the northern HERBICIDE RESISTANCE Reporter

SEPTEMBER 2002

A Newsletter keeping you up to date with research and development in herbicide resistance in the Northern Region

New project funded by GRDC 'Risk assessment and preventive IWM strategies for herbicide resistance in the diverse farming systems in the northern region'

The grains industry considers research on preventing further escalation of herbicide resistance in northern weeds a high priority. Recently GRDC supported a new initiative by researchers at Queensland's Department of Primary Industries, NSW Agriculture, University of Queensland and Conservation Farmers.

The team, lead by Dr Steve Walker, is comprised of agronomists, economists, weed scientists and technicians based at Emerald, Toowoomba, Brisbane, Kingaroy and Tamworth. Contact details of the team are listed on the last page.

The four-year project will identify key weeds and farming systems at risk of developing herbicide resistance, and will then develop and promote options for improved weed management and maintaining the effectiveness of important herbicides.

Part of our risk assessment is to survey growers and agronomist across the northern region to accurately identify the extent of the problem and those areas at risk of developing resistance problems.

Once we have established the weeds at risk, we can further refine existing integrated weed management strategies that take advantage of both chemical and non-chemical weed control options.

This will be done in consultation with growers and agronomists at small workshops, and the strategies will be evaluated for effectiveness on-farm at sites across the region.

The economic benefits of the preventive strategies will be compared with the current situation and situations with herbicide resistant weeds.

Progress on these aspects will be covered in future editions of this newsletter.

Steve Walker

Workshop Notice

Workshops will be held throughout the NGR during October and November to discuss with growers and agronomists best weed management (BWM) strategies to prevent herbicide resistance developing in major summer weeds and farming systems identified through the survey. The workshops will help the project team to formulate field trials to investigate the BWM strategies which will play a major role in overcoming the threats of resistance. Further workshops will be held in 2003 to discuss management of winter weeds at risk of developing herbicide resistance. Keep your eyes and ears open for more information about these workshops.

In this issue...

Print Post Approved 424022/1517

Editorial

Welcome to the first edition of ' The Northern Herbicide Resistance Reporter'. This biannual newsletter is a revamped version of the previously produced 'Herbicide Resistance Reporter'. The newsletter aims at keeping you up to date with research and developments on herbicide resistance in the northern grain region (NGR). The NGR has been defined by GRDC as the region of eastern Australia stretching from approximately Emerald to Dubbo. For the purpose of this newsletter, the NGR has been broken up into four more localised regions of central Queensland, southern Queensland, northern NSW and central NSW as shown in the map right. Each issue of the newsletter will have articles from and relevant to each of these regions.

You will notice the 'Resistance is Futile' branding that accompanies the newsletter. This branding will be used on any publications or presentations made in conjunction with the two newly funded projects that this newsletter reports on. You as the grower, agronomist or researcher are then able to easily identify and keep up with project happenings.

Resistance is indeed futile. As we aim to effectively manage existing resistant weed populations and prevent further resistance, we have a positive outlook that we are able to stop resistance in its tracks. The splashes on the brand represent the patches of current herbicide resistant weeds in the NGR. We as a research team aim to prevent these patches spreading or new patches forming. With the help of yourself and others in the industry, resistance will be futile.

The northern herbicide resistance reporter will play an important role in keeping you up to date with herbicide resistance in the NGR. We appreciate your eagerness to be involved in the fight against herbicide resistance and look forward to a long relationship aimed ultimately at improving farming in the northern region.

If you have any questions about our plight, or contributions and suggestions for the newsletter, anyone in the herbicide resistance team would be willing to assist. Contact details are provided on the back page.

Michael Widderick, Kathryn Galea.

Northern Grain Region

The project team gets together

The team met for the first time at Emerald in the first month of the project - July 2001. Eight of the team braved a charter flight in a small plane. Whilst the flight from Toowoomba to Emerald was smooth, the return flight was a wee bit bumpy. The project leader, Steve Walker, was rather white and very pleased to disembark at the Toowoomba airport.

The group got together in May this year to review progress and plan activities for the following 6 months. It is not easy to find a venue convenient for people based from Emerald to Tamworth, but the vineyard retreat outside of Stanthorpe was a great place to work uninterrupted while enjoying the autumn colours and cool weather.

