

IRF Cotton Research

The CCA 2003 IPM Report:

A Survey of Cotton Growers' and Consultants'
Experience with Integrated Pest Management
For the 2002 & 2003 Seasons

A Report Prepared for

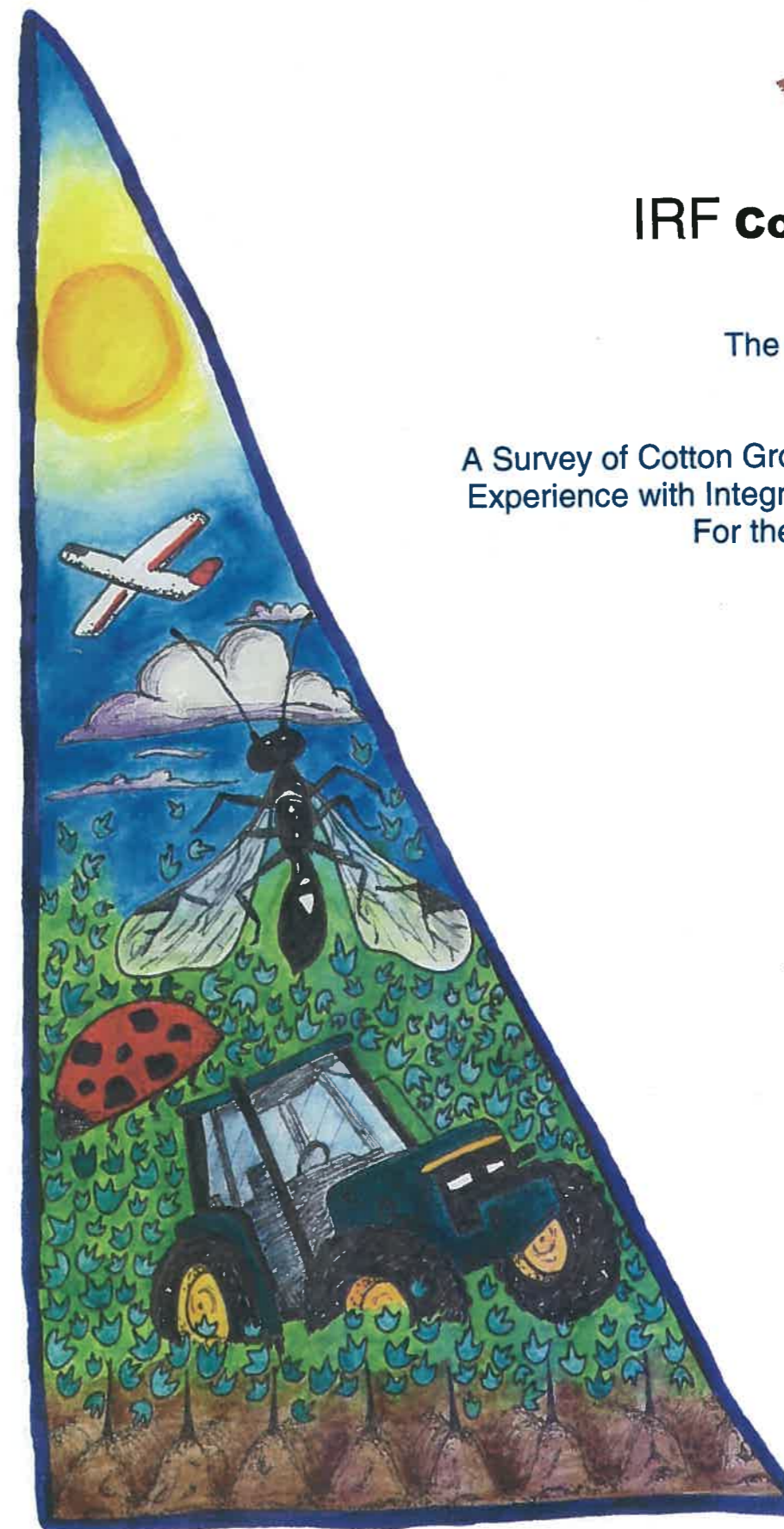


Australian Government

**Cotton Research and
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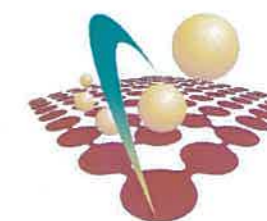
On Behalf of

Cotton Consultants
Australia Inc



Institute for Rural Futures, University of New England





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Cotton Consultants Australia Inc

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January 2004

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It is stated here and must be understood by any reader that 'users of the information contained in this report do so at their own discretion'. While every care has been taken to verify the accuracy of figures and associated claims, the data is supplied by respondents across all cotton growing regions, and their individual assessments and interpretations are 'best estimates' from sampled survey data and must be used in that light.

Finally while all care has been taken in the preparation of this report, users of the compiled information do so at their own risk and discretion.

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1. INTRODUCTION

1.1. Introduction

In their 1999 guidelines for Integrated Pest Management (IPM), Robert Mensah and Lewis Wilson describe IPM for cotton as 'a system that integrates all means of managing pest populations with the aim of reducing insecticide use whilst maintaining profitability' (Mensah & Wilson, 1999). Pragmatically, this has resulted in IPM being a method of encouraging beneficial insects to carry out the part of the work that was formally undertaken by broad-spectrum pesticides, i.e. keeping the damage to the crop from insect infestations down to acceptable levels. This process has been made possible in part by the development of "narrow spectrum" or soft insecticides that are very specific in which insects are targeted and the rise of the area wide management philosophy in chemical use. Consequently, when a group of growers or consultants start talking about IPM, the conversation tends to circle around how many soft sprays they were able to get away with, beneficial activity and whether they had problems with "hard neighbours".

In other words, IPM is now a mainstream approach (some would say the only approach) to insect management in cotton, and, as will be shown in this report, is being adopted by a larger proportion of growers as time goes by. The philosophy is not without its challenges: broad-spectrum or hard sprays can be disruptive to an IPM strategy, sustained high pressure can wear down the resolve of the crop managers to trust that the strategy will limit damage sufficiently, while avoiding resistance building up to the newer soft chemistry means that "keeping soft" can be a challenge.

1.2. Objectives of the Study

The aim of this report is to provide a picture of how IPM is working on the ground, by giving an understanding of the thoughts of cotton growers and consultants in relation to IPM. Quantitative and qualitative information is used to assist in this goal.

Of particular interest are the attitudes of growers to the individual components of a successful IPM approach. Their commitment to Area Wide Management (AWM) Strategies and the barriers they encounter are discussed in this report. Similarly, the role of beneficials and the recovery of the plant from damage is considered. Agronomic Consultants are central to the implementation of insect management strategies. This report aims to provide an overview of their experience and impressions, and how management has changed over time.

1.3. Methods

Data for this report is drawn from a wide range of sources.

- Cotton Consultants Australia (CCA) conducts an annual survey of consultants that canvasses quantitative and qualitative information at the end of each season.
- The survey data are supplemented by the annual focus group series, where consultants bring one or two of their growers to a lunch or dinner, and topics of interest to the industry are discussed in depth.
- Information is also gleaned from the round of Insect Resistance Management Meetings (IRMS) that are conducted with consultants. This forum often finds a range of insect management strategies being aired and discussed in full and frank terms.
- The first annual Grower Context Survey (GCS) was commissioned by Cotton Consultants Australia Inc. in response to a need for detailed information about the production base in the Cotton Industry. Qualitative and quantitative information was collected in this survey including demographic, situational (context) and attitudinal data.

The response to these surveys and the data received can both be rated as being exceptionally high. The annual survey of consultants consistently results in data covering between 75 to 80 per cent of the annual production. Focus groups were held with consultants and growers from six

valleys in 2002, and nine valleys in 2003. The GCS was replied to by growers covering between 19 and 20 per cent of the planted area in 2001-2002 and 2002-2003. The responses are outlined in tables 1-3 below.

	Con	Con RR	Ing	Ing RR	Total
Central QLD	3100	300	1500	100	5000
St George	21261	1648	8428	492	31829
Darling Downs	14252	1770	6520	1689	24231
Macintyre	25847	3091	14337	1326	44601
Gwydir	28615	7204	13689	2932	52439
Namoi	36617	3850	15419	2925	58811
Macquarie	14534	7407	4428	4402	30770
Bourke	7711	275	3091	152	11229
Emerald	23681	952	9643	768	35044
Southern NSW	15959	3865	2644	5280	27747
Total	191578	30361	79697	20066	321701

	Con	Ing	Boll	Con RR	Ing RR	Boll RR	Totals
Bourke	0	0	0	0	0	0	10099
Central Qld	5476	2315	30	1218	1060	37	11596
Darling Downs	5559	1483	105	2830	1583	21	13416
Emerald	7883	2646	96	1519	1252	106	22571
Gwydir	10851	3274	94	4508	3738	63	29676
Macint	18092	4792	92	2841	3796	0	19075
Macqu	3802	887	188	9060	5138	22	43855
Namoi	22905	9019	1365	5910	4634	72	14691
Sth NSW	7429	908	63	3428	2791	22	7027
St George/ Dirr	4444	1401	42	827	291	43	4000
Upper Namoi	1579	523	109	1042	704	386	176005
Total	88020	27247	2184	33182	24986	386	176005

	2001/02	2002/03
Sum (hectares)	77,517	46,909
Percentage of total area for the year	19.2%	20.3%
Average (hectares)	901	545
Stand. Dev (hectares)	1,402	830
Range low (hectares)	50	0
Range High (hectares)	7300	4126

1.4. Report structure

Data from growers is presented from the GCS and focus groups run during 2002 and 2003 in the next section. Further analysis of the GCS is undertaken in Section 3. Information collected from consultants is presented and discussed in Section 4. The report concludes in Section 5 with a summary of the findings.

2. GROWERS AND IPM

This section of the report uses information collected from growers in focus groups and from responses to the GCS. CCA recognised that there was a need to understand how their growers viewed a range of topics associated with cotton production. To facilitate this understanding, the CCA conducted the first annual GCS in winter 2003. Grower addresses were received from members of the CCA after they had received approval from their growers to supply addresses to IRF Cotton Research. Addresses were received from 60 consultants who supplied 277 addresses for growers in total. The number of grower addresses supplied varied between 1 and 26 addresses per consultant. A mail survey was posted to the growers, complete with a reply paid envelope. A reminder was posted five weeks later and the survey was closed for responses six weeks after that time.

Responses were received from 88 growers or just less than 32 per cent of growers contacted. The quality of responses was exceptionally high, with considerable thought being given to the range of questions asked. A summary of results was sent to all growers who agreed to participate in the survey, and to consultants who facilitated the collection of addresses from these growers. Enquiries about the full range of results from the Grower Context Survey can be directed to the Executive Officer of the CCA, an overview of the subjects canvassed can be found in Appendix 1.

The report divided the data into responses segmented by production zone. To provide anonymity to respondents, three zones were developed:

1. Northern - Responses for Queensland,
2. Central - Responses for NSW above the Macquarie region,
3. Southern - Responses for NSW below the Upper Namoi, Namoi and Walgett regions.

2.1. Demographic Characteristics

Respondents were asked to indicate their year of birth, the year they started in the industry and their highest education level. Respondents in the southern region were older on average, however their time in the industry was similar to the other regions.

