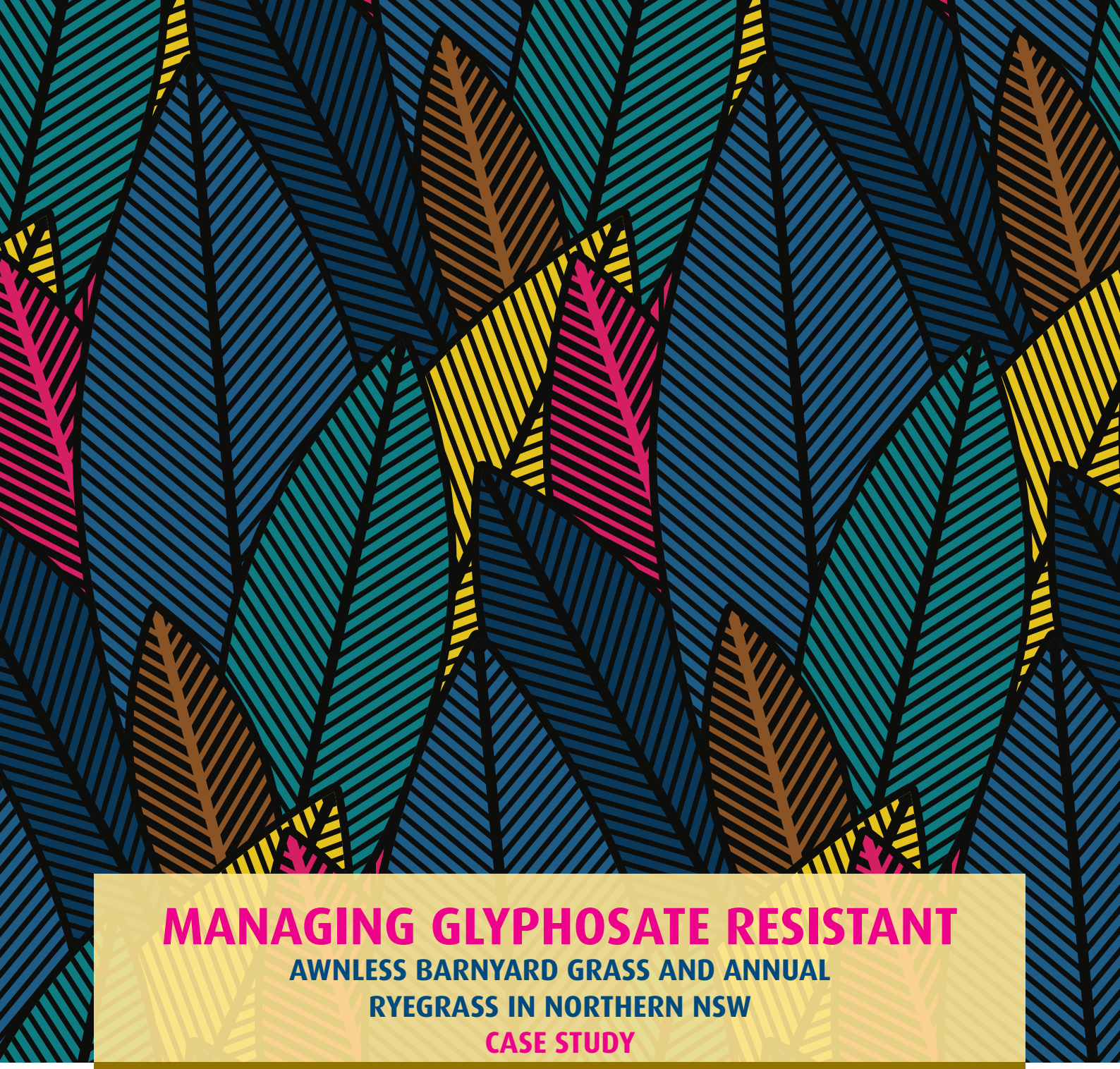

MANAGING GLYPHOSATE RESISTANT

AWNLESS BARNYARD GRASS AND ANNUAL RYEGRASS IN NORTHERN NSW

CASE STUDY

Tony Cook

March 2013

funded by GRDC Grains Research & Development Corporation
Your GRDC working with you