Steve Walker

Photo of team at Emerald:
Back row – Michael Widderick, Tony Cook, Jim Barnes, Fred Chudleigh, Geoff Robinson, Chris O'Donnell, Steve Adkins. Front sitting – Steve Walker, Andrew Storrie, Kathryn Galea, Vikki Osten and Megan McCosker.

Photo of team at Stanthorpe:
Back row – Bob Farquharson, Glen Wright, Fred Chudleigh, Andrew Storrie, Steve Walker, Tony Cook, Paul Moylan. Sitting – Michael Widderick, Vikki Osten, Geoff Robinson and Kathryn Galea.

‘Detection, monitoring and management of herbicide resistance in the northern region’

Project UQ138 funded by GRDC.

A major role in preventing further escalation of herbicide resistance in the northern region is the early detection of herbicide resistant populations. A new project funded by GRDC aims to do exactly this.

A team of researchers and agronomists from throughout the northern region, lead by Assoc Prof Steve Adkins from the University of Queensland, aim to detect and monitor resistance to herbicides at the paddock level. Molecular diagnostics and the Rothamsted Rapid Resistance Test (RRRT) are to be used in this process.

At completion of the project a detailed map showing the locality of herbicide resistant weeds will be produced and the degree of resistance, whether cross resistant or multiple-resistance, will be quantified. In addition, the project aims to develop new molecular tools for the early detection of herbicide resistance using rapid and cost effective methods.

As part of this four year project, the ‘Herbicide Resistance Testing Service’ (HeRTS) has been set up by the University of Queensland. This service aims to provide growers in the northern region with a free service to test weeds that are suspected of being resistant to herbicides.

Updates from this project will be covered in future editions of this newsletter and more information on HeRTS is provided on page 6.

Steve Adkins

The most common weeds in central and southern Queensland

One of the most useful facts gained from the postal survey is the relative importance of the different weeds in the cropping areas across the northern region. The weeds were ranked based on the total number of entries in the surveys.

The 12 most common weeds in central Queensland and southern Queensland are listed in tables 1 and 2 respectively. It is interesting to note that, apart from common sowthistle and barnyard grass, the two regions have a very different weed spectrum. However, the one thing in common between central and southern Queensland is that common sowthistle is by far the most widespread weed in broad acre cropping across the state.

Steve Walker

Table 1. The 12 most common weeds in central Queensland

Weed	No of entries in survey
Common sowthistle	101
Parthenium weed	78
Sesbania pea	65
Black pigweed	64
Mexican poppy	62
Native jute	57
African turnip weed	57
Summer grass	55
Cowvine	42
Turnip weed	42
Crownbeard	38
Barnyard grass	36

Table 2. The 12 most common weeds in southern Queensland

Weed	No of entries in survey
Common sowthistle	273
Turnip weed	161
Liverseed grass	154
Wild oats	144
Barnyard grass	143
Black bindweed	142
Bladder ketmia	83
Pigweed	61
Mustards	59
Thornapples	58
Caltrop	58
Burrs	57

Good response to our postal survey

The team is pleased with the good response from agronomists and growers to our postal survey. We received completed forms from 68 growers in central Queensland, 69 in southern Queensland and 33 in northern NSW. As well, 73 agronomists responded mostly from southern Queensland and northern NSW.

The survey asked for the following information:

- Main crops grown
- Importance of the following farming practices for managing weeds in each crop - long fallows, pre- and post-emergence herbicides, high sowing rates, late spraying of weed survivors, inter-row cultivation, shielded spraying and pre-harvest desiccation
- Importance of the following farming practices for managing weeds in each fallow - knockdown and residual herbicides, late spraying of weed survivors, cultivation and grazing
- Main weeds for each crop and fallow, level of infestation, main herbicides and times applied over 5 year period, and control achieved.

The survey was modified slightly for agronomists, with some additional questions.

A summary of the information from the survey is outlined in articles in this newsletter and in subsequent editions.

We greatly appreciate the time and effort taken by the responding growers and agronomists. We now have an extensive database, which will help us identify and prioritise our research on herbicide resistance in the northern region.

Steve Walker

Weeds at risk in central and northern NSW

Results of a comprehensive mail-out survey were collated and a number of weeds, herbicides and cropping systems have been identifzied and ranked for risk of developing herbicide resistance. A total of 74 surveys were returned, 41 from agronomists and 33 from growers, with most shires well represented.

