



2019 INTEGRATED WEED MANAGEMENT

INDUSTRY SURVEY REPORT



Bollgard₃

Roundup
Ready **FLEX**
COTTON

ROUNDUP READY PLUS
WEED MANAGEMENT SOLUTIONS

TABLE OF CONTENTS

INTRODUCTION	2
METHODOLOGY	4
KEY FINDINGS	5
Weeds on Farm	5
Glyphosate Resistance	7
Non-Glyphosate Herbicide Resistance	9
Weed and Resistance Management	11
CONCLUSIONS	15
RESOURCES AVAILABLE	16



INTRODUCTION

Glyphosate is a critical herbicide for the cotton industry, and for agriculture in general, so protecting the longevity of the product is important. Over the last 20 years, over-reliance on glyphosate has seen a marked decrease in residual chemistry use within cotton systems and has also been a key contributor to the development of glyphosate resistance.

In 2016, Bayer commenced a program to collect data on glyphosate usage and integrated weed management (IWM) in the cotton industry. Insights gathered from 200 farmers and consultants led to the development of several programs and initiatives to assist cotton growers in implementing their on-farm Integrated Weed Management (IWM) program and to help protect glyphosate into the future.



FREE HERBICIDE RESISTANCE TESTING

Bayer offer free herbicide resistance testing to growers who have planted Roundup Ready Flex[®] cotton in any of the past 3 seasons, to test a range of weeds for resistance to important herbicide groups.



ROUNDUP READY PLUS[®]

In the 2018/19 season Bayer, in conjunction with Syngenta, launched the Roundup Ready PLUS[®] program to cotton growers. The Roundup Ready PLUS program is designed to protect the longevity of glyphosate and the Roundup Ready Flex trait by rewarding cotton growers who use herbicides sustainably. The program encourages growers to use a range of weed control practices through product recommendations, educational tools and financial rebates.



MIX IT UP™

'Mix It Up' is an initiative designed by Bayer to help growers manage herbicide resistance. The website features a resistance tracker, which is a free online tool that growers and consultants can use to view information on herbicide resistance levels in their location.



WEEDSMART

In 2019, Bayer continue to be a proud sponsor of the WeedSmart program. WeedSmart is an initiative that promotes the long-term sustainability of glyphosate and other herbicide use in Australian agriculture. The program provides farmers and agronomists with the latest tools and resources to manage herbicide resistance.

In 2019, Bayer have again conducted a research program with farmers and consultants to understand the impact of the above programs and any changes in prevalence of glyphosate resistant weeds, and IWM practices. The results of this research will enable Bayer to refine programs to assist in managing resistance and promoting the longevity of the Roundup Ready Flex technology.

While the problem of glyphosate resistance is significant, it is also manageable, and this project was fundamentally driven by a desire to influence positive change in on-farm use of glyphosate products and effective integrated weed management practices.

METHODOLOGY

Bayer collaborated with market research specialists Kynetec to conduct the 2019 research program. The program consisted of a quantitative survey.

The quantitative survey consisted of **170 telephone interviews** with growers and advisors across cotton growing regions.

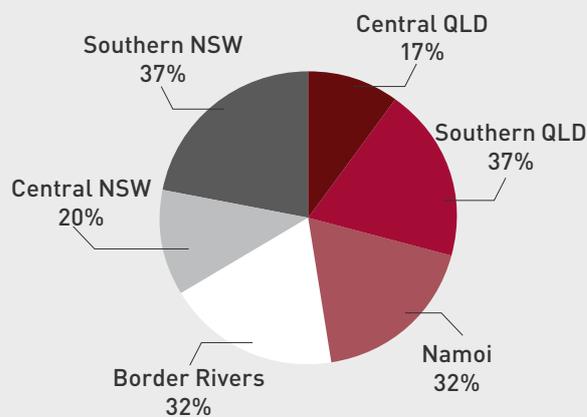
Interviews captured detailed information about on-farm management practices used to prevent and manage glyphosate resistance.

FARMERS



150
RESPONDENTS

REGION



ADVISORS



20
RESPONDENTS



KEY FINDINGS

WEEDS ON FARM

TOP 5 WEEDS

Growers and advisors identified five main weeds targeted for control in cotton (subject to regional variation);



FLEABANE



BARNYARD GRASS



MILK/SOW THISTLE



FEATHERTOP RHODES GRASS



PEACHVINE

These weeds are targeted in both pre-planting and in-crop periods.

The weed spectrum targeted for control is seasonally dependent, however, the top five weeds identified by growers is consistent with those identified in the 2016 survey.

