Evaluation of New Generation Herbicide Chemistry to develop Herbicides Systems for Resistance Management

**Summary**

After 25 years of continuous and increasing usage, herbicides are still regarded by growers as the most cost effective method to control weeds. They continue to be the most readily adopted method in broadacre agriculture. This has recently been confirmed in a survey of growers conducted by Rick Llewellyn, the Western Australian Herbicide Resistance Initiative (WAHRI) News, November 2002. The survey found that the most widely adopted method for weed control by growers was through the use of herbicides, with non herbicide integrated weed management (IWM) practices adopted if they were relatively inexpensive.

With widespread use of herbicides in WA agriculture, herbicide resistant annual ryegrass and wild radish are a major threat to continuous cropping systems, particularly with the rise of glyphosate-resistant annual ryegrass and diflufenican, group B and triazine-resistant wild radish. These two weeds, along with other common WA agricultural weeds such as emex, mustard and turnip, are an emerging threat.
As weed resistance continues to develop to herbicide groups, growers are becoming increasingly reliant on fewer herbicides to control resistant populations of annual ryegrass and wild radish. A current example of this is grower reliance on trifluralin for control of resistant annual ryegrass. Usage has increased from 100,000L in 1991 to more than 3,000,000L in 2003. Trifluralin forms an integral part of the diminishing soil applied herbicide options. Atrazine falls into a similar category.

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**Conclusions**

The national farming system is becoming more reliant on soil incorporated herbicides to provide annual ryegrass control in most crops due to the diminishing number of post emergent options.

Most weed control options evaluated in the project were soil incorporated herbicides. The indication from industry is that there is little in the way of new herbicide chemistry being developed for growers in the near future.

The introduction of herbicide resistant crops will not be a solution. It will cause increased usage and over-use of valuable products such as glyphosate.

Non herbicide IWM strategies must be combined with herbicide usage in order to prolong the useful life of herbicides.

**Recommendations**

Registration of some of the products evaluated needs to proceed to ensure growers have access to the herbicides, particularly unique chemistry such as cinmethylin and products that have not been widely used in broadacre agriculture such as Kerb.

As herbicides are adopted into the farming system, growers need to be made aware through active extension of the range of non herbicide IWM strategies that can be adopted into farming systems to ensure longevity of new herbicides. Without a holistic approach, herbicides will become ineffective faster than they can be evaluated, registered and adopted.
Outcomes

Expected Outcome (benefits)

Economic Outcomes

The results of this research will provide growers with some potential herbicide options for registered and soon to be registered products for use in the canola and wheat phase of the crop rotation. With herbicide options diminishing rapidly for many growers, new herbicide options will help improve farm profitability as a result of increased yields and product quality due to reduced crop competition from weeds.

Environmental Outcomes

A reduction in the herbicide resistant weed population with an IWM approach would see a corresponding reduction in the amount of pesticide used in the environment. Herbicide application would be more of a targeted approach to weed control rather than broad scale control measures currently employed by growers.

Social Outcomes

Any project that contributes to farm profitability benefits the rural community. Increased farm profitability results in expenditure and improved infrastructure in the rural community.

Achievements/Benefits

Overview of Project Achievements

Project Aims

1. Investigate the level of efficacy on herbicide resistant wild radish and annual ryegrass and crop safety of herbicide compounds currently unavailable to growers.
2. Evaluate efficacy and crop safety of currently available reformulated herbicides when combined with new herbicide technology with differing modes of action.
3. Develop a herbicide rotation system that will maintain a viable chemical control option for the management of herbicide resistance.

Background

Although diminishing at a rapid rate, agro-chemical company research is continuing to develop some new herbicide chemistry for use in broadacre agriculture. Only a limited number of herbicides screened in this process actually gain commercial release, with companies generally assessing products in isolation and in terms of estimated returns from the market before continuing down the registration path.

It is often growers and agronomists who continue to develop and improve use patterns for new and old herbicides in the farming system after product release. After initial registration and product release, there is often a need to further refine use rates and adjuvants to fine-tune efficacy and crop safety, determine alternative crop uses and performance in mixtures in order to develop sustainable herbicide systems which will prolong the use of new herbicide technology.