The data presented below (Table 1) is split into central and northern NSW, which roughly correlate to non-seasonal (central) and summer (northern) rainfall dominant zones. Also weeds are categorised into in-crop or fallow problems. Issues to note from Table 1 include:

- Wild oats was ranked 3rd place or higher in each category and was most frequently treated with herbicides.
- Sowthistle was the next most treated weed, dominant particularly in fallows.
- The 3rd most frequently treated weed was wireweed.
- Black bindweed / climbing buckwheat is more troublesome in northern cropping areas while annual ryegrass is more evident in crops of central NSW.

Risk assessment ratings were calculated from the survey data such that a higher risk assessment score would indicate a greater chance of developing herbicide resistance. Factors such as repeated reliance on the same herbicide group, lack of alternative control techniques and greater level of control with herbicides would increase the risk assessment scores. The summary of risk assessment scores, in Table 2 below, highlight the heavy reliance on Group A (selective grass) and B (eg. Ally®, Glean® and Spinnaker®) herbicides for in-crop weed control, and the increased likelihood of the weeds being selected for resistance to these groups. The perceived risk of developing herbicide resistance in fallows is shared between mode-of-action groups B, I (eg. 2,4-D, MCPA and dicamba) and M (glyphosate).

Andrew Storrie, Tony Cook, Paul Moylan

Table 1: Frequency of the 5 most common in-crop and fallow weeds for central and northern NSW. Numbers in the right hand column indicate the relative level of herbicide application.

In-crop Weeds		Fallow Weeds	
CENTRAL NSW (central Macquarie, Macquarie-Barwon & Hunter)			
1. Wild oats	115	1. Sowthistle	16
2. Annual Ryegrass	95	2. Wire weed	15
3. Phalaris	39	3. Wild oats	11
4. Wild Radish	32	4. Paddy Melon	11
5. Wire weed	29	5. Camel Melon	8
NORTHERN NSW (north-west slopes & plains)			
1. Black bindweed	67	1. Sowthistle	44
2. Wild oats	51	2. Black bindweed	35
3. Sowthistle	34	3. Wild oats	21
4. Turnip Weed	30	4. Cow/Peach vine	13
5. Wire weed	22	5. Barnyard grass	11

Table 2: Top ten weed/herbicide combinations with the highest risk assessment ratings for northern and central NSW.

In-crop Weeds			Fallow Weeds		
	Weed	Herbicide Group		Weed	Herbicide Group
1.	Phalaris	A	1.	Sowthistle	B
2.	Wild oats	A	2.	Charlock	I
3.	Wild turnip	B	3.	Black bindweed	B
4.	Phalaris	B	4.	Wire weed	B
5.	Turnip Weed	B	5.	Sowthistle	I
6.	Mustards	I	6.	Black bindweed	I
7.	Annual Ryegrass	A	7.	Sowthistle	M
8.	Barnyard grass	A	8.	Bishop's weed	M
9.	Variegated thistle	I	9.	Liverseed grass	M
10.	Black bindweed	B	10.	Barnyard grass	M

A wheat competition study in CQ - impacts of row spacing and crop population

Manipulating crop agronomy is a tool available for use in integrated weed management programs. It will be particularly important for strategies aimed at avoiding the development of herbicide resistance. By increasing crop competitiveness, the total reliance on herbicides for weed control is reduced. In central Queensland this winter, a trial has been undertaken to examine the influence of crop population and row spacing on the competitiveness of wheat using sown chickpea as the test "weed".

A small split-plot (replicated) balanced factorial trial was set up on the Emerald Research Station in late May. Chickpea was sown at right angles to treatment plots prior to a planting irrigation. Wheat (cv. Kennedy) was sown in mid-June to establish 500 000, 750 000, 1 000 000 and 1 250 000 plants ha^{-1} with each population planted on 25, 30, 37.5 and 50 cm row spacings. Each treatment plot was later split for weed control with metsulfuron methyl (3 g ha^{-1}) plus MCPA (225 g ha^{-1}) applied to half of each plot 20 days after planting. Crop plant and weed numbers were recorded just prior to the herbicide application. Crop and weed biomass samples were taken 46 days after planting (and 26 days after the herbicide application) and oven-dried. Wheat yields will be measured in mid-October.

The early crop plant counts indicated target population establishment was close. At the lower populations, establishment was over target (by 7 – 17 %); at the higher populations, establishment was slightly under target (by 1 - 4 %). Establishment across the populations also tended to be lower on the wider rows compared to the narrower spacings. Weed numbers were fairly uniform across the trial (average 31 weeds m^{-2}).