WEEDS CONTROLLED

■ 2016 ■ 2019

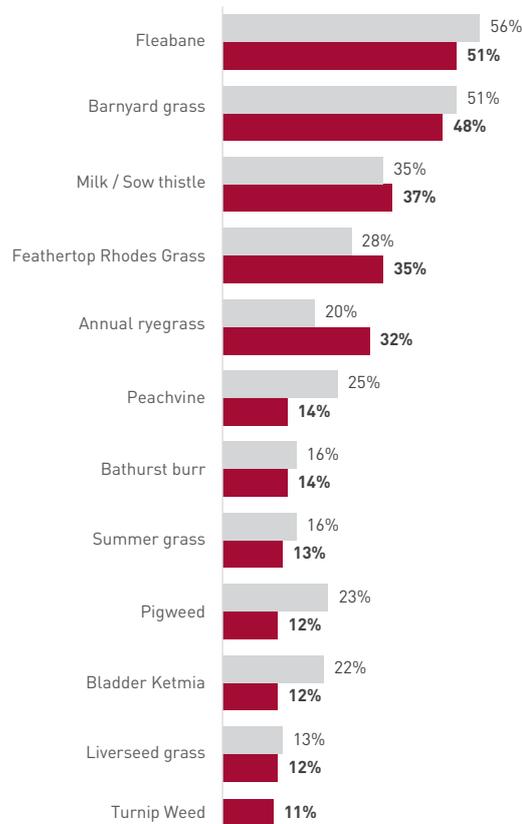


Figure 1. Percentage (%) of respondents identified main weeds for control prior to planting and within the cotton cropping phase in 2016 compared to 2019.

TOP 5 WEEDS CONTROLLED IN 2019

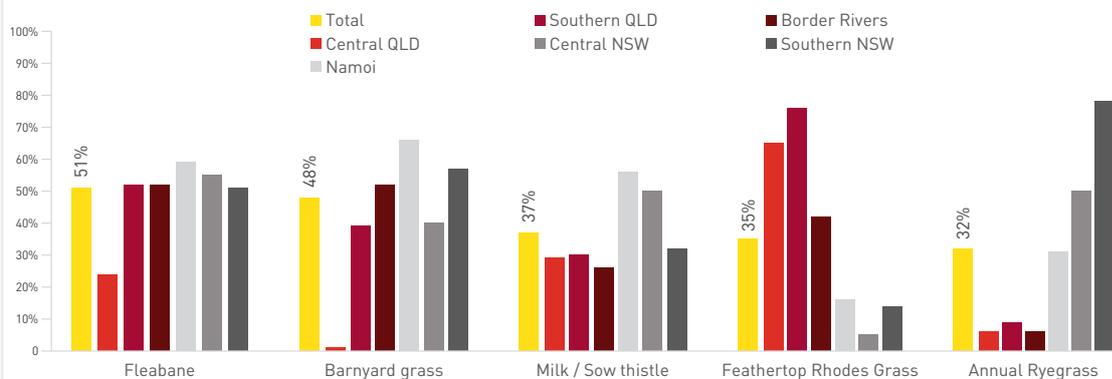
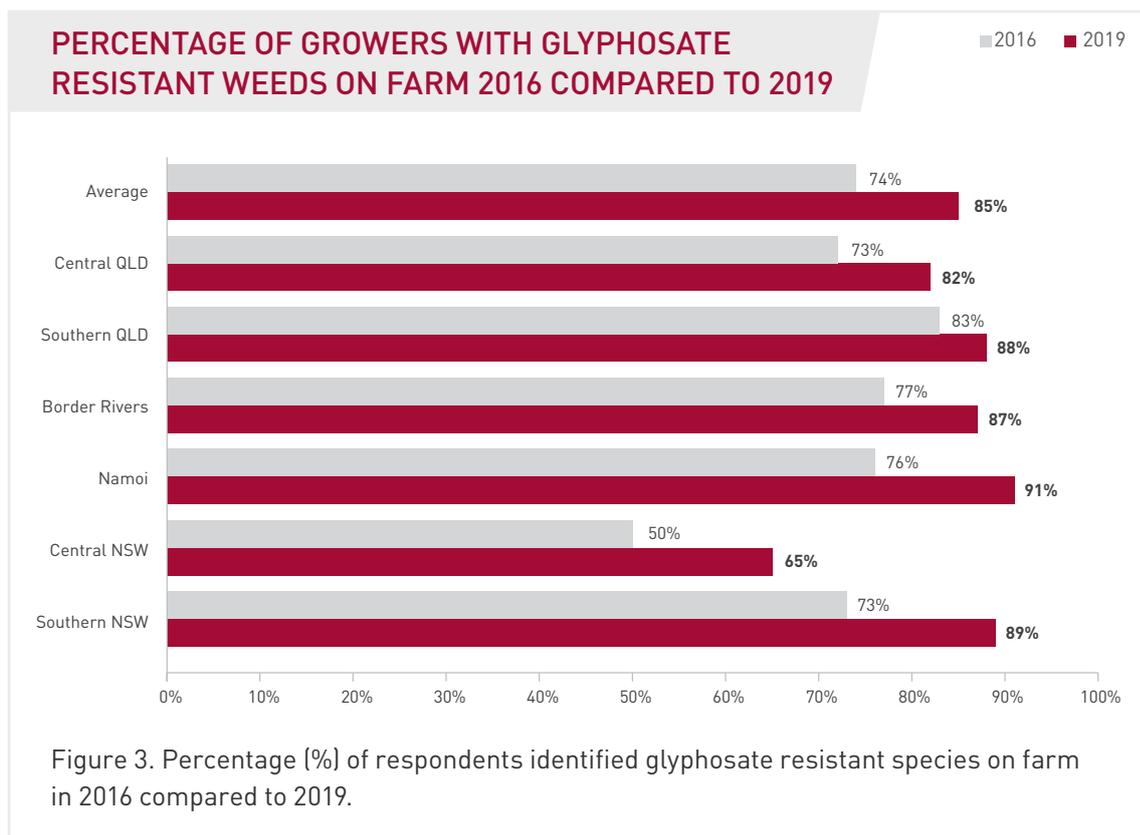