Agritech has been conducting research on behalf of companies, developing potential new chemistry and new uses for old chemistry in controlling herbicide resistant annual ryegrass and wild radish in wheat and canola. With the continuing amalgamation and demise of research based companies in Australia, opportunities for the development of new molecules and new uses for old are diminishing. Agritech's role in this project has been to source herbicides and provide product evaluation in areas not likely to be immediately pursued by companies because of current commercial constraints (e.g. no current registration, tank mixes, adjuvants, specialised agronomic techniques). To complement the project work, many of the research and development (R&D) based companies have been involved in generating data through field trials for registration on products that show commercial potential.

Over the term of the project, a number of companies have provided Agritech with a range of herbicides to carry out agronomic evaluation on wheat and canola. Field trials were used to evaluate a range of new and reformulated chemistry not
Currently available to growers for use in wheat and canola for the control of herbicide resistant wild radish and annual ryegrass. With the significant increase in no-till, most of the products were evaluated for improved crop safety under knifepoint establishment systems, similar to Agritech’s development work with trifluralin#.

Product performance was evaluated across a range of soil types and environmental conditions.

Project Achievements

Conducting contract research for herbicide manufacturing companies placed Agritech Crop Research in a unique position of having access to a range of new herbicide technology not yet available to growers. The products were sourced with a view to finding niche positions and alternative uses for growers. The herbicides were evaluated in field trials in wheat and canola and across a range of environmental conditions and soil types.

As a result of the project, BASF commenced registration of cinmethylin# (Argold®#), a soil incorporated herbicide of unique chemistry that provides similar levels of annual ryegrass control to that of trifluralin. This has the potential to reduce the selection pressure on trifluralin and provide growers with a viable alternative to resistant annual ryegrass control in wheat, lupins and canola. By relieving the pressure on trifluralin and by providing an alternative, growers who initiate a range of non herbicide IWM strategies along with targeted herbicide use will prolong the useful life of their herbicides.

The product tank mixes with a range of other soil incorporated herbicides perform similarly to trifluralin in these mixtures.

AGT01 was a product that was removed from the development and registration process by the company concerned for unknown reasons. The product was unique chemistry and provided 90% plus control of resistant annual ryegrass populations on a consistent basis and gave some suppression of wild radish.

This product has significant potential in WA agricultural systems. The supporting data generated from trial work as part of this project may assist in the revival of this product. The benefit to WA growers would be significant in terms of resistant annual ryegrass control and improved farm income. It is hoped that AGT01 will be reviewed for further development.

On the other hand, some products evaluated in this project did not provide the required level of crop safety or efficacy on the target weed and as a result were not suitable for WA farming systems. IPU# and 2,2-DPA# are examples of products that growers have spent money on development and procurement and yet are products that did not provide satisfactory weed control or consistent crop safety. By demonstrating this in trial work, growers have been able to save significant dollars by investing in other areas that provide adequate weed and seed set control.

Herbicide evaluated 1999 and 2000

<table>
<thead>
<tr>
<th>Chemical/Code Name</th>
<th>Target Crop</th>
<th>Target Weed</th>
</tr>
</thead>
<tbody>
<tr>
<td>napropamide# (Devrinol®#)</td>
<td>canola, chickpeas, lupins, faba beans</td>
<td>annual ryegrass</td>
</tr>
<tr>
<td>2,2-DPA (Dalapon®#)</td>
<td>chickpeas, canola</td>
<td>annual ryegrass</td>
</tr>
<tr>
<td>isoxaflutol# (Balance®#)</td>
<td>chickpeas</td>
<td>wild radish</td>
</tr>
<tr>
<td>AGT01#</td>
<td>wheat, lupins, chickpeas</td>
<td>wild radish, annual ryegrass</td>
</tr>
<tr>
<td>cinmethylin# (Argold®#)</td>
<td>wheat, lupins, canola, other pulses</td>
<td>annual ryegrass</td>
</tr>
<tr>
<td>AE720# (Conquest®#)</td>
<td>wheat, lupins</td>
<td>wild radish</td>
</tr>
<tr>
<td>dosinex#</td>
<td>wheat</td>
<td>annual ryegrass, wild radish?</td>
</tr>
<tr>
<td>isoproturon# (IPU)</td>
<td>wheat, pulses</td>
<td>annual ryegrass, wild radish</td>
</tr>
<tr>
<td>DPX1945#</td>
<td>unknown</td>
<td>annual ryegrass + unknown</td>
</tr>
</tbody>
</table>

# Refer to ‘Report Disclaimer’
Review of product performance and likelihood of success:

Napropamide: Relatively high use rate 2L/ha. Performs well in mixtures with trifluralin and atrazine on resistant annual ryegrass in canola. Doubtful for registration.