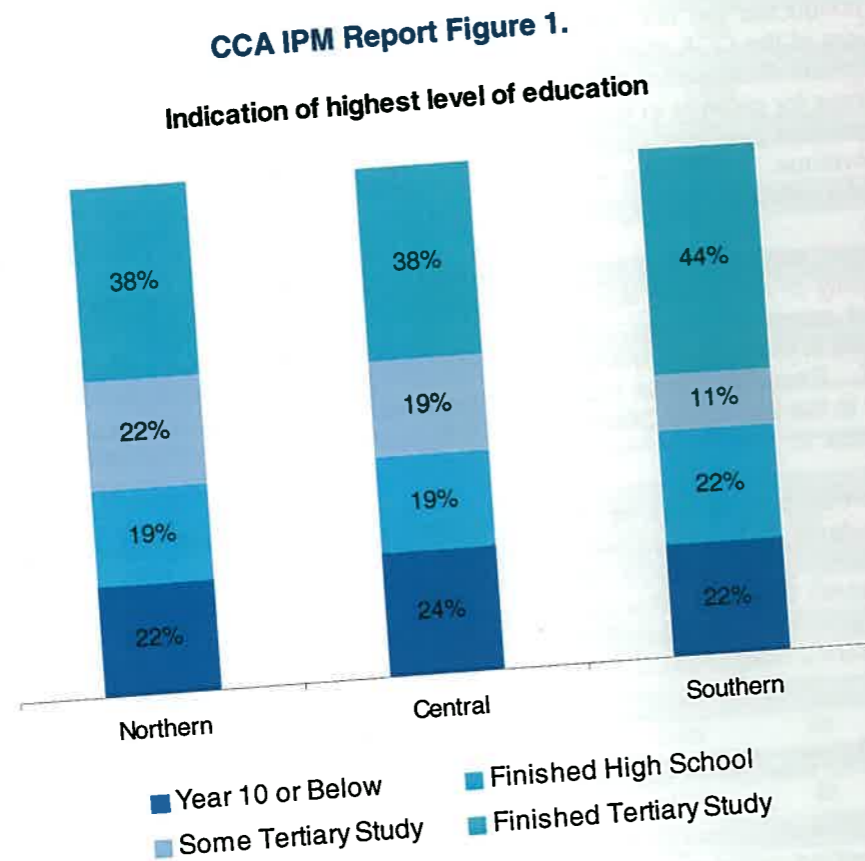
2.1.1. Age and Experience

Northern	1962
Central	1962
Southern	1955

Northern	1989
Central	1985
Southern	1986

2.1.2. Education

Growers were asked to indicate their highest level of education. The responses are presented by region in Figure 1 below.



2.2. Production Area

Table 6 shows the average number of hectares covered by the cropping enterprises of the respondents for each region, and the areas under irrigation. Average farm size (for cropping enterprises) is largest in the Central region followed by the Northern region with the production areas in the South smallest on average.

Table 6. Production Area	Northern	Central	Southern
Average Total Hectares	2758	3768	2238
Average Total Irrigation Area	1252	2078	634

2.2.1. Cropping History 2001-2003

Table 7 outlines the cropping history for the sample of farms surveyed. These data demonstrate the difference in cropping mix between regions. As expected the cotton areas are largest in the Central region on average. The Southern region reported larger areas of winter cereals and oilseed production on average.

Table 7. Cropping History 2001-2003

	Northern	Central	Southern
Cotton Ha 2001/02	734.7	1166.1	335.6
Winter Cereals Ha 2001/02	540.5	648.6	766.9
Winter Oilseeds Ha 2001/02	9.1	6.8	247.2
Summer Cereals Ha 2001/02	109.1	156.8	0.0
Summer Oilseeds Ha 2001/02	5.3	55.4	44.4
Other 1 Ha 2001/02	19.0	33.9	12.2
Other 2 Ha 2001/02	7.2	9.6	3.3
Cotton Ha 2002/03	387.5	779.6	112.6
Winter Cereals Ha 2002/03	215.6	553.8	881.4
Winter Oilseeds Ha 2002/03	12.1	2.5	337.2
Summer Cereals Ha 2002/03	111.5	122.3	26.7
Summer Oilseeds Ha 2002/03	1.1	9.2	0.0
Other 1 Ha 2002/03	6.2	24.0	88.9
Other 2 Ha 2002/03	3.1	5.1	24.4

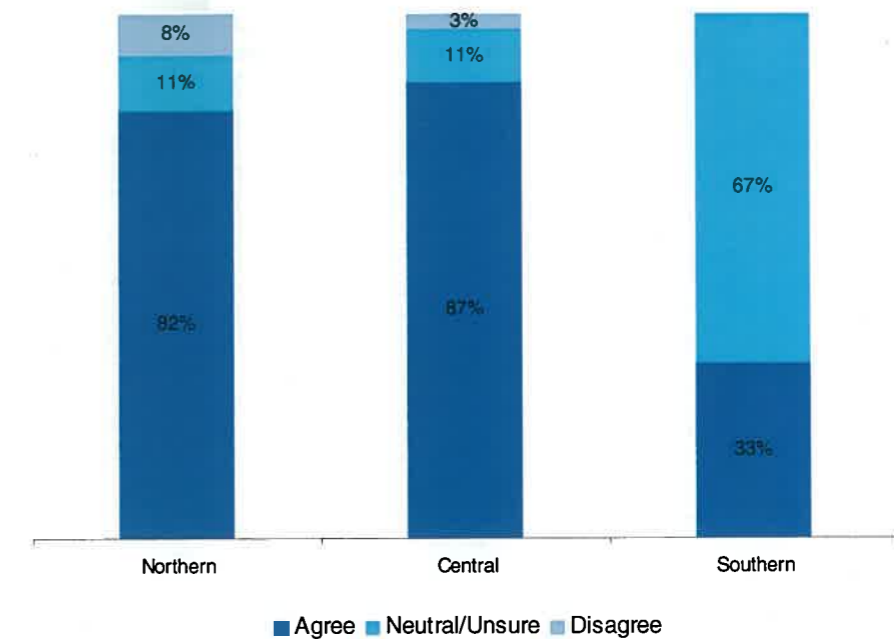
2.3. Grower Attitudes to IPM

A range of attitudinal questions were included in the GCS to create an understanding of cotton growers' thoughts on topics of interest. The survey sought to gather information across many different aspects of cotton production; questions that relate directly to IPM were included but were not necessarily the focus of the survey.

Figure 2 shows that IPM is generally well accepted as providing an economic benefit in the Central and Northern regions but fewer respondents in the Southern area agreed with this statement. Southern growers explained in Warren and Hillston focus groups that, due to the shorter season in the Southern regions, the need to retain fruit as early as possible meant that IPM was given less latitude to work. Contrasting this opinion, growers in central Queensland believed the plant could compensate adequately if some damage was experienced early in the season while beneficial numbers were building.

CCA IPM Report Figure 2.

IPM normally delivers economic benefits across our areas

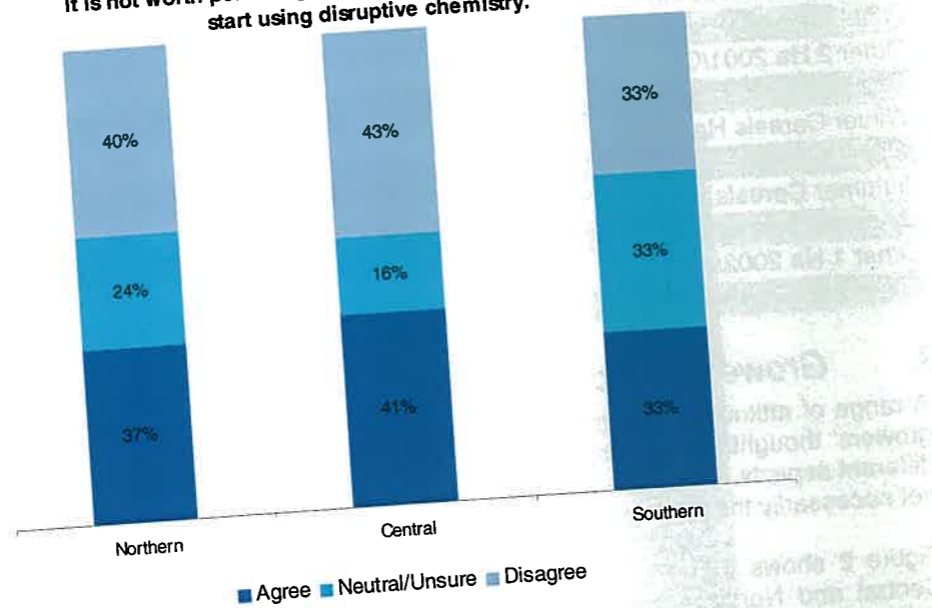


Commitment to using softer IPM chemistry was looked at in this statement, with the situation where a neighbour "goes in hard" when a grower is pursuing a soft strategy. Clearly, more than a

third of growers are prepared to continue with their soft approach when disruptive chemicals have been used nearby.

CCA IPM Report Figure 3.

It is not worth persisting with soft products once neighbours start using disruptive chemistry.



Participation in AWM groups is always a topic of conversation in the industry. The data for this statement suggest that there is a spread of opinions regarding the benefits of these groups when considering the "costs" of being involved. Comments collected from growers in relation to AWMs are presented later in this section.

CCA IPM Report Figure 4.

Area Wide Management groups can be difficult to be part of; I find that the hassles outweigh the benefits.

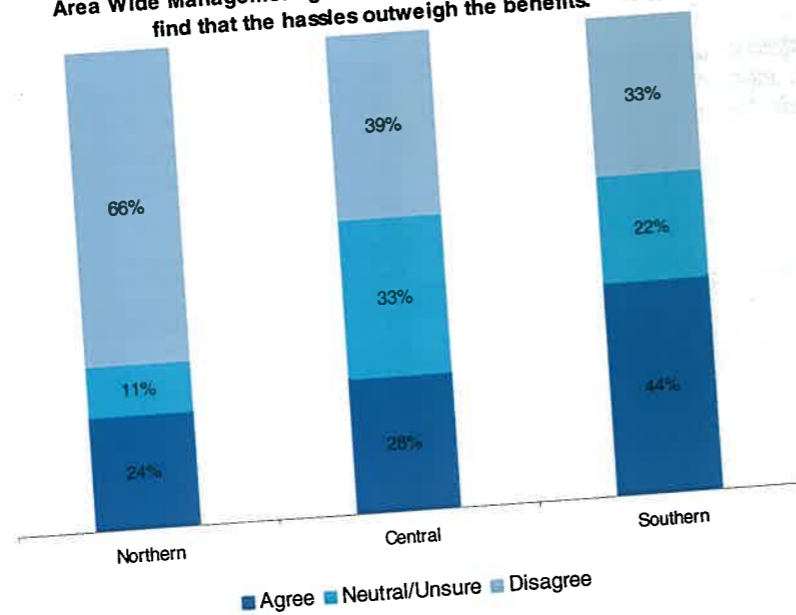


Figure 5 demonstrates the attitude to innovation and risk that prevails in the industry. The data shows that generally, the approach of growers is to make rapid assessments of technology and adopt them in a timely manner. This characteristic is important in assessments of newer chemistry and other innovative management approaches associated with IPM.

CCA IPM Report Figure 5.

If a new product looks like being effective in our situation, we will generally use it as soon as it is available.