Figure 2. Percentage (%) of respondents identified main weeds for control prior to planting and within the cotton cropping phase.

GLYPHOSATE RESISTANCE

85% of all growers identified that they had suspected glyphosate resistant weeds on farm in 2019, up from 74% in 2016.

In each valley surveyed, the number of growers with glyphosate resistant weeds on farm has increased from the 2016 base.



Respondents state that Fleabane, Feathertop Rhodes Grass and Annual Ryegrass continue to be the main weeds resistant to glyphosate. Figure 4 shows that while reported rates of glyphosate resistance in many broadleaf weeds has remained constant, several grass species, including Annual Ryegrass and Barnyard Grass are showing higher rates of reported resistance.

GLYPHOSATE RESISTANT WEEDS

2016 2019

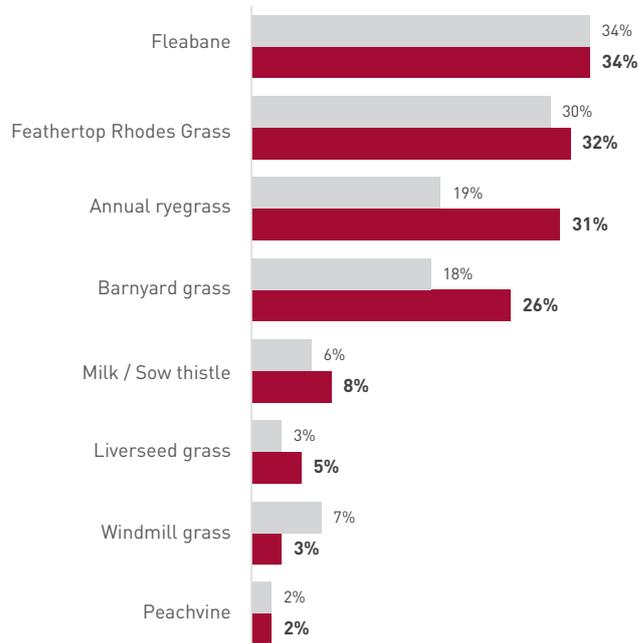


Figure 4. Percentage (%) of respondents identified glyphosate resistant species in 2016 compared to 2019.

Figure 5 shows many growers are identifying glyphosate resistant populations of Annual Ryegrass and Feathertop Rhodes Grass. However, these results are region specific. Southern NSW reports the highest prevalence of glyphosate resistant Annual Ryegrass. In contrast, Southern Queensland reports the highest rates of glyphosate resistant Feathertop Rhodes Grass.

