphosate\# resistant ryegrass. One such population was discovered in a chemical fallow paddock near Mullewa in 2009 and is currently being tested for resistance. It is recommended that growers be vigilant in monitoring these paddocks for populations of glyphosate resistant ryegrass. It is also recommended that growers use WeedSeeker® technology in this chemical fallow phase to detect glyphosate resistant weeds and spray them with an alternative herbicide to stop weeds setting seed. This technique has already been developed in eastern Australia and should now be applied to the West.

Outcomes

The adoption of profitable integrated weed management techniques has increased as a result of this project. This has enabled many growers to increase crop area grown in the Northern Agricultural Region of Western Australia while improving the management of resistant weeds.

Economic outcomes

The true measure of how herbicide resistant weeds are affecting profitability is the area of crop and the density of weeds. Case studies from this project have documented a number of instances where growers who have used IWM tools such as crop topping, burning narrow windrows and chaff carts, and good crop rotation, have maintained continuous crop while eroding ryegrass seed banks despite alarming levels of resistance. The final survey indicates growers have increased the area of crop they are growing and now rate annual ryegrass as being a lower threat to wheat production than it was in the past.

Environmental outcomes

The main aim of integrated weed management is to reduce reliance on herbicides. Many of the growers involved in the project demonstrated that adding non-herbicide IWM tools to the farming system reduces reliance on herbicides. This is expected to continue into the future as the success of non-herbicide weed management tools is realised by the broader farming community. The final survey shows that growers have reduced the area of whole paddock burning that they are practising. This is partially due to growers adopting windrow burning as an alternative to whole paddock burning. Growers and the community in general benefit from reduced use of herbicides to grow food.

Social outcomes

The development of herbicide resistant weeds on a farm comes with a social cost. Growers experience stress as they come to terms with strategies to tackle this problem. Many growers in this project are now winning the battle against resistant weeds by using a range of IWM techniques. Hence, grower stress is reduced while building confidence in grain growers who may experience the challenge of resistant weeds in the future. The final survey indicates growers are less concerned about weeds as a threat to wheat production.

Achievements/Benefits

Herbicide resistant weeds are such a big issue that they are now considered as just another aspect of farming life for grain growers in the Northern Agricultural Region of Western Australia. The focus has shifted from having herbicide resistant weeds to the management of resistant weeds. Growers, agronomists and researchers are now less focused on preventing development of herbicide resistance and more focused on managing populations of resistant weeds. As most growers have experienced and accepted the problem, I believe we will be in a better position to implement effective management of resistant weeds in the future.

Two years of drought (2006 and 2007) and one year of exceptional grain production (2008) were experienced during this project. The project has continued to achieve all outcomes and milestones despite this production volatility.

Participation with four grower groups (Yuna, Mullewa, Mingenew-Inwin and Liebe) has continued in a very positive manner throughout this (and the previous) integrated weed management project. This project uses a ‘do with growers, rather than a do for growers’ approach. Growers have been continually consulted at regular intervals to participate in and to direct research and extension activities. Principle Research Officer, Peter Newman was the winner of GRDC’s Seed of Light award for WA in 2008 for excellence in communication.

Thirty-one ryegrass focus paddocks and at least fifteen wild radish focus paddocks continue to be monitored and
communicated. These paddock case studies are a very effective means of demonstrating that mid west growers are winning the war against resistant weeds. Growers have eroded ryegrass seed banks by 98% across thirty one paddocks over nine years of integrated weed management while increasing crop area. Most growers comment that their focus paddocks are an accurate reflection of what they are achieving over their entire property. This is an enormous achievement in the face of some of the world’s most herbicide resistant ryegrass, therefore the overall objective of this project has been met.

Detailed research has been conducted over a range of IWM practices including double knockdown, knockdown of small grass, crop competition, herbicide rotation, crop topping, selective crop topping, windrow burning to destroy weed seeds, WeedSeeker® technology and inversion ploughing for paddock renovation. The final survey shows that all of these practices are now being used extensively in the Northern Agricultural Region (NAR) of WA and the focus paddock results are a clear indication of their success.

Some of the highlights of this IWM research include:

Crop topping

Six trials evaluating the use of WeedSeeker® to detect and spray green radish in mature wheat were undertaken in 2006 and 2007. This research developed this practice utilising WeedSeeker® technology as well as generating data on the effect of conventional crop topping herbicides on wild radish seed set control. Further to this research, three other crop topping trials evaluated a range of herbicides for seed set control of wild radish and annual ryegrass in lupin and barley crops. This research fine-tuned crop topping timing, generated herbicide efficacy data and developed a new practice using WeedSeeker® technology for seed set control of wild radish in cereal crops. Two WeedSeeker® booms have now been purchased and are being used in the mid west.