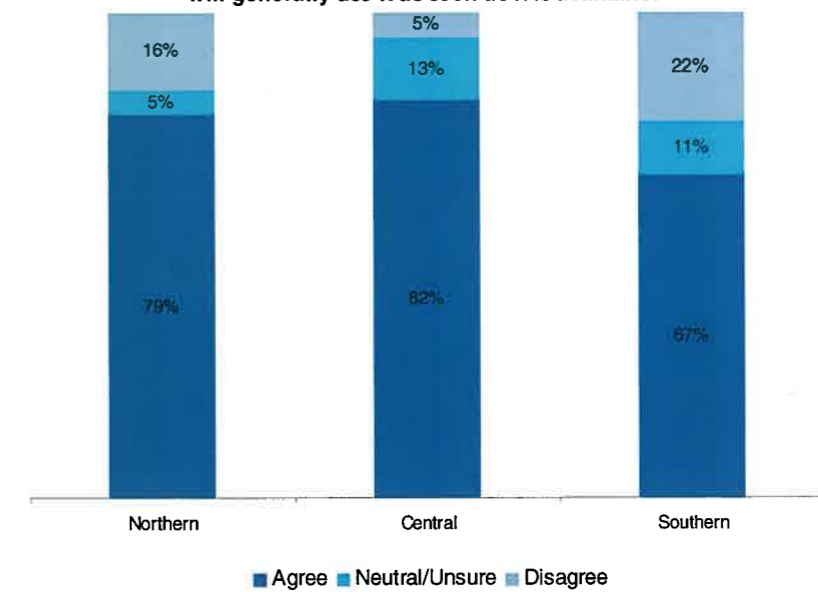
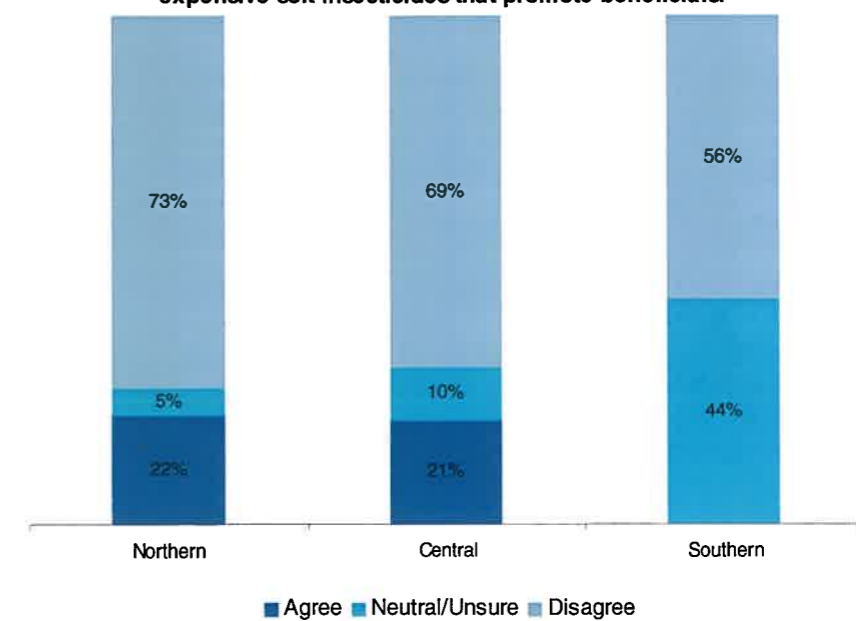


Figure 6 reveals that the majority of growers in the sample did not regard soft products as being an input into the farming system that would suffer reduced usage when economic pressure was being experienced during the season. This confirms the commonly held view that soft products are an important management tool and valued by growers at the current pricing levels.

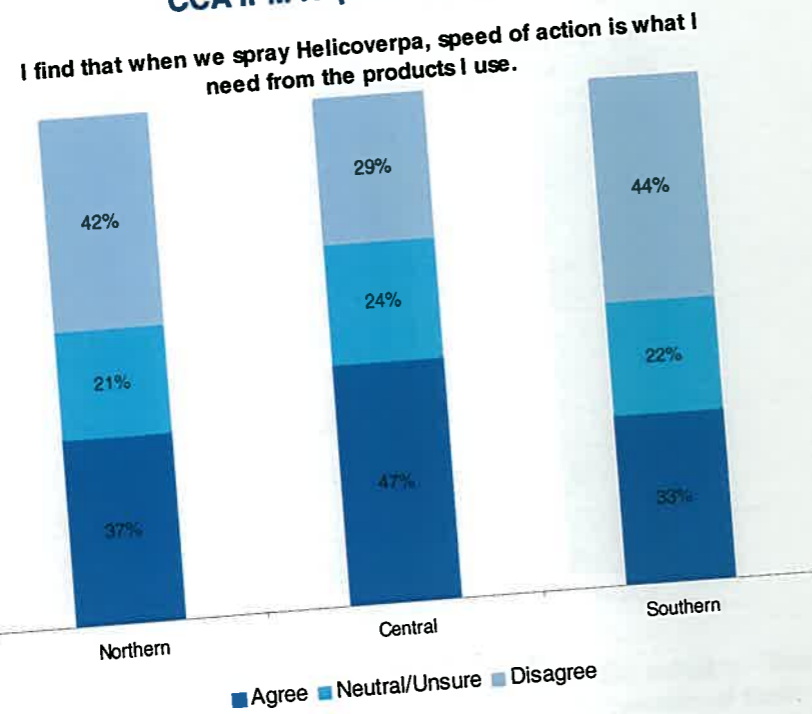
CCA IPM Report Figure 6.

When things are tighter than normal, I try to limit the use of expensive soft insecticides that promote beneficials.

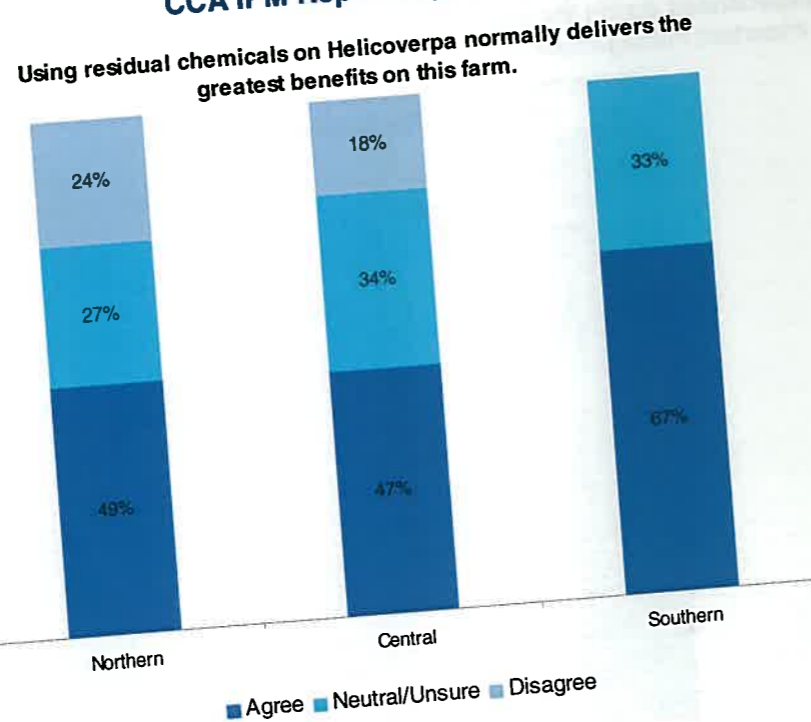


Figures 7 and 8 illustrate the attitudes of growers in relation to different characteristics of products for Helicoverpa control. The figures demonstrate that both speed of action and residual benefits can be important.

CCA IPM Report Figure 7.



CCA IPM Report Figure 8.



2.4. Difficulties in following IPM Strategies

Growers were asked to put forward their opinions on following IPM strategies in the regional focus groups. Their responses to the question, 'What can make it difficult to follow an IPM strategy?' are listed in Table 8. Regional differences in responses were quite apparent. In the Darling Downs, the farming system is a 'mosaic', i.e. cotton is often interspersed across a district with a wide variety of other summer and winter crops. This situation was reported by the growers and consultants as having the potential to make a strategy difficult if, for example, neighbouring maize crops were sprayed with products that disrupted IPM on cotton. This was also the case at Emerald, where it was reported that environmental constraints make it harder to 'leave an application for another check because the wind might shift and I wouldn't be able to spray for a number of days'. This was the opposite of the average situation in the Macintyre and St George regions. Growers there did have concerns about neighbours, but generally the cotton was not near other crops and growers were able to follow IPM strategies without the fear of being 'blown out of the water' with a neighbour spraying disruptive chemicals.

Table 8. What can make it difficult to follow an IPM strategy?

Macalister	Neighbours; cost.
Warra	High insect pressure. Low cotton prices. High cost of soft selective chemicals.
Dalby	Disruptive chemicals used in district; cost of soft alternatives; effectiveness of soft products.
Dalby	Confidence to stay with it. Loss of beneficials due to drift of sprays.
Dalby	Changing environmental/economic conditions.
Darling Downs	Low incidence of beneficials.
Darling Downs	Extreme egg pressure - mid season.
Darling Downs	Availability of soft chemistry to conserve beneficials.
Dalby	Weather; not enough soft chemicals.
Cecil Plains	Non-conformity by neighbours and large amount of grain crops.
Darling Downs	Expensive chemicals and lack of credible data on IPM.
Brigalow	Risk; economics; methods being used by neighbours and their effect on my crops and effectiveness.
Chinchilla	Neighbour not following strategy.
Darling Downs	Mirids.
Cecil Plains	High pressure.
Darling Downs	Mirids; Thrips; Aphids and high Heliothis pressure.
Dalby	Insect pressure; neighbours; weather.
Dalby	Insect pressure; cost of soft chemicals.
Downs-Brookstead	Mirids; neighbours using disruptive chemistry too early.
Jimbour	Spray activities of neighbour; cost of soft option chemicals; availability of soft options.
Dalby	Neighbours not following the same strategy; drift.
Darling Downs	Neighbours; lack of options in stage 3.
Dalby	Non-beneficial insects.
Dalby	Insects and neighbours.
Darling Downs	Uncooperative neighbours. Seasonal conditions.
MacIntyre	Very few chemicals for soft approach.
MacIntyre	Secondary pests.
MacIntyre/Mungindi	Changes in pest dynamics, i.e. unexpected secondary pests.
MacIntyre	Weather conditions; new problems with an insect; resistance.
MacIntyre	Having the right chemistry available when it is required; e.g. in the right stage.
MacIntyre	High insect pressure; low fruit loads; running out of time for crop to produce.
MacIntyre	Secondary pests.
MacIntyre	Limited choice of soft options allowed in the strategy.
MacIntyre	Hard neighbours.
Mungindi	Early season heavy H punctigera pressure; aphids/mites early stage II;

Mungindi	whitefly. Very heavy; consistent early pressure; neighbours not following same strategy.
St George	Cost; insect pressure; weather.
St George	Heavy pressure; costs.
St George	Heavy insect pressure.
Gwydir	Ability to rotate chemistry without it being too expensive and not wanting to use OPs; secondary pests; high pressure.
Gwydir	Overall seasonal/climatic conditions; i.e. very slow start (heat units); severely diseased stand.
Gwydir	Heavy insect pressure.
Namoi	Weather; timing.
Lower Namoi	Neighbours; strategy.
Lower Namoi	Growing other crops; next door.
Namoi	Neighbours spraying it out; heavy insect pressure.
Upper Namoi	Insect pressure; spray results; weather.
Namoi	Neighbours.
Lower Namoi	Your neighbour does not follow your program.
Lower Namoi	Your neighbour's strategy.
Lower Namoi	Cost and lack of soft options; weather; strategy too rigid.
Upper Namoi	Weather (growth stage); chemical availability; spray failure.
Lower Namoi	The impact of neighbours.
Lower Namoi	Cost.

For the most part, IPM principles are followed very closely, and growers reported that they were in no doubt that while it was almost impossible to know what individual beneficials were doing, their presence meant that they would be 'comfortable leaving 1 or 2 very small Heliothis per metre for another check to see if they were being taken out'. A small number of growers reported that they were changing defoliation insecticide application strategies to assist beneficials to survive for the winter.

In the Gwydir and Namoi Valleys, it was reported that traditional approaches to managing insects by neighbours made it difficult to stay with an IPM program. As in all valleys, consultants and growers expressed difficulty 'using \$80 sprays early in the season', with some growers arguing that beneficials can be intermittent in the field and that expensive chemistry was 'a waste if there is nothing there to preserve anyway'.

The Macquarie Valley and Southern NSW expressed the range of views reported above, also highlighting that there is sometimes a 'lack of soft options' available. Sustained early pressure was seen as a major inhibitor to IPM strategies fitting in with budgetary constraints.

Grower impressions of Area Wide Management Groups are presented in Table 9. In summary, growers are very supportive of AWMs in principle but commented in the group discussions that they can be difficult for a number of reasons. Problems centred around the lack of communication once the season was going in earnest; *"We all get together before the season starts, then again once we have put out our first bit of water, but then nobody seems to have time to get to meetings, and I include myself in this."* Generally the feeling was that people went into the season with the right intentions, however unexpected or persistent pressure found individuals acting autonomously. Figure 4 demonstrates the "costs of being in AWMs". This figure shows that adverse opinions have an impact with approximately one in three growers finding the hassles being greater than the benefits.