TOP 5 GLYPHOSATE RESISTANT WEEDS IN 2019

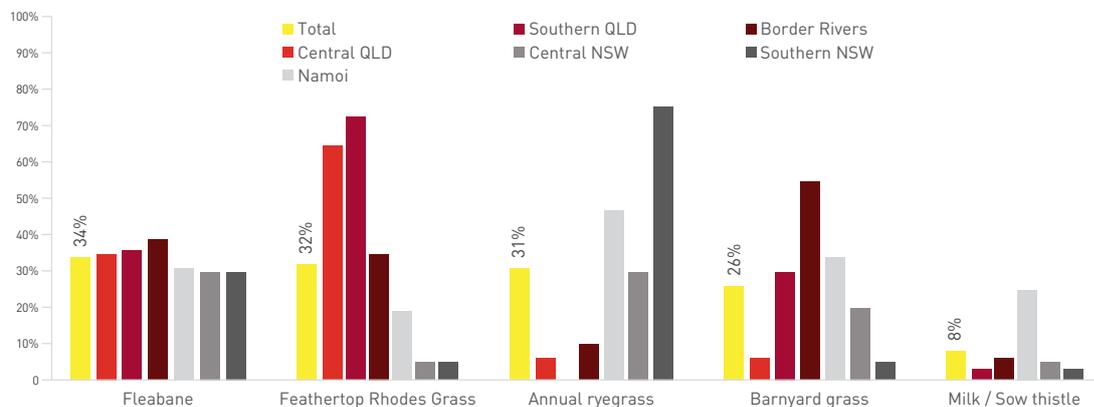
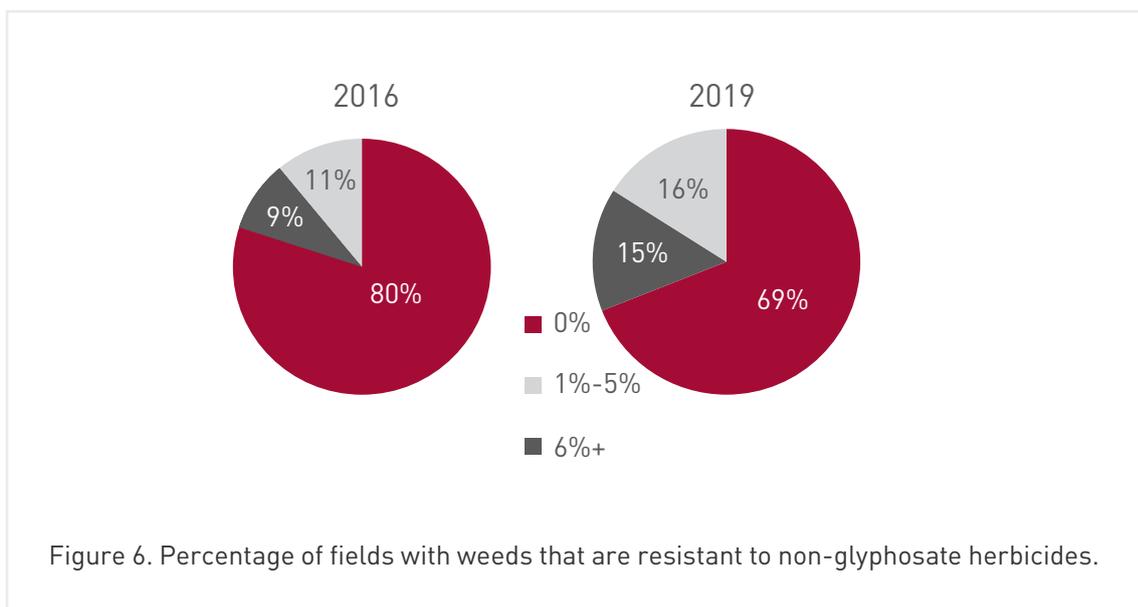


Figure 5. Percentage (%) of respondents identified main glyphosate resistant species in 2019.

NON-GLYPHOSATE HERBICIDE RESISTANCE

The percentage of fields that growers state have non-glyphosate herbicide resistance is increasing. In 2016, 80% of growers stated they had no fields with non-glyphosate herbicide resistance, compared to 69% in 2019.



Growers showed concern about development of resistance to other herbicide groups. Across all herbicide groups, growers were more concerned about resistance development in 2019 than in the 2016 survey. Growers are particularly concerned about resistance development in Group A herbicides. Group J and K herbicides featured in the survey for the first time, showing growers' increasing concern.