Preliminary statistical tests on the wheat biomass data indicate no interactions between the treatment factors. The ANOVA does however show highly significant (F Pr < 0.001) variation within the main treatments (population, row spacing and weed control). The following table is the summary of means for main treatment factors:

Variable	Wheat Biomass (t ha^{-1})
Row Spacing (cm)	
25.0	0.62
30.0	0.54
37.5	0.34
50.0	0.42
LSD (P=0.05)	0.07
Population (plants ha^{-1})	
500 000	0.37
750 000	0.45
1 000 000	0.51
1 250 000	0.59
LSD (P=0.05)	0.07
Weed Control	
Yes	0.57
No	0.39
LSD (P=0.05)	0.05

Individual treatment means will be provided in a later newsletter edition along with the analysis and discussion of the co-variate (weed biomass).

The results presented here simply show the impact of row spacing, plant population and weed control regime on crop biomass. The recorded responses are not unexpected with higher crop populations providing greater crop biomass. Removing the weeds reduces competition, hence crop biomass should be higher where weed control regimes have been used. Row spacing however can be an unknown quantity. In this instance, wider rows reduced the crop biomass considerably, irrespective of crop population or weed control regime. Crop competitiveness can be increased by establishing higher populations or planting on narrower rows. The interesting results from this trial will lie in the impact of these factors (row spacing, crop population) on the weed biomass.

Vikki Osten, Megan McCosker, Glen Wright.

Herbicide resistance and its likelihood in the peanut farming system

The peanut industry has slowly but surely adopted new weed management methods as the industry has progressed. However in doing so it has increased the likelihood of developing herbicide resistance. It is by no means as vulnerable as other industries but a small trend is there.

For example:-For many years now the peanut farming system has relied on the use of Group D *(trifluralin and pendimethalin)* herbicides as their mainstay pre-emergence herbicides, but now these are often used in maize (grown in rotation).

Also, in peanuts themselves, we have seen an explosion in the use of Group B herbicides *(Flame and Spinnaker)* at the same time as Group B herbicides have become more widely used in winter crops and fallows (Ally etc.).

Added to this is the fact that some of our weed species are occurring in both winter and early summer crops (for example Wild Radish, Turnip Weed, and Spiny emex), and the potential for these to be targeted by group B herbicides have increased significantly. This will also beexacerbated as group B herbicides in maize (Lightning with IR/IT maize) become more prevalent. Added to this is the shift to reduced till farming in the rotation crops and even now in peanuts and the possibility of herbicide resistance becomes even closer.

Management of herbicide resistance is still relatively easy due to the large number of herbicide groups and crops available to this industry, but it (herbicides resistance) must be a factor in all weed management decisions before the industry develops resistance. Pursuit of viable rotations with Integrated Weed Management practices will ensure this industry will remain herbicide resistance free at least for the foreseeable future.

Jim Barnes

Free testing service available

If you suspect that you have a weed that is resistant to a herbicide, why not have it tested for free at the University of Queenslands Herbicide Resistance Testing Service (HeRTS).

You may have resistant weeds if

- other susceptible weed species have been successfully man aged but one susceptible species hasn't.
- there are healthy plants living next to dead ones.
- surviving weed species have been successfully controlled in the past, and maybe you have seen a gradual decline in control over time.
- there has been repeated and exclusive use of the same herbicide or herbicides from the same mode of action group.
- resistance of the same weed to the same herbicide has been confirmed in nearby paddocks.

If resistance is suspected then a sample of seed from the plants should be forwarded to HeRTS for a resistance confirmation test. Remember when collecting seed to ensure the seed is mature, is not collected in wet conditions, is collected from as many plants as possible but avoid collecting from the edge of paddocks, collect about 350 mL by volume of wild oats and several thousand of other species. As soon as possible after collection of seed transfer seeds to a container made of breathable material such as paper, envelope or cardboard. Package the seed securely and forward via Australia Post to HeRTS. The mailing address is:

HeRTS
Attn: Chris O'Donnell
School of Land and Food Sciences
The University of Queensland
Brisbane Qld 4072

In addition to the sample, please provide your name, contact details, locality of suspected resistance and a history of herbicides used, their rate applied and their effectiveness. It may help the researchers if you also include a rough scetch of the location the samples were collected from and where the paddock is in relation to roads, houses and other physical features.