Growers were asked to consider the future for insecticides that are specific to certain pests. Their responses are listed in Table 10. Clearly the responses of growers to questions on NPV's are very supportive, but show that they are acutely aware of the cost associated with using these products. In the focus groups it was said that IPM is vital to a large part of the industry, chemistry that targets specific pests will be important in the future to preserve beneficials and extend the usefulness of cheaper knockdowns that have a perceived softer impact. The example that was often given in this role was Endosulfan. Consultants also highlighted the role that chemicals of this type will have with crops other than cotton.

Table 9. Area Wide Management Groups are?

Cecil Plains	Hard to get going.
Macalister	Neighbours getting together and fixing a strategy together.
Warra	Of benefit.
Dalby	Good if like-minded.
Dalby	Essential.
Dalby	Good for the general image of the cotton industry.
Dalby	Useful strategy.
Darling Downs	Helpful - big picture.
Darling Downs	Useful.
Dalby	Good.
Cecil Plains	A good idea.
Darling Downs	Dodgy science.
Brigalow	Very important.
Chinchilla	Not possible.
Darling Downs	Good for IPM.
Cecil Plains	Essential.
Jimbour Plan	Good.
Darling Downs	Large IPM groups.
Dalby	Good for insect control.
Dalby	Helpful.
Downs-Brookstead	Good if active.
Jimbour	Growers and consultants working together for crop management.
Dalby	A good idea.
Darling Downs	Good for IPM strategies.
Dalby	Alright.
Dalby	Good for IPM.
Darling Downs	Working well.
McIntyre	Important for IPM program.
McIntyre/Mungindi	Useful.
McIntyre	Very effective.
McIntyre	Important to share information.
McIntyre	Necessary IPM.
McIntyre	Excellent.
McIntyre	A necessity for IPM to work.
McIntyre	A key to IPM.
Mungindi	Not very applicable to me as I am relatively isolated from other cotton farms.
Mungindi	Vital to IPM.
St George	Beneficial.
St George	Beneficial.
St George	Informative and interactive.
Gwydir	Beneficial.
Gwydir	Useful.
Gwydir	Very informative.
Namoi	Don't know - no experience.
Lower Namoi	Essential.
Upper Namoi	Worthwhile.
Namoi	Useful.
Lower Namoi	Groups of farmers following the same.
Lower Namoi	Group of farmers following a strategy.
Lower Namoi	Good where strategies are upheld; hard to manage.
Upper Namoi	Worthwhile.
Lower Namoi	A good idea, if all neighbours are interested.
Lower Namoi	Variable in terms of usefulness.

Table 10. In the future, insecticides that are specific to certain pests (eg NPV) will be?

Cecil Plains	Very important.
Macalister	Useful in IPM to target just the problem pests.
Warra	Used more widely by non-cotton growers.
Dalby	Very good in IPM and controlling resistance.
Dalby	Used to protect beneficials.
Dalby	More common; expensive and in wide use.
Darling Downs - Dalby	Good to take pressure off current chemicals.
Darling Downs	Soft on predators; easy to apply; expensive.
Darling Downs	The main insecticides used with Ingard technology and aid in conventional technology.
Cecil Plains	Indispensable.
Darling Downs	Very important to keep the GM technology from overwhelming the industry - organic and GM-free cotton will have a place in the industry.
Brigalow	Some of the main weapons against problem insects.
Darling Downs	Considered normal practice.
Jimbour Plan	Essential.
Darling Downs	Good.
Dalby	Excellent because they won't harm beneficials.
Downs-Brookstead	Critical to IPM to target the pest species only.
Jimbour	Most important.
Dalby	More important.
Darling Downs	More popular as there will be more products available.
Dalby	Expensive.
Dalby	More widely used.
Darling Downs	Used more frequently but will have to be monitored so resistance won't occur.
MacIntyre	Good in high pressure years of certain pests.
MacIntyre	A great tool and looking forward to seeing it.
MacIntyre/Mungindi	An important tool.
MacIntyre	Hopefully cheaper so they can be more widely used.
MacIntyre	Very beneficial.
MacIntyre	More available.
MacIntyre	Essential.
MacIntyre	Hopefully cheaper.
Mungindi	Expensive to me but has a place. NPV is not very effective in cotton in my experience.
Mungindi	More dominant in the market.
St George	A management tool.
St George	Vital.
Gwydir	A useful tool in IPM and saving beneficials.
Gwydir	Even more useful.
Gwydir	Increasingly important.
Namoi	In most cases increasingly important.
Lower Namoi	An important part of IPM.
Namoi	Expensive and common.
Namoi	More readily used and pushed.
Lower Namoi	An important part of crop management.
Lower Namoi	An important part of IPM.
Lower Namoi	Useful in biotech crops.
Lower Namoi	Expensive but necessary in the overall strategy.

2.4.1. Conclusion

This section presented information from focus groups with growers and data from the first annual Grower Context Survey. This survey, conducted with the support of members from Cotton Consultants Australia Inc., has provided a unique insight into the thoughts of growers across a range of topics, related to IPM and an overview of these are presented. In summary IPM was seen to deliver economic benefits by a majority of growers with the exception of a small number in the southern areas. Around 40 per cent of growers were prepared to persist with "soft products" when non-selective chemistry had been used nearby, and on a related issue, around a quarter of all growers surveyed felt that hassles associated with Area Wide Management groups outweighed the benefits, less in the northern regions and more in the south.

Growers were canvassed about what can make it difficult to follow an IPM strategy. Typically, the high cost of soft products, neighbours using disruptive chemistry, and product-fit problems were mentioned. Variation was observed between regions, often relating to the type of farming systems surrounding the cotton fields.

Problems associated with membership of Area Wide Management Groups were canvassed showing that a range of issues were important. The single biggest factor centres on communication methods and exasperation associated with a lack there of! Generally growers in focus groups were keen to see them succeed and appeared to welcome the assistance of consultants, industry personnel and chemical companies in getting growers together. The trade-off between ownership/empowerment and actually getting together (with outside help) was evident.

Selective insecticides were generally considered to be the way of the future, and while expensive chemistry needed to be used prudently, maintenance of beneficials was considered to be paramount by the majority of growers present in the focus groups.

3. AN IPM TYPOLOGY OF GROWERS

Further analysis of the data from the GCS was undertaken to examine the differences between growers based on their measured commitment to IPM principles. Figure 9 displays the questions used to compile the "IPM Commitment Indicator". Scores were given as 1 for "Totally Agree" through to 5 for "Totally Disagree". Scores were reversed for the second statement such that someone who totally disagreed with the notion that it was not worth persisting with soft chemistry was given a score of 1 and someone who totally agreed was given a score of 5.

The scores for the two statements were summed and the frequency table of scores for growers who answered both questions is presented in Figure 10. This figure shows the groupings of growers based on these summed scores. Three classifications of growers were developed:

1. Committed IPM Grower
2. Strategic IPM Grower
3. Uncommitted or Non IPM Grower

CCA IPM Report Figure 9.

Attitude Questions used to distinguish IPM Commitment Level

(13) There are a range of views held by growers with respect to various trends and practices that form current thinking in the industry today. Please give your opinion on the following statements by indicating your level of agreement or disagreement.

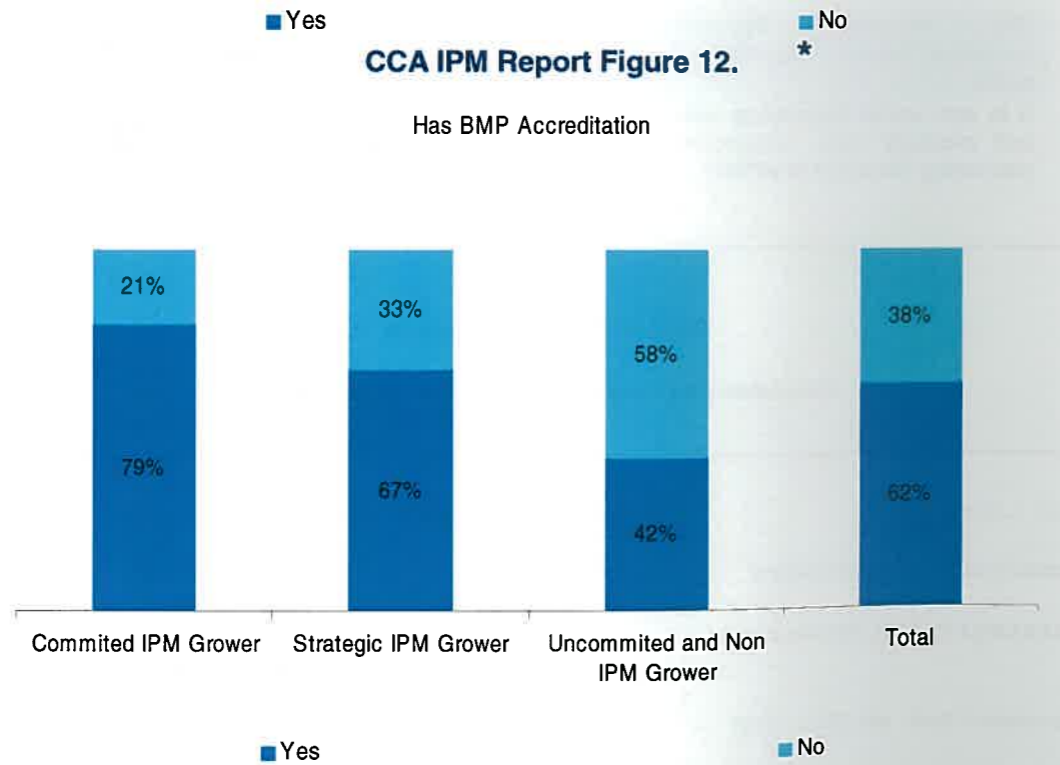
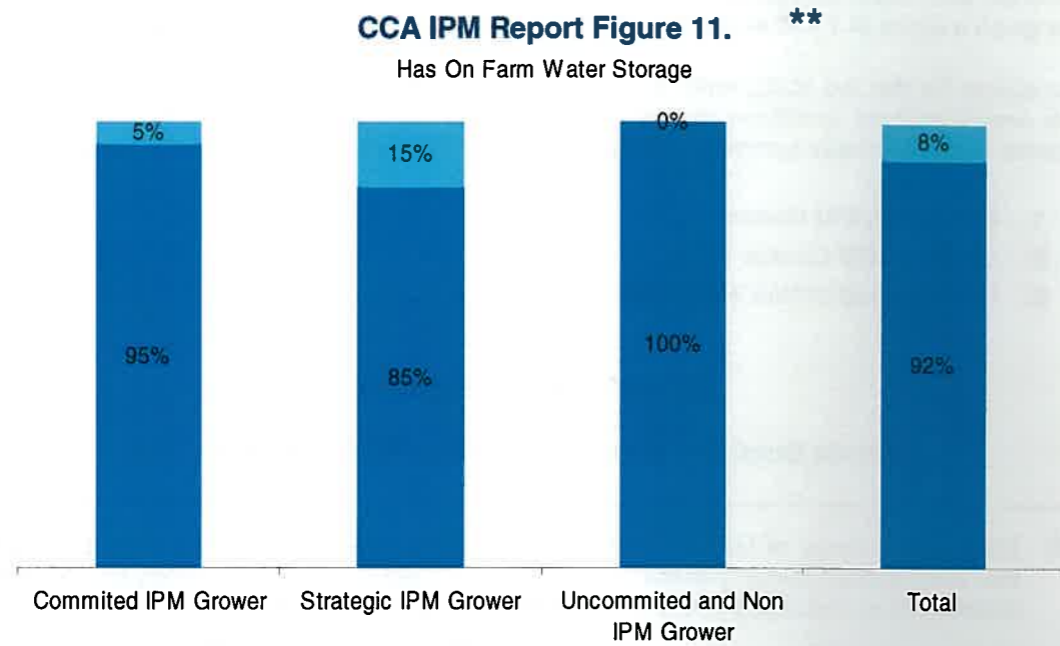
	Totally agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Totally disagree
IPM normally delivers economic benefits across our areas.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is not worth persisting with soft products once neighbours start using disruptive chemistry.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CCA IPM Report Figure 10.