PERCENTAGE OF GROWERS CONCERNED ABOUT HERBICIDE RESISTANCE BY GROUP

■ 2016 ■ 2019

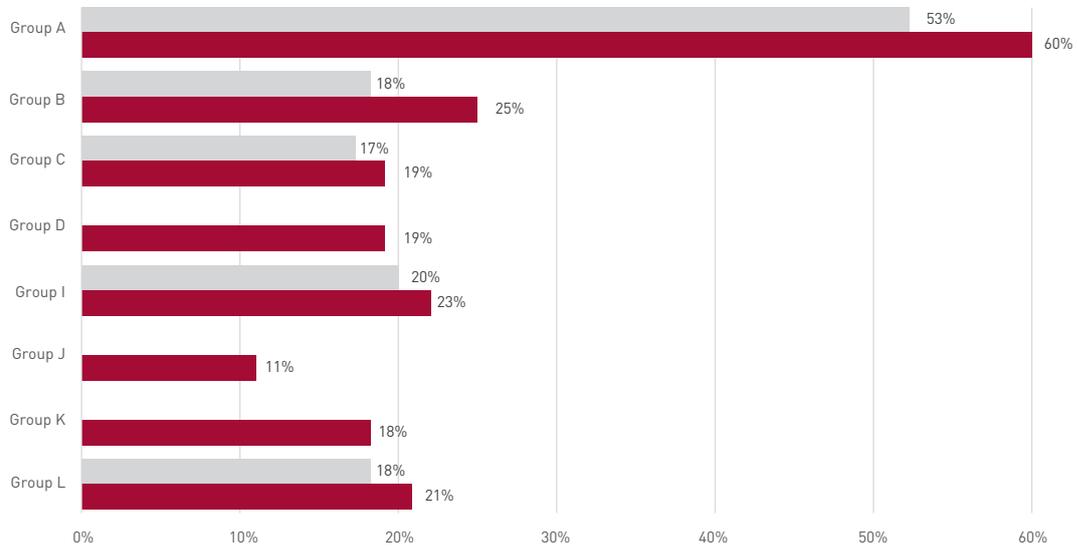


Figure 7. Percentage of growers concerned about development of resistance by herbicide group.



WEED & RESISTANCE MANAGEMENT

Survey results indicated most growers were active in on-farm weed management decisions, rather than completely delegating to an advisor or other third-party. Results also indicated 87% of growers rely on paddock inspections to tailor their weed management plan, which is consistent with the 2016 survey result. This is in preference to a set weed management program.

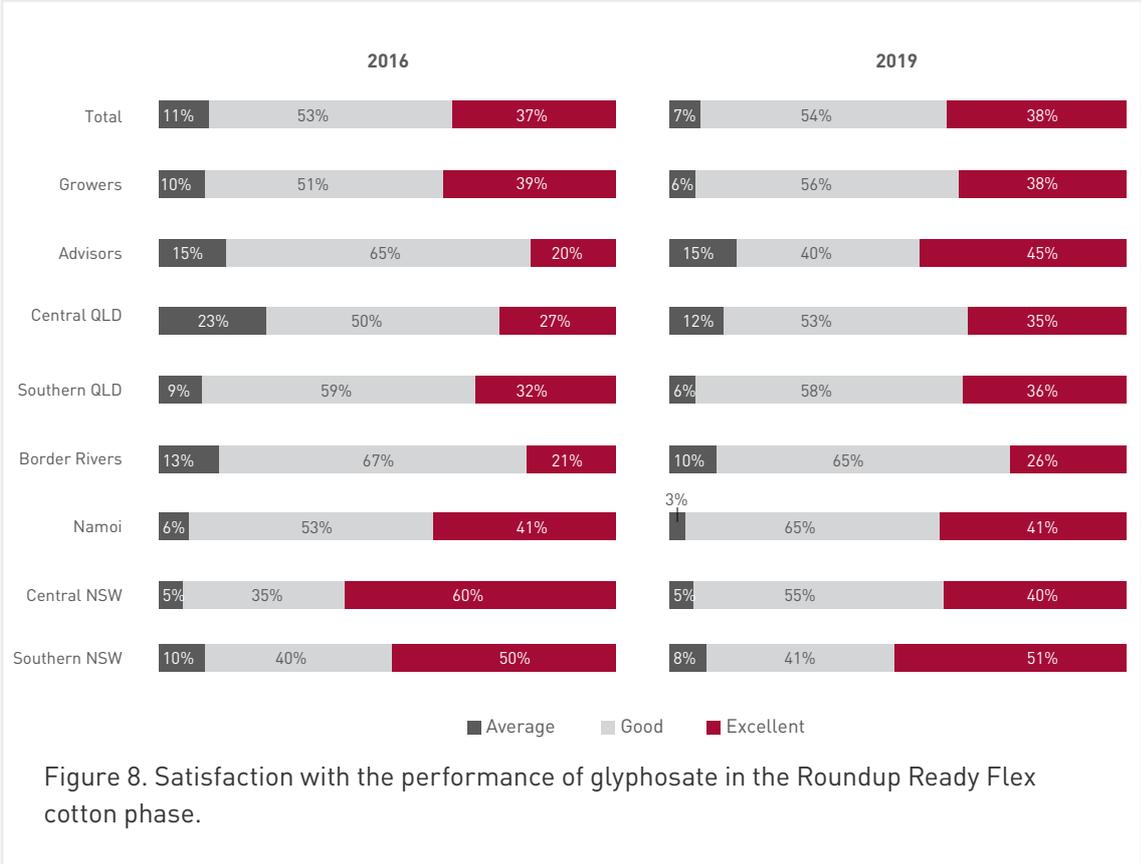
Cotton growers use an average of 4.9 applications of glyphosate each cotton growing season. This equates to average applications of:

- 1.9 during fallow (compared to 2.1 in 2016)
- 0.6 at sowing (compared to 0.5 in 2016); and
- 2.4 over-the-top of cotton (compared to 2.7 in 2016)

However, application frequency varies by region.



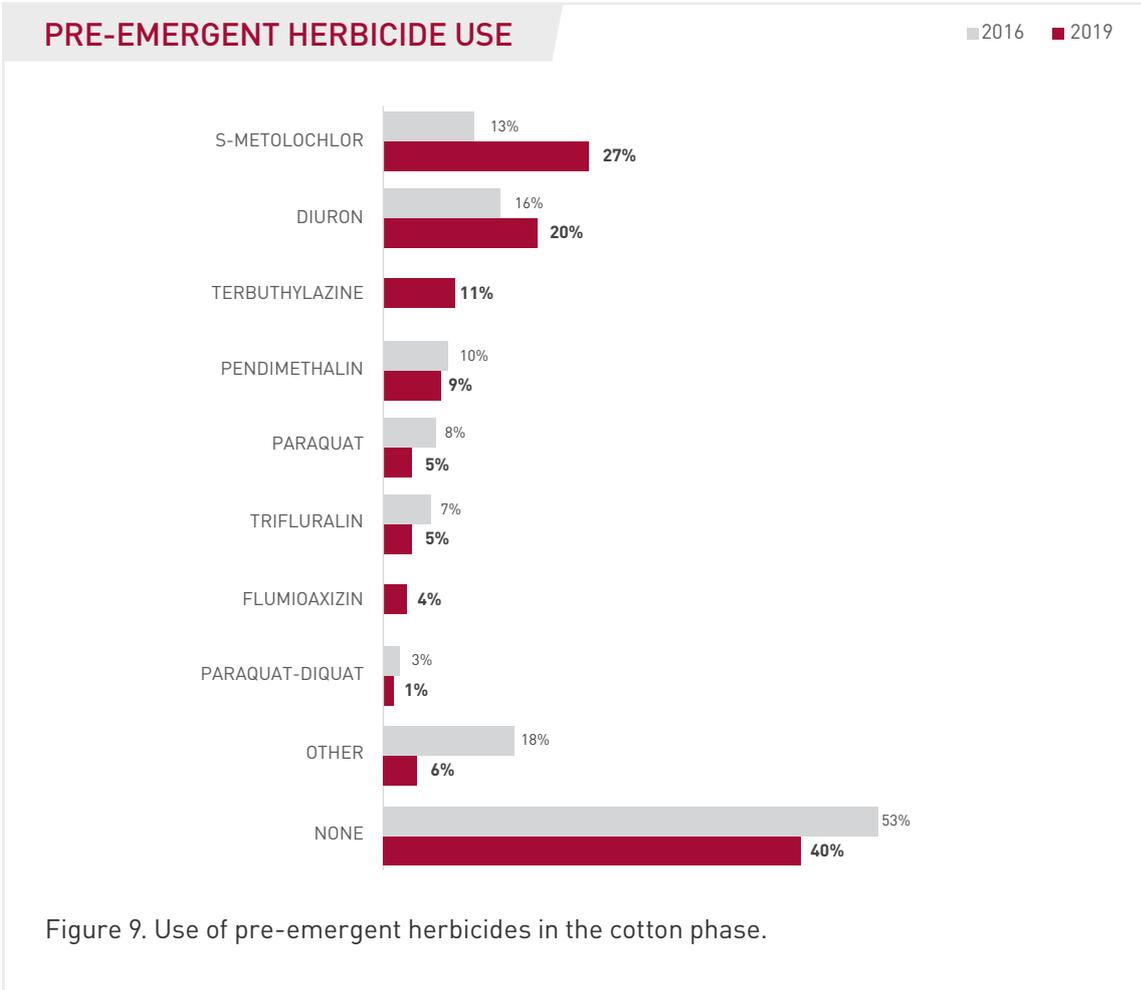
As shown in Figure 8, growers continue to be happy with the performance of glyphosate. 93% rated the level of control achieved as *Excellent* or *Good*. The continued performance of glyphosate is pivotal to the success of the Roundup Ready Flex cotton system.