In partnership with

Department of Agriculture and Food, Government of Western Australia
NSW Government Department of Primary Industries
The University of Adelaide
The University Of Queensland Australia
QAAFI Queensland Alliance for Agriculture and Food Innovation
The University of Western Australia Achieve International Excellence
Queensland Government

9. Case Study

9.1 Management of glyphosate resistant awnless barnyard grass and annual ryegrass in northern NSW

9.2 Introduction

There are two species of weeds resistant to glyphosate on this farm at Bellata in northern NSW. The first and most widespread species is awnless barnyard grass and resistance was first suspected in the summer of 2004/05 and later confirmed in 2007/08. The second species exhibiting resistance to glyphosate is annual ryegrass and was suspected of being resistant in 2010 and confirmed in 2011. The extent of the annual ryegrass infestation is limited to a patch less than a hectare.

Since the confirmation of resistance to glyphosate, the barnyard grass population has been in steady decline due to improved management practices. Weed management on this property is flexible, using chemical and non-chemical options. However, there have been some challenges, such as a wet summer period in 2009/10 reducing the persistence and effectiveness of pre-emergent herbicides. Rapid growth of barnyard grass combined with wet summers resulted in barnyard grass management tactics aimed at large plants, thus limiting the effectiveness of many post-emergence options. Knowledge gaps on how to optimise the use of bipyridyl herbicides also caused some difficulties.

The recent addition of glyphosate resistant annual ryegrass further increased the complexity of the overall weed management on this farm.

9.3 Property characteristics

The 840ha farm near Bellata, north of Narrabri, New South Wales was acquired by the current owner in 1993 and been under his sole management since. An occasionally flowing watercourse passes through the farm and could be a vector for dispersal of glyphosate resistant weed seed after heavy rainfall. The property is lightly stocked with cattle which infrequently has been used for grazing weeds and failed crops. Cattle could spread resistant weed seeds. The soil types on the property vary and this contributes to the inconsistent control results and increases persistence of resistant awnless barnyard grass in dry seasons.

Summary

- Location: Narrabri Shire, northern grain belt, New South Wales;
- Rainfall: summer dominant, 600 mm average annual rainfall;
- Soil type: variable, from black vertisol to sandy clay loam;
- Enterprises: predominantly winter cereals and the occasional faba bean crop;
- Summer crops are sunflowers, sorghum and mung beans. There are some cattle on the property which occasionally graze on cropping paddocks during the fallow;
- Major weed problems: awnless barnyard grass, Johnson grass *(Sorghum halepense)*, wild oats *(Avena* spp.*)* and annual ryegrass;
- Herbicide resistance status: glyphosate resistant barnyard grass and glyphosate

resistant annual ryegrass and;

- Results of the management program: Glyphosate resistant barnyard grass populations have been reduced to a very sparse (10 plants per ha) but widespread infestations of over 10% of the property area, compared to approximately 1000 plants per **m²** in 2006/07. The farm profitability has been reduced slightly as some of the tactics used have a moderate increase in cost compared to management without glyphosate resistance. Glyphosate resistant annual ryegrass since 2012 was managed by spot treatment with a selective grass herbicide (Group A) combined with hand weeding of the survivors.

Figure 26: Sandy loam soil in dry times leading to failed sorghum crops while allowing the survival and seeding of glyphosate resistant barnyard grass (Tony Cook).

Figure 27: The density of barnyard grass immediately after confirmation of glyphosate resistance in 2007 was approximately 1,000 plants/**m²** (Tony Cook).