Frequency of summed scores for "IPM Questions"

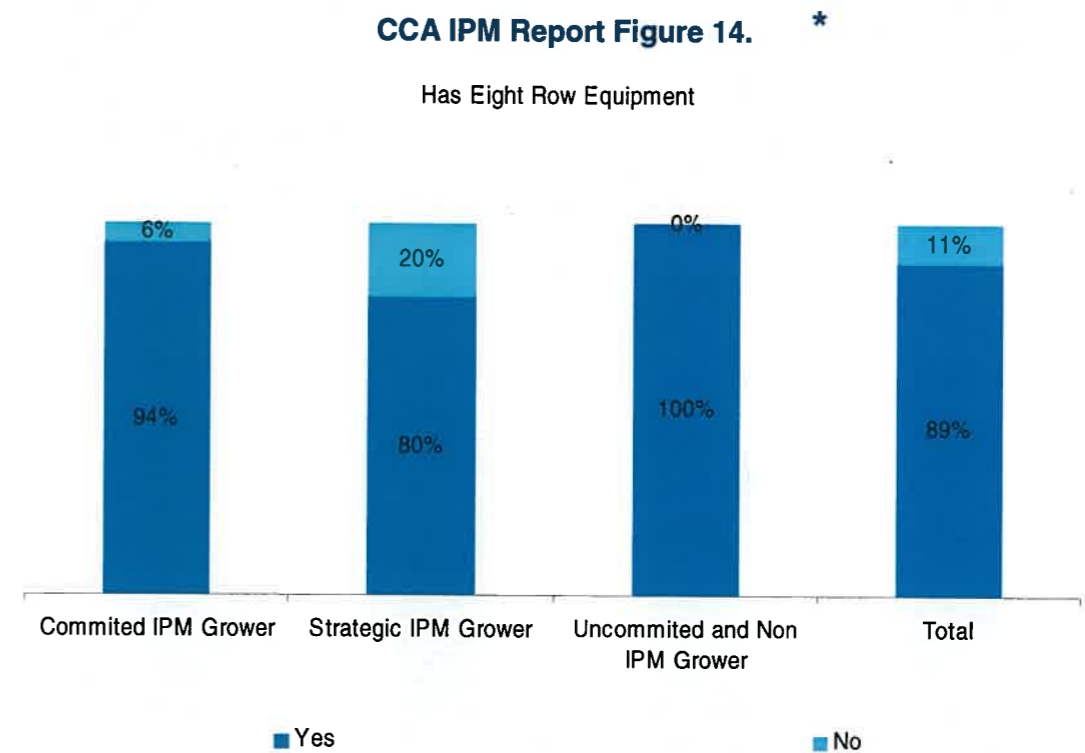
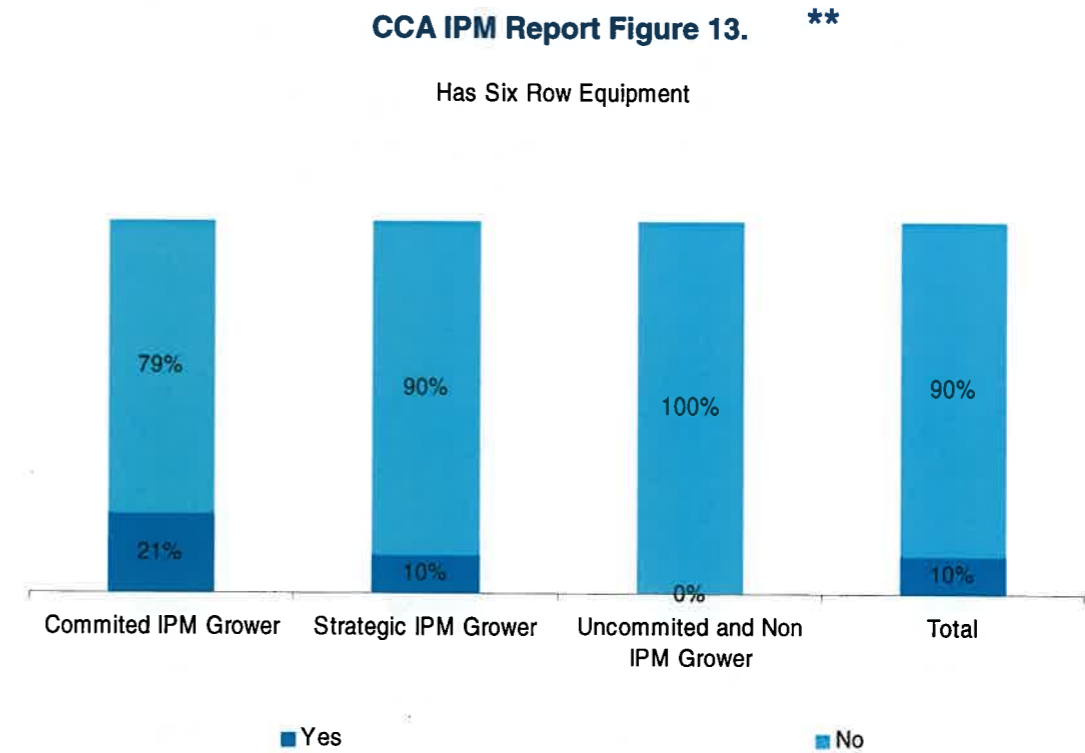
Value Label	Score	Frequency	Percent	Valid Percent	Cum Percent
Committed IPM Growers	2.00	6	7.2	7.2	7.2
	3.00	13	15.7	15.7	22.9
	4.00	18	21.7	21.7	44.6
Strategic IPM Grower	5.00	22	26.5	26.5	71.1
	6.00	14	16.9	16.9	88.0
	7.00	6	7.2	7.2	95.2
Uncommitted or Non IPM	8.00	3	3.6	3.6	98.8
	9.00	1	1.2	1.2	100.0
Total		83	100.0	100.0	
	Valid cases	83		Missing cases	0

Figures 11 through 14 provide an overview of results for various situational or growing context questions in the GCS, where differences between the IPM Commitment Groups were significantly different¹. Figure 11 shows that marginally fewer strategic IPM users have water storages on farm. Figure 12 shows a strong positive relationship between IPM and the industry's Best Management Program (BMP).



¹ Test performed was the Pearson's Correlation Test yielding a Chi Square statistic. One star (*) Indicates a significance of +/- 5%, two stars (**) Indicates a significance of +/- 10%

Figure 13 and 14 show that marginally more Committed IPM Growers use six row equipment, while less Strategic IPM growers have eight row equipment. While not presented here, the data indicates that 11 per cent of Committed and 15 per cent of Strategic IPM growers have twelve row equipment. Interestingly, all of the Uncommitted and Non IPM growers had 8 row equipment only.



Attitudinal statements were used to measure the thoughts of growers in relation to a range of topics. Results for those statements that had statistically significant differences are presented in Figures 15 through 21. Figures 15 and 16 outline the responses of growers to the two statements used to build the IPM Commitment Indicator, hence they are highly significant. Figure 15 shows that 78 per cent of growers agree that IPM delivers an economic benefit. Looking at the groups, 100 per cent of the committed IPM growers agree, 85 per cent of the Strategic and only half the Uncommitted and Non IPM Growers.

CCA IPM Report Figure 15. *

IPM normally delivers economic benefits across our areas

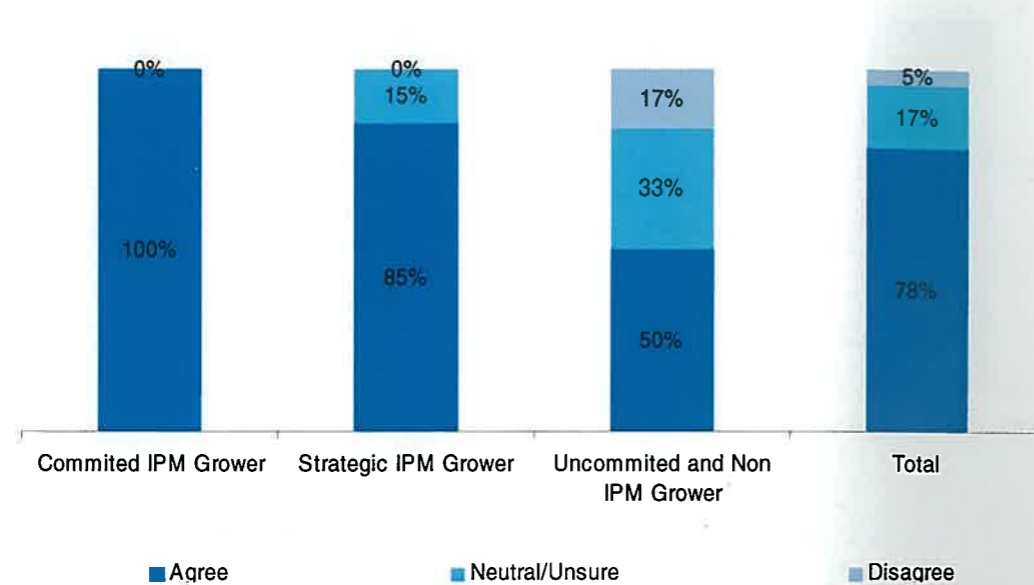
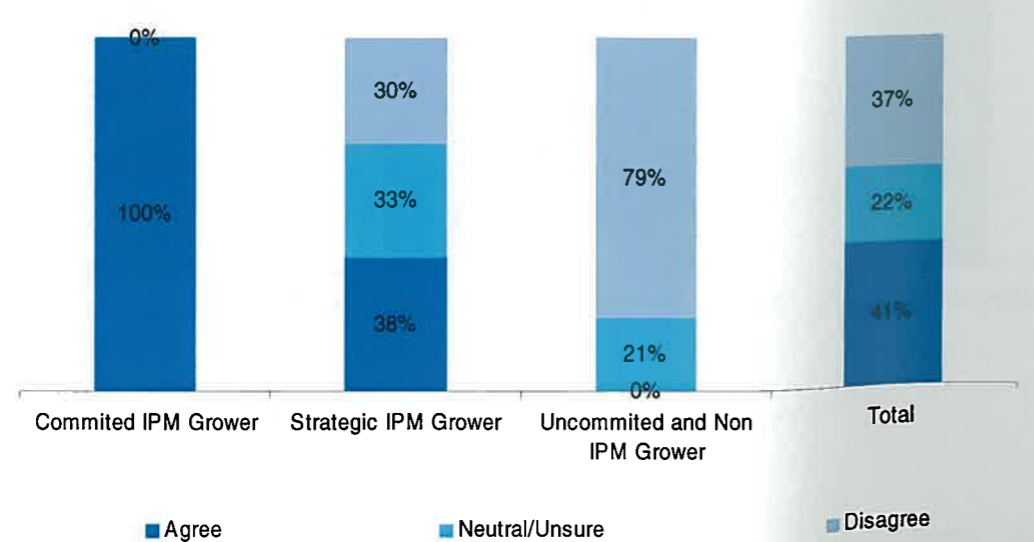


Figure 16 shows the attitude of growers to the use of expensive selective insecticides when the soft strategy has been compromised. The data show that 100 per cent of Committed IPM growers will continue to use soft chemistry as opposed to the Strategic IPM Grower, where only 38 per cent agree. Four out of five Uncommitted and Non IPM growers disagree with the statement, and would stop spraying soft products once disruptive chemistry had impacted on the beneficial populations in their crops.

CCA IPM Report Figure 16. *

It is worth persisting with soft products once neighbours start using disruptive chemistry.