Whilst glyphosate continues to perform well in the Roundup Ready Flex phase, survey results indicate that growers are relying on it heavily for in-crop weed control.



Since 2016, pre-emergent herbicide use has increased by 13%, as shown in Figure 9. This increase may be due to a number of factors, including the Roundup Ready PLUS program, with an increase in the use of program herbicides.



In contrast to pre-emergent herbicide use, since 2016 the use of post-emergent herbicides has decreased by 7%. This may be influenced by seasonal conditions.

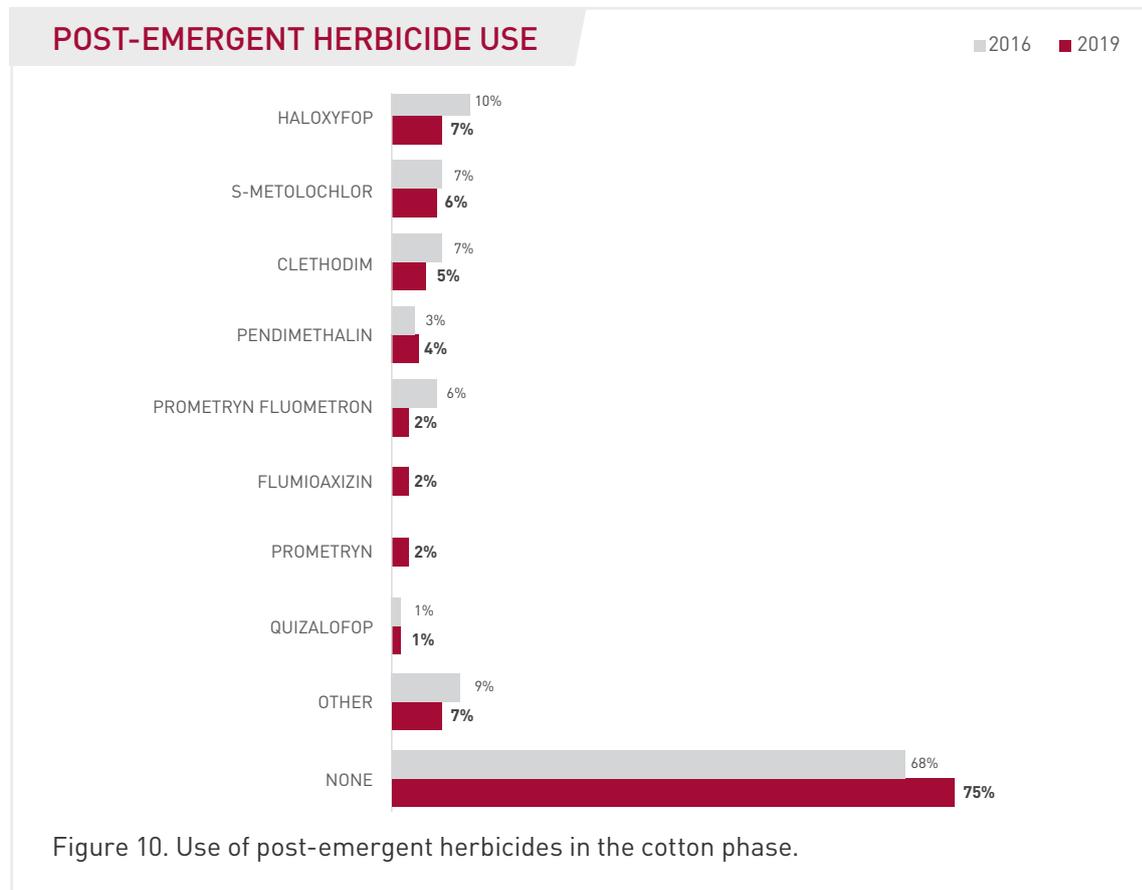
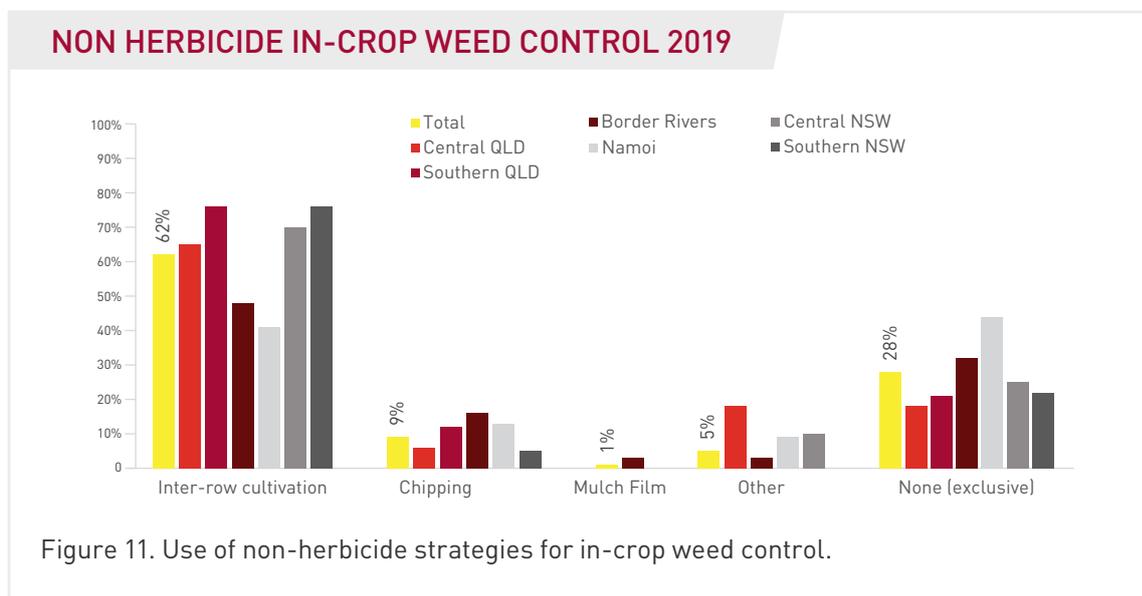