Propyzamide: Also performs well in mixtures with trifluralin and atrazine. Shows potential and requires further trials to evaluate post emergent applications in tank mixes and adjuvant combinations. One of the better performing products as a standalone. This product will not proceed with registration until data protection is legislated for.

2,2-DPA: Very high use rate for efficacy on annual ryegrass. Can be applied incorporated by sowing (IBS) or post emergent in mixtures with grass selectives. This product has a low potential application for annual ryegrass control in canola and pulse crops due to crop phytotoxicity and resultant yield reductions. Application rates of 4kg/ha and 6kg/ha will also be a limiting factor to grower adoption.

Balance®; Shows excellent wild radish control in chickpeas and has been registered for use in chickpeas.

AGT01: Excellent ryegrass control with enough mobility to control furrow annual ryegrass in conservation tillage. 90% control of resistant annual ryegrass not uncommon with this product. Needs specialised agronomic practice to maintain crop safety. This product has since been deleted from the registration process for reasons unknown.

Argold®: This product is likely to progress to registration. Performs well in mixtures with other soil incorporated herbicides on herbicide resistant ryegrass. Unique chemistry.

AE720: This product has been dropped and will not be pursued any further.

Dosinex: An old substituted urea. Does not show much promise for the control of annual ryegrass.

IPU: This is a very overrated product for resistant annual ryegrass control. The concern is that growers are pushing for the registration of this product and believe it to be the solution to resistant annual ryegrass. The trials indicate that when used as a standalone herbicide, it performs below expectation on resistant annual ryegrass. It is a product that will need to be used in conjunction with other soil incorporated herbicides to achieve acceptable levels of annual ryegrass and wild radish control.

Metalachlor: This product is being revisited for use in wheat in mixtures and with knifepoint crop establishment techniques in an effort to increase and maintain crop safety and efficacy on annual ryegrass.

DPX1945: This product has been supplied with little knowledge of the weed spectrum or crop species it can be used on. This product, if successful, is a long way from registration.

As a result of the trial work, the products evaluated have shown a range of parameters that need to be considered in order to gain maximum weed control benefits.

Project Outputs

Through the use of field trials, this research has evaluated a range of new and reformulated herbicide technology for control of herbicide resistant wild radish and annual ryegrass. The parameters of crop safety, efficacy, tillage system and yield have been assessed in order to develop a range of safe and useful herbicide tank mixes. The result of this research will provide growers with viable and effective herbicide options for use in the wheat and canola phases of the crop rotation.

Other research

As herbicides are registered for use in broadacre crops, they need to be incorporated into alternative IWM strategies to evaluate their effectiveness in controlling weeds and reducing weed seedbanks. Evaluation in the WAHRI Ryegrass Integrated Management (RIM) model is an example of data utilisation and extension that would be beneficial to growers.

Intellectual property summary

# Refer to ‘Report Disclaimer’
The information generated by the project has been made available. Some efficacy information on napropamide\(^{#1}\), propyzamide\(^{#2}\) and cinmethlyn\(^{#3}\) has been provided to Farmoz and BASF. The relevant information has been used to add data to the registration application. This project has provided very little in terms of the overall data package required. The companies are responsible for the total registration package and have paid for and generated the bulk of tolerance, residue and efficacy data for the purpose of registration. The companies own all intellectual property (IP).

**Additional information**

**Attachment**

The attachment includes:

- Table 1: Chemistry Evaluated.
- Table 2: Evaluation of Product Performance And Likelihood Of Success.
- Table 3: AOV Means Table - Ryegrass Resistance Management with IPU in Wheat, Goomalling, 1997.
- Table 4: AOV Means Table - Ryegrass Control & Wheat Yield from Pre-Emergent Herbicide Applications, Meckering, 1998.
- Table 5: Ryegrass Control & Wheat Yield from Pre-Emergent Herbicide Applications, Meckering, 1999.