As shown in Table 9, growers agree that area wide management is a worthwhile, if not an essential activity for planning pest management strategies. Uncoordinated spraying of disruptive chemistry in a district can make various soft options unworkable. Figure 17 shows that there is a relationship between commitment to IPM and preparedness to put up with the hassles of being involved.

CCA IPM Report Figure 17. **

Area Wide Management groups can be difficult to be part of; I find that the hassles outweigh the benefits.

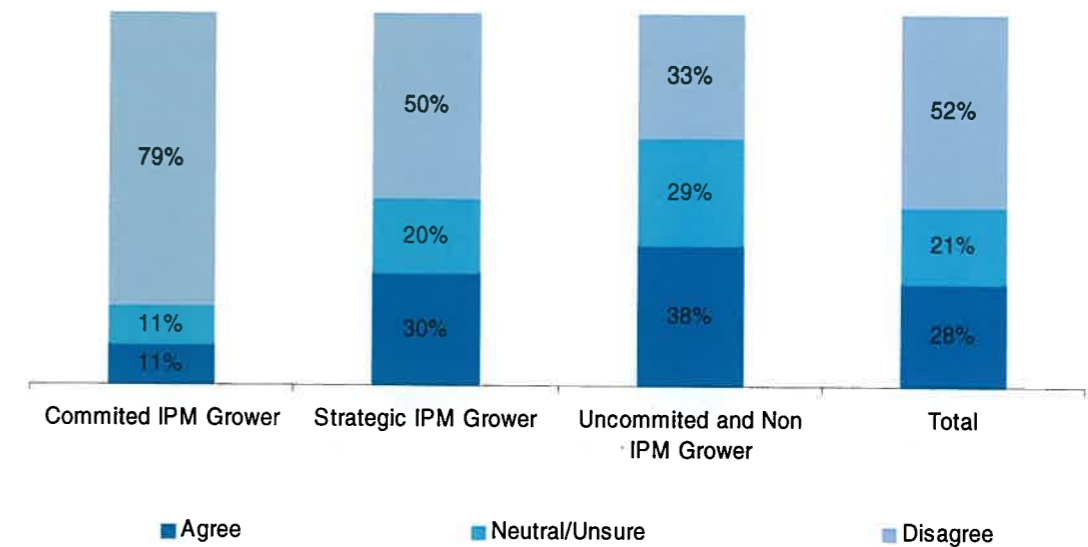
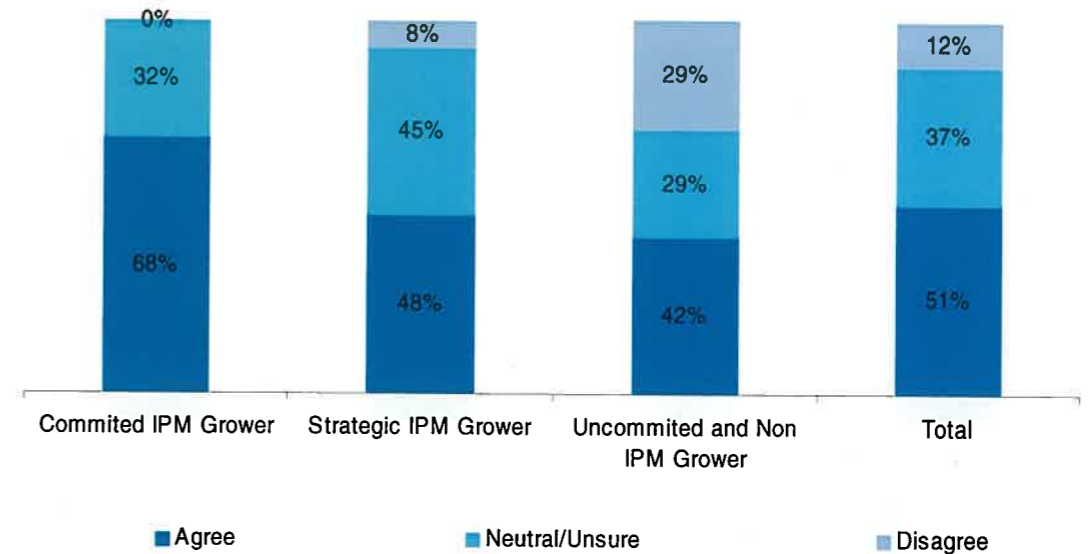


Figure 18 shows that Committed IPM Growers are also more ready to accept that new Biotech products will contribute to profit.

CCA IPM Report Figure 18. *

I can see that the new Biotech products that are coming into the industry will make me more profitable in the medium term.



In keeping with the IPM philosophy, committed growers will not limit the use of soft chemistry when budgetary constraints are imposed. Interestingly, only 17 per cent of all growers agreed with the statement suggesting that soft chemistry is good value for money for at least four out of five growers.

CCA IPM Report Figure 19. *

When things are tighter than normal, I try to limit the use of expensive soft insecticides that promote beneficials.

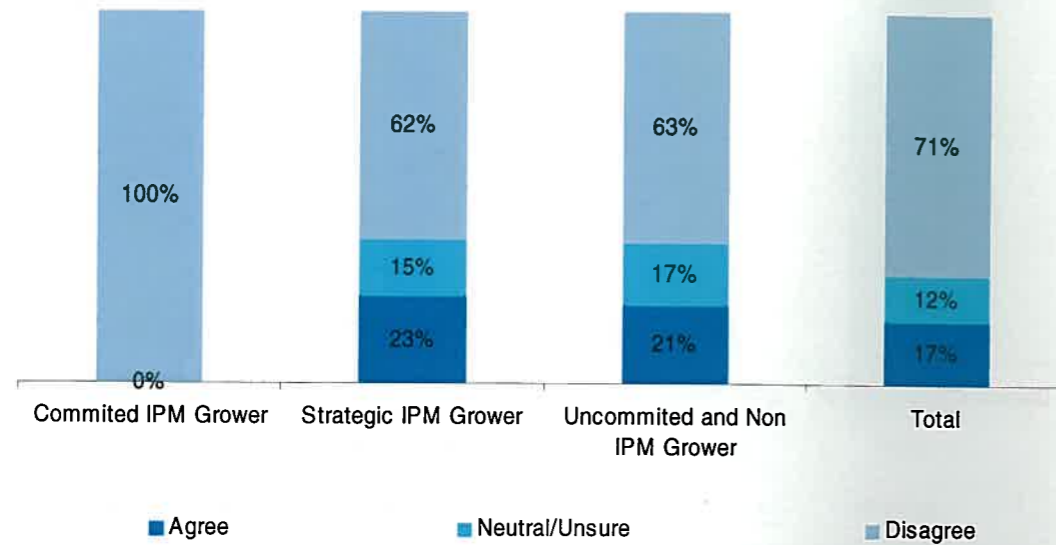
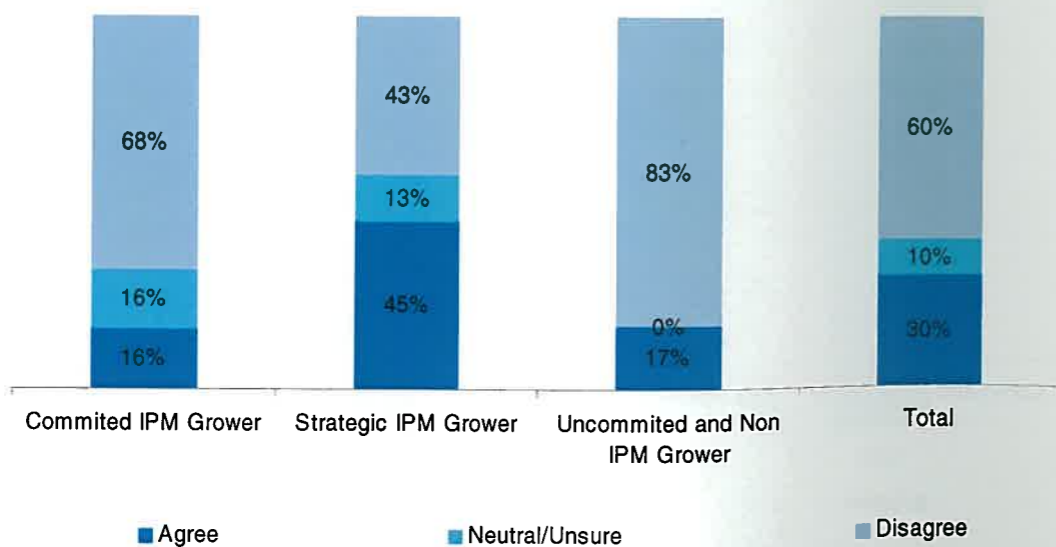


Figure 20 shows that around one third of all growers make decisions in relation to weed management without the assistance of consultants. Less Committed IPM Growers were of this opinion, while almost half of the Strategic IPM growers agreed.

CCA IPM Report Figure 20. *

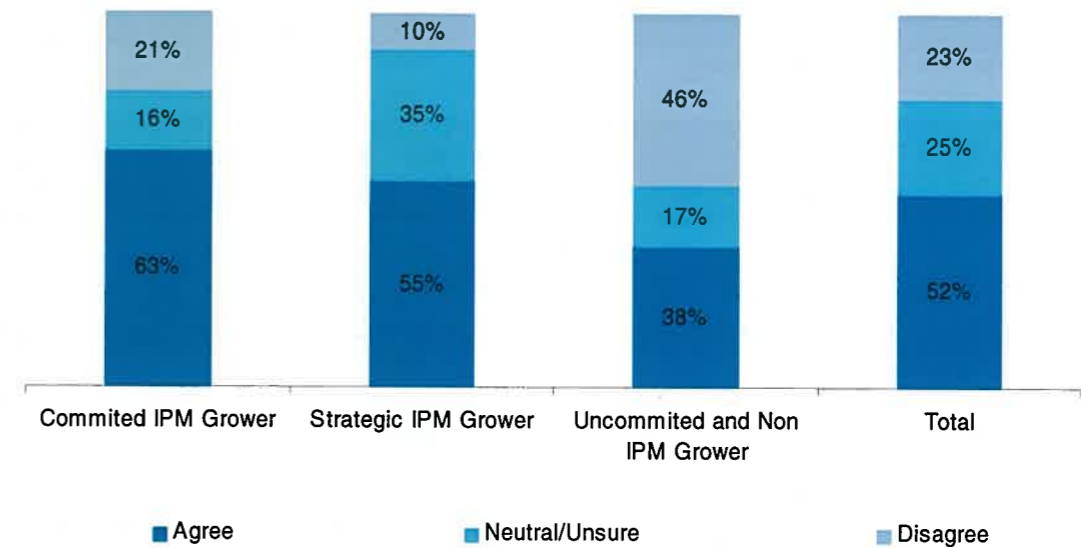
Generally I make decisions in relation to weed management without a lot of input from my consultant.



The opinions outlined in Figure 21 confirm the attitudes to risk that can be characterised as being evident in those producers who are committed IPM growers. 63 per cent of these growers are prepared to accept that the benefits of new products and practices outweigh the risks of early adoption compared to 38 per cent of uncommitted and non IPM growers.

CCA IPM Report Figure 21. *

Generally, the benefits of new products and practices outweigh the risks in trying them in the field.



Figures 11 through 21 show how a range of situational and demographic factors were different between the groups constructed in this section. Examination of figure 20 shows that from the point of view of outside influences on decision making, Strategic growers are different to other growers in that they use their consultant less in weed management decisions. Committed growers use them considerably more. Table 11 will show that Committed IPM growers have larger irrigation enterprises and more cotton on average than Strategic Growers, but does this alone explain the expanded use of the consultant, or is it an artefact of their relationship on other management aspects including IPM? The expanded role of the consultant on Committed Growers' farms may be the reason why these growers are prepared to accept the benefits of IPM, however this cannot be shown categorically here as a direct linkage was not investigated in the survey.