Chris O'Donnell

Glyphosate resistant annual ryegrass in the northern grain region

There are currently three weed species confirmed resistant to glyphosate around the world. Australia has lead the way with at least five separate populations of annual ryegrass (ARG) (*Lolium rigidum*), while California and South Africa also have populations resistant to glyphosate.

Another annual grass, *Eleusine indica* (crowsfoot grass, goose grass) has been confirmed resistant in Malaysia, while the first broadleaf, *Conyza canadensis* (Canadian fleabane, horseweed) has been identified as resistant in the USA.

Resistance developed in Australian populations following 10 to 15 years of glyphosate application, with multiple applications per season. If you look at the number of glyphosate applications most growers have been using in fallows in the northern grain region, this frequency of application is quite common.

Currently there are populations of ARG resistant to amitrole, triazines, ureas and metribuzin, Group A fops and Group B herbicides, and most recently Group M. Some populations are resistant to two or more groups while one population is thought to be resistant to most herbicide groups.

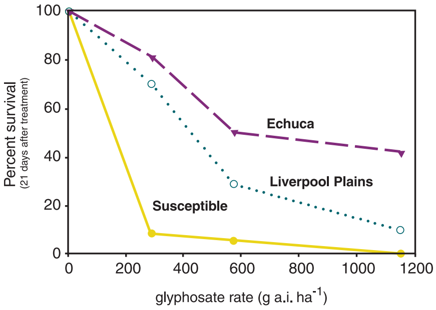
This propensity for resistance is due to ARG's:

- high genetic variation
- large populations (1000-2000 plants m^{-2} not uncommon)
- obligate cross pollination
- rapid turn-over of the seed bank as an annual species, and
- use as a pasture species across southern Australia

ARG can also possesses two types of resistance. The first is target site resistance, which is due to a change in the target site, preventing the herbicide from binding to the target enzyme. This is the main form of resistance to fops (Group A) and Group B herbicides. The second type is enhanced detoxicative metabolism that confers resistance (cross resistance) to a wide number of herbicides, often without ever being exposed to them. This is the same mechanism that allows cereals to be sprayed with Group A herbicides to control annual grass weeds.

Figure 1 shows a comparison of relative resistance to glyphosate between 3 accessions of ARG. The Echuca accession has had a higher selection pressure than the Liverpool Plains accession.

Figure 1. Glasshouse glyphosate screen on 3 accessions of annual ryegrass, 1998.



Source: R. Stanton, Farrer Centre for Conservation Farming, C.S.U., Wagga

Populations of resistant ARG have 'slipped through' the winter fallow-summer crop rotation for 3 main reasons. Firstly all cases were no-till situations. Cultivation has been removed from the system, leading to a total reliance on glyphosate for fallow weed control. Secondly, populations of weeds are sprayed with no follow-up control of escapes, allowing seed set and the restocking of the seedbank. Thirdly, atrazine is widely used in the winter fallow leading up to sorghum. Atrazine is only effective on ARG before Z13 (3 leaves), or as a pre-emergent. Current practices have atrazine being applied to fallows when surviving ARG plants are too large to be controlled. Earlier application of atrazine with paraquat or Spray-seed® will lead to better control.

So what do we do to prevent glyphosate resistance in any species? Follow the following 5 points and herbicide resistance will be someone else's problem.

- **Review** spray records before any spraying
- **Monitor** results of spraying within six weeks of application
- **Prevent seed set** of any suspect weed populations
- **Plan** for next year's weed management now!
- **Act now!!**

Andrew Storrie

Common sowthistle reigns supreme

Common sowthistle (*Sonchus oleraceus*), also commonly referred to as milk thistle, is a pre-dominant weed of NGR farming landscapes. The recent survey of the NGR found that common sowthistle was recognised by growers and agronomists as being the weed most at risk of developing herbicide resistance. Several populations of this weed are already resistance to Group B herbicides resulting from repeated and almost exclusive use of chlorsulfuron.

Research aimed at understanding the ecology of common sowthistle with the view of devising an effective management strategy for this weed has been carried out over the past four years by QDPI researcher Michael Widderick. While research has focused on the weed's ecology, considerable effort has been made to explain it's increase in prevalence and to assess the effects of alternative weed management strategies.

Research has provided an understanding of the germination, emergence, seed persistence and morphological characteristics of the weed. As well, experiments on tillage, herbicide efficacy and crop competition have given insight into how this weed reacts to different management strategies.