Problems and History

In 2004/05 the farmer realised a patch of barnyard grass was becoming difficult to control, however resistance testing was not undertaken until 2006/07, leading to a few years of poor control. Results confirmed a moderate 7-fold resistance to glyphosate. The farmer believes that resistance developed through repeated applications of glyphosate in his zero-till system and poor control of a high numbers of weeds. In this area a low number of glyphosate resistant plants were able to survive in patches and spread from there. However, the infestation of glyphosate resistant barnyard grass is still limited to less than 10% of the farm with only two paddocks infested.

Other resistance problems on this farm include the recent development of glyphosate resistant annual ryegrass along a contour bank that had been repeatedly treated with glyphosate. As this area is very small, the infestation will be patch managed and impact on the overall farm operations is unlikely.

It is suspected that populations of wild oats resistant to Group A herbicides exist in several paddocks and they appear to be at the early stages of spread. A thorough resistance test is yet to be conducted.

9.4 Management program

The approximate size of the awnless barnyard grass infestation is about 80 hectares. Although the owner considers this infestation is only present in two paddocks, it may have spread to other parts of the property. The grower intends to regularly monitor other paddocks and to control any suspect patches which will prevent new large scale infestations.

Weed management plans have been developed with a private agronomist and a state government weed expert. Information was gathered from GRDC grower updates, field days, herbicide resistance newsletters and having trials located on the property. This improved the farmer's level of understanding of the weeds' ecology, and highlighted alternative methods of control that could be used in developing a weed management plan.

The grower claimed there were no limitations or barriers to adopting new weed management tactics which included different herbicide mode-of-actions, cultivation to control large plants and using the double knock technique.

Integrated awnless barnyard grass strategies used since glyphosate resistance was confirmed included:

- Removing sorghum and sunflower from the rotation in affected paddocks as these crops increase barnyard grass densities. Most of the control tactics are now employed in the fallow phase.
- Using Flame® (Group B) and atrazine (Group C) as a pre-emergent fallow treatment in early spring. This tank mix was the superior pre-emergence treatment confirmed in research trials and farmer demonstrations.
- Regularly monitoring of affected paddocks and hand weeding light infestations of barnyard grass. This occurred after barnyard grass populations were reduced to extremely low levels.
- Cultivation to control large barnyard grass of sizes greater than mid tillering stage. There are no registered chemical options to control barnyard grass beyond the early tillering stage, except glyphosate (Figure 29).
- Application of the double knock technique in fallow: either using a Group A herbicide or Flame® (Group B) followed with a Group L herbicide.

Results

Initial infestations were very dense and were estimated to be over 1,000 plants/**m²** in some patches (refer to Figure 27). After four years of active management, the density of barnyard grass is approximately 10 plants per ha. Although the farmer now uses a hand weeding strategy to control survivors, reliance on effective pre-emergence herbicides remains a critical part to glyphosate resistant barnyard grass management.

A wet period in the 2008/09 season tested the determination of the grower. The initial application of a pre-emergence herbicide did not effectively control the first few flushes of barnyard grass and extended periods of wet weather prevented the farmer from treating the seedlings. Sequential applications of paraquat were required to prevent large barnyard grass plants from setting seed. Although this fallow management was expensive, it was limited to a small proportion of the farm and resulted in cleaner fallows the following year.

The farmer believes he may eradicate the problem in a few more years. Whether eradication is possible or not, the grower has increased his awareness of glyphosate resistant weeds, using non-glyphosate-based strategies and understands that without seed production, weeds cannot perpetuate resistance.

Challenges

No challenges arose after glyphosate resistance was confirmed, because the farmer had no 'mind-set' limitations to what had to be done. There was no hesitation using cultivation or Group L herbicides. Often farmers refuse to cultivate due to potential damage to soil structure or soil moisture loss and the use of Group L herbicides can be perceived as too hazardous for the applicator. However, planning, good timing and the use of appropriate safeguards enable these tactics to be integrated into the farming system.

Although the original infestation was confined to a small part of the farm only, resistance could have spread to other areas. Therefore, the farmer monitored surrounding areas and likely corridors of spread, such as verges of farm roads to manage this risk.