Development of weed seed management at harvest

Weed seed management at harvest has been a key focus of this project. Research into windrow burning was continued from project DAW672 and compared wind speed at burning for a range of crop types. This final research concluded that it is important to burn in light wind to fuel the fire all of the way to the soil surface where the majority of weed seeds are. This was the final piece in the puzzle for growers to achieve successful weed seed destruction. Computer simulation alone with grower case studies has been used in many presentations and articles to demonstrate to growers that weed seed management at harvest is the most important non-herbicide weed management tool that they have. The final survey shows that the vast majority of growers are looking to adopt a range of harvest weed seed management techniques at harvest. Ninety percent of growers surveyed will use some windrow burning in the coming years. There is renewed interest in chaff carts with 30% of growers surveyed likely to adopt this practice in the next five years. Seventy three percent of growers surveyed indicated they would like to buy a Harrington Seed Destructor (four growers would like to buy two) when it is released in the coming years.

Inversion tillage with a mouldboard plough for paddock renovation

To date, this research over six sites in the NAR on sandplain soils has averaged a 41% increase in crop yield, 90 to 95% weed control, and demonstrated the ability to correct soil water repellence and subsurface acidity. Four additional sites were established in 2009 in collaboration with project UWA00081 and local grower groups. Two mouldboard ploughs were purchased by mid west growers and were used on 380 hectares of sandy, water repellent soil in 2009. The results of this ploughing on a commercial scale look very encouraging. More growers are likely to adopt this practice in 2010.

Thirty-six in paddock herbicide resistance tests for wild radish have been conducted over the past four seasons with a purpose built resistance boom. These sites have proven to be excellent in demonstrating resistance levels to growers and providing options for the control of these resistant weeds. However, the response of growers to a free in-paddock resistance test was very disappointing. Consequently fewer sites were sprayed than planned. In many cases growers had made incorrect assumptions about their resistance status which has major management implications. In 2008, two new herbicides and a new herbicide mix averaged 99% wild radish control across all twelve sites demonstrating to growers that viable herbicide options are available for those prepared to pay the cost.

Two long term trials evaluating a range of farming practices to erode wild radish seed banks are continuing. These sites are evaluating crop rotation, chemical fallow, windrow burning, autumn tickle, slashing, and inversion ploughing to manage very large wild radish seed banks. These sites demonstrate that it is possible to erode wild radish seed banks in cropping rotations,
but it is a longer process than annual ryegrass management.

**Other research**

Wild radish is now rated by WA growers as the number one weed problem. Greater emphasis should be placed on wild radish than ryegrass in future research.

Chemical fallow is now more popular in the farming system in WA and is likely to be a significant component of the system in the future. There is an opportunity to conduct research into chemical fallow to develop a best practice system that minimises the risk of glyphosate\(^*\) resistance while maintaining soil cover.

There is an opportunity for research and development (R&D) to improve crop competition with weeds. A combination of competitive cultivars, narrow row spacing, high seeding rates and nutrient placement of cereal crops should be researched to increase competition and maximise yield potential. The cereal agronomy group has a key role to play in this area in collaboration with weeds researchers.

Inversion ploughing for paddock renovation was partially evaluated during the course of this project. This preliminary research shows great promise for the use of the mouldboard plough to bury weed seeds, bury water repellent sand and for deep placement of lime. It is anticipated that there will be a recommendation that grows plough a paddock only once every ten to fifteen years. A survey of 51 growers at the Mingenew-Irwin spring field day in 2009 resulted in 50 of the growers indicating they would be prepared to use a mouldboard plough on their farm if research could demonstrate the benefits. The grower who said he would not use a mouldboard plough was a cattle producer who had a perennial grass based system. The main reasons quoted for wanting to plough were firstly to correct water repellence and secondly to bury weed seeds. Several main research questions that require further investigation include; How long does it take for soil microbes to degrade the wax on the water repellent sand that has been buried?; How long does it take for water repellence to redevelop on the 'new' topsoil; What are the nutritional implications of a one-off soil inversion; How many weed seeds are still viable after ten years; Is it possible to correct low soil pH through the top 50cm of soil by liming before and after a one-off soil inversion? There are also development issues over which is the most appropriate machine for the sandy soils of WA and the logistics of ploughing and establishing cover to minimise the risk of wind erosion.

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