While the current research on common sowthistle is drawing to an end, further research will no doubt be prompted by the prominence of this weed in the recent herbicide resistance risk survey. Michael Widderick recently produced a 4-page brochure which summarises the major research findings and aims at getting growers and agronomists to consider the ecology of common sowthistle when devising management strategies for this weed.

A copy of the Crop Link brochure can be obtained from Michael Widderick by contacting him on (07) 46 398856 or michael.widderick@dpi.qld.gov.au .

This PhD study was funded by GRDC and is a joint project between the University of New England and QDPI.

Michael Widderick

Weeds at risk in central and southern Queensland

A risk assessment was performed using the information supplied from the postal survey to identify the weeds and herbicide groups at greatest risk of developing herbicide resistance. The assessment will be used to identify potential new resistant weeds or further spread of currently confirmed resistant weeds. The information will assist in planning further project research and extension activities, particularly with the development and validation of preventive management strategies. The assessment process was based on the selection intensity applied to the weeds by each herbicide group in the different cropping systems of the regions.

The weeds with the highest risk for fallow and in-crop are listed in Tables 1 and 2 for central and southern Qld. The herbicide groups at risk are B, C and M in central Qld, and A, B and M in southern Qld. In addition to these weeds and herbicide groups, there are a number of other weeds at risk that are less common. These will be discussed in later editions of the newsletter.

Steve Walker

Table 1: The most common fallow weeds with the highest risk ratings for potential of developing herbicide resistance in central and southern Queensland.

Fallow weeds	Herbicide group
CENTRAL QUEENSLAND	
Sowthistle	B, I
Parthenium	B
African turnip weed	B
Liverseed grass	M
Sweet summer grass	M
SOUTHERN QUEENSLAND	
Sowthistle	B, M, I
Wild oats	M
Liverseed grass	M

Table 2: The most common crop weeds with the highest risk ratings for potential of developing herbicide resistance in central and southern Queensland.

Crop weeds	Herbicide group
CENTRAL QUEENSLAND	
African turnip weed	B
Sowthistle	B
Parthenium	B
Black pigweed	C
Barnyard grass	C
SOUTHERN QUEENSLAND	
Wild oats	A
Turnip weed	B
Mustards	B
Sowthistle	B
Paradoxa	A
Black bindweed	B

Editors

Michael Widderick (QDPI)
Phone: (07) 4639 8856
PO Box 2282 Toowoomba Qld 4350
E-mail: michael.widderick@dpi.qld.gov.au

Kathryn Galea (CFI)
Phone: (07) 4638 5399
PO Box 1666 Toowoomba Qld 4350
E-mail: kathryn.galea@cfi.org.au

For further information contact

Steve Walker (Project Leader - QDPI)
Phone: (07) 4639 8838
PO Box 2282 Toowoomba Qld 4350
E-mail: steve.r.walker@dpi.qld.gov.au

Steve Adkins (Project Leader - UQ)
Phone: (07) 3365 2072
University of Queensland 4072
E-mail: s.adkins@mailbox.uq.edu.au

Vikki Osten (QDPI)
Phone: (07) 4983 7406
LMB 6 Emerald Qld 4720
E-mail: vikki.osten@dpi.qld.gov.au

Andrew Storrie (NSWAg)
Phone: (02) 6763 1174
RMB 944 Tamworth NSW 2340
E-mail: andrew.storrie@agric.nsw.gov.au

Chris O'Donnell (UQ)
Phone: (07) 5460 1345
University of Queensland 4072
E-mail: c.odonnell@mailbox.uq.edu.au

Jim Barnes (QDPI)
Phone: (07) 4160 0724
PO Box 23 Kingaroy Qld 4610
E-mail: jim.barnes@dpi.qld.gov.au

the northern HERBICIDE RESISTANCE Reporter

is proudly supported by...

GRDC Grains Research & Development Corporation

Queensland Government Department of Primary Industries

NSW Agriculture

The University of Queensland

Conservation Farmers Inc. – For our farming future

CRC Weed management

RESISTANCE is FUTILE

If you know anyone interested in receiving this newsletter please send their contact details to the editors.

the northern HERBICIDE RESISTANCE Reporter
SEPTEMBER 2002
A Newsletter keeping you up to date with research and development in herbicide resistance in the Northern Region

If undeliverable return to
PO Box 2282, Toowoomba Qld 4350
Print Post Approved 424022/1517

SURFACE MAIL

POSTAGE PAID AUSTRALIA