Table 11 outlines the responses for supplementary variables covered in the GCS, grouped on IPM orientation. This information demonstrates that there are differences between groups in terms of their demographic and contextual situations; however this variation was not statistically significant for the sample across these variables. Examination of the table reveals that on average IPM growers are more likely to have larger cropping and irrigation areas than strategic or uncommitted growers.

The data also indicate that committed IPM growers have a larger area committed to cotton in both the 2002 and 2003 seasons, less area in winter cereals in 2002 and larger areas in 2003 than other types of growers. Little variation between groups was apparent in terms of reported average cotton yield.

In terms of the sources of irrigation water, committed IPM growers were slightly above the average for all growers with respect to their supply from regulated rivers. A higher proportion of their water came from unregulated supply than other growers, and they had the lowest proportion of water supply from ground water.

A larger proportion of committed IPM growers applied chemicals using their own ground rigs (33 per cent) with around a quarter of both committed and uncommitted growers applying by ground using contractors. The highest proportion of any group using air application were the uncommitted growers where 55 percent of applications were by air.

Table 11. Means and Standard Deviations for Variables with Continuous Data

	Committed IPM Grower	Strategic IPM Grower	Uncommitted IPM Grower	Total
Average Year of Birth	1961 (11) ²	1962 (9)	1958 (11)	1960 (9)
Average Year First Involved in Cotton	1988 (8)	1987 (7)	1985 (8)	1986 (7)
Average Education Level ³	3.00 (1)	2.64 (1)	2.77 (1)	2.75 (1)
Total Hectares - Cropping Enterprises	4712 (7427)	2485 (3014)	3187 (4054)	3198 (4678)
Total Irrigation Area	1978 (2623)	1483 (2601)	1378 (2250)	1567 (2487)
Cotton Area 2001/2002	1014 (1443)	861 (1352)	805 (1490)	879 (1398)
Winter Cereals 2001/2002	403 (562)	429 (708)	1109 (1585)	619 (1054)
Cotton Area 2002/2003	727 (1166)	535 (808)	422 (568)	545 (843)
Winter Cereals 2002/2003	909 (1981)	204 (292)	501 (876)	451 (1093)
Cotton Yield 2001/2002	7.86 (2.0)	7.70 (2.3)	7.63 (1.9)	7.71 (2.1)
Cotton Yield 2002/2003	7.23 (2.1)	7.22 (2.6)	7.74 (2.4)	7.36 (2.4)
Irrigation Water from Regulated Streams or Rivers	67% (37)	63% (41)	66% (39)	64% (39)
Irrigation Water from Unregulated Streams or Rivers	17% (34)	11% (21)	10% (29)	12% (26)
Irrigation Water from Ground Water	16% (22)	22% (30)	20% (30)	20% (28)
Spray Applications by Ground Rig (using own equipment)	33% (32)	30% (29)	21% (24)	27 (28)
Spray Applications by Ground Rig (using contractor)	24% (26)	19% (25)	25% (25)	21% (24)
Spray Applications by Air	44% (24)	44% (25)	55% (24)	47% (24)

² Standard deviations reported in brackets directly below each average figure.

³ 1=Year 10 or Below, 2=Finished High School, 3=Some Tertiary Study, 4=Finished Tertiary Study

3.1. Demographic and Contextual Influences on IPM

In the previous section, growers were segmented on the basis of their commitment to IPM and the difference between these groups across a range of variables was examined. To create a deeper understanding of the typologies developed and their relationship with the contextual and demographic situations, discriminant analyses (Tabachnik and Fidell, 1989) was conducted.

The overall statistical significance of the analysis is summarised in table 12. An examination of this table reveals that two statistically significant discriminant functions were identified. These two functions accounted for approximately 99 per cent of the variance in the data. The nature of these two functions can be interpreted by reference to table 13. This table contains the correlations between each of the discriminant functions and the individual variables used in the analysis.

Table 12. Canonical Discriminant Functions

	Function One	Function Two
Eigenvalue	1.15	0.54
Variance (%)	68.07	31.93
Canonical Correlation	0.73	0.59
Wilks' lambda	0.3	1.6
Chi-square	78.25	28.22
Probability	0	0.02

Table 13. Pooled Within Group Correlations

	Function 1	Function 2
BMP Accreditation	0.31	0.02
Area Wide Management groups can be difficult to be part of; I find that the hassles outweigh the benefits	0.29	-0.25
I can see that the new Biotech products that are coming into the industry will make me more profitable in the medium term	0.27	
Generally, the benefits of new products and practices outweigh the risks in trying them in the field	0.26	
Year of Birth	-0.22	
Six Row Equipment	0.21	
Generally I make decisions in relation to weed management without a lot of input from my consultant	-0.22	0.52
When things are tighter than normal, I try to limit the use of expensive soft insecticides that promote beneficials	-0.21	-0.38
Eight Row Equipment		0.37
I find that when we spray Helicoverpa, speed of action is what I need from the products I use		-0.32
On Farm Water Storage		0.28
Using residual chemicals on Helicoverpa normally delivers the greatest benefits on this farm	-0.21	-0.22

The first function is clearly correlated with BMP accreditation, acceptance of Area Wide Management and preparedness to accept risk associated with new products and approaches to management. The second function shows the influence of the use of consultants in weed management decisions (use of consultants over a wider range of decisions than insecticide applications only), the continuing use of soft insecticides when economic conditions are tight, and, the preference for residual chemistry rather than a fast knockdown.

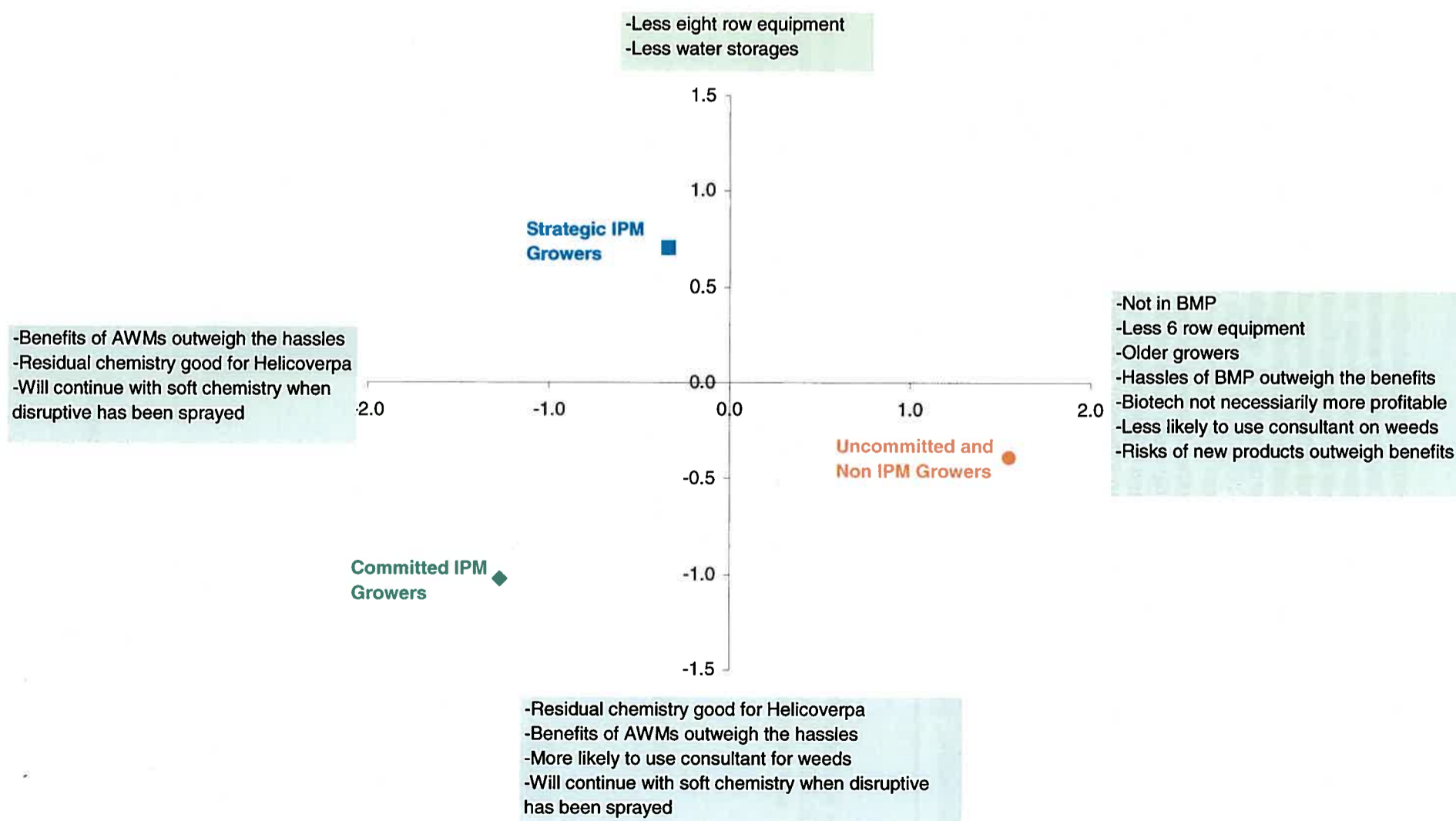
Figure 22 provides a graphic overview of this analysis, placing the IPM groupings in the diagram in relationship to their correspondence with the variables listed. The placement of Committed IPM growers in the bottom left corner finds them in agreement with the sentiment of the variables at the bottom and left of the diagram. Strategic IPM growers tend to differ in that they are less associated with the variables at the bottom of the diagram. The Uncommitted and Non IPM growers are distinguished by their association with the variables listed in the rightmost box.

Table 14 provides an overview of the explanatory power of the analysis, that is, the reliability of the discriminant analysis is given by the capacity of the analysis to correctly classify growers into groups. In excess of 80 percent of growers have been correctly classified, this is substantially greater than the 33 per cent of cases that would be expected to be correctly classified on the basis of chance alone and represents a substantial proportional reduction in error.

Table 14. Classification Results

Actual Group	No of Cases	Predicted Group Membership		
		Committed	Strategic	Uncommitted
Committed IPM Grower	17	13 76.50%	4 23.50%	0 0.00%
Strategic IPM Grower	37	3 8.10%	29 78.40%	5 13.50%
Uncommitted and Non IPM Grower	22	2 9.10%	0 0.00%	20 90.90%

CCA IPM Report Figure 22. Influences on IPM Commitment Levels



3.1.1. Conclusion

In this section, data from the Grower Context Survey were used to develop groups of growers that described their commitment to the IPM philosophy of growing cotton. Responses to whether growers felt that IPM delivered an economic benefit and the value of soft products when disruptive chemistry had been used nearby were used to construct three groupings; Committed, Strategic and Uncommitted or Non IPM growers. These different types of growers were then contrasted across a range of questions from the survey to look for variation in the responses.

Statistically significant differences were observed across 11 demographic and contextual variables. The strongest relationship was evident in relation to BMP accreditation, acceptance of new biotech solutions and risk associated with new products and the scope of use of consultants in management. An argument for considering the role of the consultant in positively influencing perceptions of IPM was put forward in this section.

Using discriminant analysis, a deeper understanding of the typologies developed was sought. This analysis showed that considerable statistical weight can be placed on the relationship between BMP accreditation and the expanded role of the consultant in positively influencing commitment to IPM principles. There were a range of other variables correlated with group membership, these generally supported the IPM philosophy.

4. CONSULTANTS AND IPM

IPM continues to be the central methodology and strategy that is used to drive the decisions on chemical selection and crop management by an increasing number of growers. Consultants estimated that 50 per cent of the growers that they consult to were managing their farms using IPM principles. This was confirmed independently when growers were asked in the focus group questionnaire to list the three most important things to consider when making a decision on an insecticide application. In response, 56 per cent mentioned IPM as one of the top three reasons. Table 15 presents the data for the percentage of consultants who followed IPM for 2000-2001 and 2001-2002 and, as described above, for the 2002-2003 season the reported percentages are based on consultants' estimates of their growers.