Costs of the control of glyphosate resistant barnyard grass in affected paddocks increased significantly and were dependent on treatment success. In the wet season of 2008/09, costs were estimated to be approximately $80/ha higher than prior to developing glyphosate resistance.

Until today, even when treatments - including residual herbicides - are working well, costs have been $30 to $40 higher than the expenditure for the regular practice of the repeated spraying with glyphosate. However, the farmer sees this additional expenditure as an investment to allow him to continue farming. Without this investment barnyard grass populations would increase in density and spread across the farm, threatening moisture conservation in fallows and reducing yields in subsequent crops.

Figure 28: Although there are effective pre-emergence herbicides for use in sorghum, only a few survivors are capable of producing large numbers of seed and re-setting the seedbank. This plant has survived an inter-row treatment aimed at controlling survivors (Tony Cook)

Figure 29: Cultivation was effective at controlling large glyphosate resistant barn-yard grass (Tony Cook).

Annual ryegrass

As outlined before, the farm has the unenviable situation of having two weed species resistant to glyphosate. However, resistance to glyphosate in annual ryegrass is still confined to a small area of approximately 1 ha along a contour bank with a smaller number of plants scattered into the cropping area (refer to Figure 30). The infestation should be easily controlled.

The farmer has just commenced a weed management plan for annual ryegrass with the first tactic to treat all plants with an effective Group A herbicide. Any survivors will then be hand weeded. Regular monitoring of all paddocks of the farm, in particular surrounding areas to the infestation, is planned to determine whether this patch has spread to other parts of the farm.

Wild oats potentially resistant to Group A herbicides

There are also concerns that wild oats have developed resistance to Group A herbicides, though at the time of writing no herbicide test has been conducted on the suspect population. The farmer has noticed classic resistance signs of weed patches developing. There were small clumps of advanced healthy plants surrounded by dead wild oats with no other plausible explanation of survival, except for resistance. It has been strongly recommended for a resistance test to be conducted as soon as possible.

It has to be noted that these wild oat plants are more widespread and occur in more paddocks, including those with glyphosate resistant barnyard grass. If Group A resistance is confirmed, it would have serious implications to the overall weed management on this property, because the farmer has included more winter cropping in the rotation. This included the use of summer fallow management to control glyphosate resistant barnyard grass populations increasing the pressure on wild oat herbicides used in-crops.

Figure 30: A new threat of glyphosate resistant annual ryegrass on a contour bank (Tony Cook).

9.5 Conclusions

Glyphosate resistance management is a daunting task for farmers with newly confirmed infestations and difficult if multiple species are resistant to glyphosate. In this case study a grain grower experienced this problem, however positive outcomes from this property are:

- The grower is now aware of the problems of resistance and is being proactive in his weed management;
- The new patch of glyphosate resistant annual ryegrass is very small and control should be easy;
- Both glyphosate resistant barnyard grass and annual ryegrass occur on separate paddocks and their management does not impact on each other;
- The initial high densities of glyphosate resistant barnyard grass have been significantly reduced to the occurrence of scattered plants only; and
- Weed management strategies have maintained consistent pressure on weed numbers and there is the potential to eradicate both glyphosate resistance problems.

Key learning outcomes from this case study are:

- Weed management must be a high priority;
- Thorough monitoring of the applied weed control including the treatment of any survivors is important to never allow the weeds to set seed;
- Residual herbicides will lessen pressure of post-emergent herbicides;
- High levels of weed control should be implemented early to minimise longer term impacts of glyphosate resistant weeds;
- Control tactics should be varied and non-herbicide treatments are essential, e.g. strategic cultivation;
- Patch management of weeds, flexibility and the maintenance of efforts to all aspects of the management is absolutely necessary;
- Resistance testing will be beneficial to determine control tactics; and.
- Keep an open mind and embrace change.

For more information on this case study contact Tony Cook Department of Primary Industries
Phone: (02) 6763 1250
Email: tony.cook@dpi.nsw.gov.au