Figure 11 shows that despite the low rates of post-emergent herbicides being used, growers are using cultural practices in-crop to manage surviving weeds. 84% of growers took action to control surviving weeds, the majority used interrow cultivation (51%) and chipping (32%).



CONCLUSIONS

Results obtained from the 2019 weed resistance management survey have provided an overview of;

- The prevalence of resistant weeds,
- Grower management strategies and
- Actions taken to prevent/manage weeds into the future.

The data suggests that since the 2016 survey, a greater number of growers are managing glyphosate resistant weeds on their farm with 85% of growers indicating they have resistant weeds compared to 74% in 2016. These 85% of growers indicated that glyphosate resistant weeds are present in 31% of their fields.

The majority of growers are taking action to prevent and manage weeds resistant to glyphosate and other chemistry groups. Most growers are implementing an IWM strategy, comprising of several varied and targeted practices to eliminate weeds and manage weed seed banks. These strategies include both herbicide and non-herbicide cultural practices.

Glyphosate continues to perform well, with 93% of growers rating its efficacy as good or excellent. It is vital in supporting Roundup Ready Flex technology and cotton farming systems.

In summary, cotton growers and advisors have robust systems in place for preventing and managing herbicide resistance, however, should continue to remain vigilant to protect vital herbicide groups into the future.

RESOURCES AVAILABLE

Several resources are available to assist growers and advisors in on-farm weed management.

- ***Bayer's free herbicide resistance testing program***
Bayer offer free herbicide resistance testing to growers who have planted Roundup Ready Flex cotton in any of the past 3 seasons, to test a range of weeds for resistance to important herbicide groups. Contact your Territory Business Manager for more details at crop.bayer.com.au/find-a-rep.
- ***Roundup Ready PLUS®***
The Roundup Ready PLUS program is designed to protect the longevity of glyphosate and the Roundup Ready Flex trait by rewarding cotton growers who use herbicides sustainably. The program encourages growers to use a range of weed control practices through product recommendations, educational tools and financial rebates. Visit roundupreadyplus.com.au for more details.
- ***Mix It Up™***
Mix It Up is an initiative designed by Bayer to help growers manage herbicide resistance. The website features a resistance tracker, which is a free online tool that growers and consultants can use to view information on herbicide resistance levels in their location. Visit mix-it-up.com.au for more details.
- ***WeedSmart***
In 2019, Bayer continue to be a proud sponsor of the WeedSmart program. WeedSmart is an initiative that promotes the long-term sustainability of glyphosate and other herbicide use in Australian agriculture. The program provides farmers and agronomists with the latest tools and resources to manage herbicide resistance. Visit weedsmart.org.au for more details.