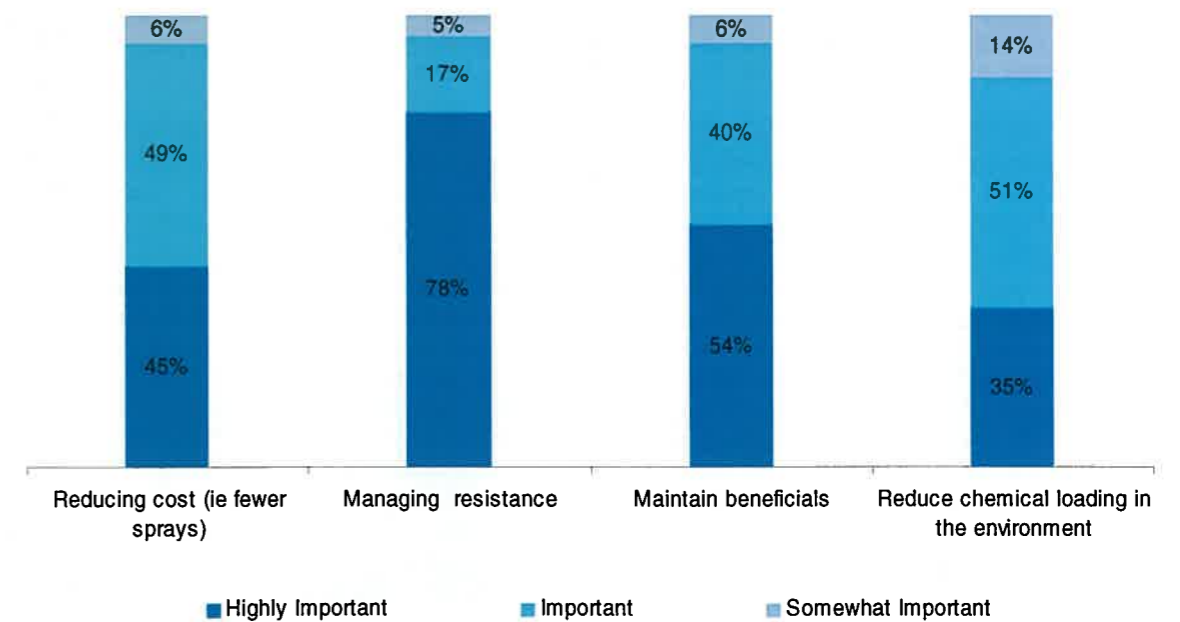
Table 15. Estimate of Growers Following IPM Guidelines

	2000-2001	2001-2002	2002-2003
Yes, totally	12%	38%	50%
Most of the time	70%	62%	42%
Some of the time	18%	0%	8%

Consistent with the result for the 2000-2001 season (78%), management of resistance was the reason rated as being highly important by 69 per cent of respondents for the 2002-2003 season (Figure 23). The other reason consultants rated highly in 2002-2003 was the maintenance of beneficials (60%), up from 54 per cent in last year's results.

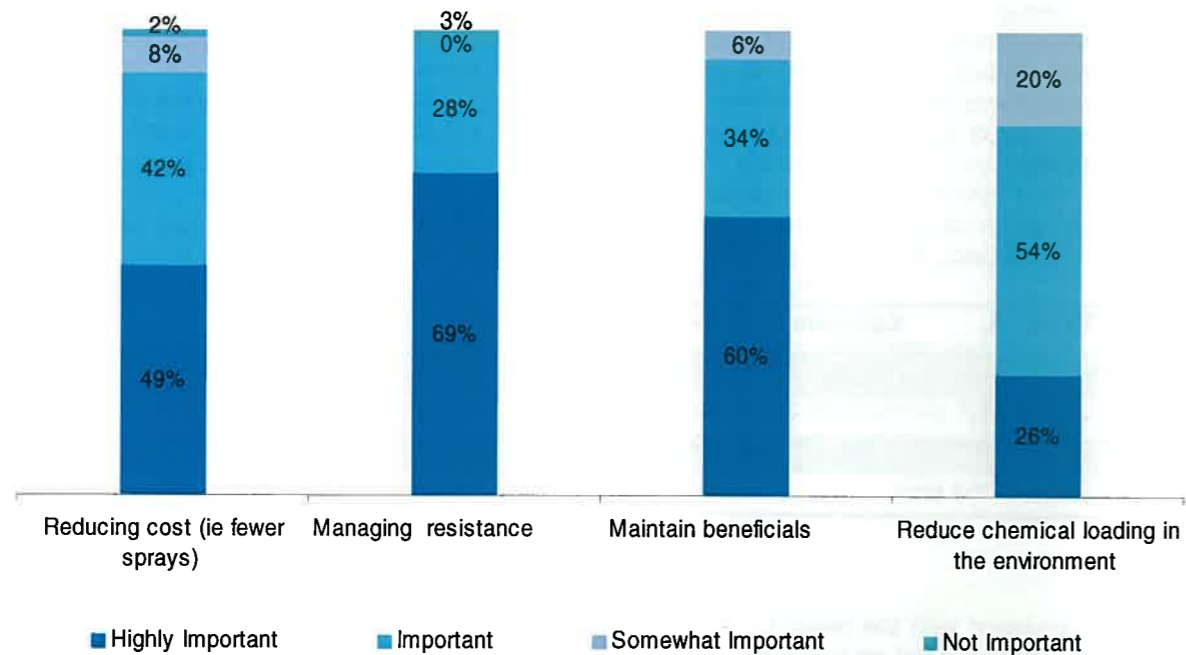
CCA IPM Report Figure 23.

Rating of the importance for following IPM for each stated reason - 2001 - 2002



CCA IPM Report Figure 24.

Rating of the importance for following IPM for each stated reason - 2002 - 2003



The importance of suggested reasons for following IPM guidelines during the 2002-2003 season can be observed. In order of importance, resistance, beneficials and reducing cost are all rated above reducing chemical in the environment, when the ratings are weighted and tabulated in aggregate. Comments for this question are presented in Table 16. A pertinent comment from a Gwydir Valley consultant touches on the practicalities of following any strategy, as was often re-inforced in the focus groups:

IPM allows us to get the best gross margin through managing costs and yield. All the other benefits are very important (environment, beneficial insects, resistance, etc), however it is difficult to be environmentally conscious when your bank balance is in the red. That is why gross margin is so important.

Table 17 highlights the aspects of IPM that consultants find most difficult to rationalise or deal with in practical terms. These include periods of sustained pressure, uncooperative growers, secondary pests, mounting costs of continuing soft sprays, "hard spray" strategies on neighbouring farms and IRMS restrictions.

Responses to the question "Area Wide Management Groups Are.....?" can be found in Table 18. Generally, the responses are positive in terms of what consultants want to see from the groups. In practice, the discussion in focus groups suggests that indeed there are general improvements in the functionality of some AWMs but there is still plenty of room for improvement. A range of the comments on problems with IPM listed in Table 17 are issues that can be addressed by AWMs when they are all encompassing and functioning well in terms of mid-season communication. Improvements to all aspects of AWMs are being strived for by growers. Consultants expressed the need for the groups to belong to and empower growers themselves. Hence a number of consultants tend to let the workings of AWMs dictate the level of their involvement. In other words, some consultants will contribute when asked to by the AWM, sitting back at other times so as not to be seen to dominate the groups. Consultant members of other AWM groups were very much hands on in their relationship with growers, and felt that they were the main driver of outcomes.

Table 16. Can you rate the importance of reasons for following IPM.

Capricorn	We follow IPM where possible. However, this is dependent on Helicoverpa levels.
Capricorn	IPM is needed to economically produce an environmentally sustainable result for now and in the future.
Darling Downs	To be profitable and sustainable.
Darling Downs	Reducing costs and maintaining beneficial insects are within season objectives, whilst managing resistance is an overhanging principle for the long term.
Darling Downs	IPM can fall apart if you receive sustained moderate to high pest pressure. New products are more selective than the 'old' chemicals but do reduce beneficial numbers if used regularly (and alternatively as stated in the IRMS).
Darling Downs	It is all IPM by degrees, depending on pest pressure.
Gwydir	IPM has been seen to work reasonably well in the Macintyre Valley over the last few years. What needs to be established now is the question: "Is it returning more money to the grower (i.e. better gross margin) or is it just lowering pesticide use?" When you compare the Gwydir Valley to the Macintyre the yields in the Gwydir appear to eclipse the Macintyre, however there are better returns available to the grower in the Gwydir for employing intensive chemical use. Also, what will happen when, and if, we find ourselves in the high-pressure insect infestations of several years ago? Will IPM still be financially viable compared to more conventional methods of control? Also how effective will Bollgard II be if there is no food source for predators because all Helicoverpa have died.
Gwydir	IPM allows us to get the best gross margin through managing costs and yield. All the other benefits are very important (environment, beneficial insects, resistance, etc), however it is difficult to be environmentally conscious when your bank balance is in the red. That is why gross margin is so important.
Gwydir	IPM does not necessarily reduce costs; it only gives the potential to use fewer sprays. The chemicals involved are very expensive.
Macintyre	IPM is here to stay in this area regardless of high- or low-pressure years, price of cotton etc. Once you have farmed this way there is just no going back to the conventional ways.
Macintyre	IPM is the basis of pest management on all my farms
Macintyre	Sustainability of the cotton industry and improving image of the industry amongst communities.
Macquarie	Ensuring that resistance is reduced to ensure that Helicoverpa do not limit cotton yields.
Macquarie	Reducing costs is the primary driver in adoption of IPM.
Southern NSW	Maintaining IPM is crucial in our cropping system to gain the most out of our sprays and to minimise any chance of developing chemical-resistant insects.
St George/Dirranbandi	Maintenance of beneficials is the number one priority when selecting 'soft' option, and then other benefits will hopefully follow; i.e. decreased costs; resistance management and less chemical loading of the environment.
Upper Namoi	Due to the high cost of most beneficial friendly chemicals & hence those favoured in IPM programs, I do not believe that reduced cost is a result of IPM practices, however reduced sprays may well be a very environmentally positive result.
Upper Namoi	Growers do not always appreciate IPM or its benefits.
Upper Namoi	I.P.M costs more, but growers understand that they have no choice, they (farmers) can't just stay on the chemical treadmill.

Table 17. What can make it difficult to follow an IPM strategy?

Brookstead	Differing neighbour strategies. Resistance and application problems. Lack of refugia.
Brookstead/Chinchilla	Lack of soft chemistry for secondary insects.
Darling Downs	1. If the pressure is constant, prolonged and high. 2. If environment/weather conditions are not favouring softer options. 3. If other growers/consultants are having difficulties and need to use more broad spectrum insecticides.
Darling Downs	Insect pressure and lack of beneficials not having reason cost options for sucking pest control.
Darling Downs	Very high pressure; high secondary pest pressure; suck up tools.
Darling Downs	High pressure, high cost of soft products, loss of beneficials.
Darling Downs	Continual heavy pressure lowering its effect of the softer options. The expense of the softer options in a continually heavy pressure period.
Darling Downs	Heavy secondary pests with no soft options.
Darling Downs	If a grower decides they wish to use cheaper chemistry which is often harder on beneficials.
Darling Downs - Dalby	Pests which are not allowed for in the IPMs, ie tip worm or excessive sucking insect pressure which cannot be controlled by softer options. Also grower attitudes.
Gwydir	Secondary pests, staying within the IPMs in very sensitive areas.
Gwydir	Rotation of products in sensitive areas (rivers, towns, houses).
Gwydir	Continual aphid pressure, tipworm, expense.
Gwydir	Cost of sprays already applied to that field in the season, if a number of pests are being targeted, if pressure is high and spray turn-around is quick.
Gwydir	Neighbours and their spray uses, Heliothis pressure, secondary pest pressure.
Gwydir	When you get to restrictions on 2 consecutive chemical uses. When you find that neighbours have used harsh chemicals when you are still trying to stay soft.
Gwydir	Neighbours, inflexible IRMS, secondary pests.
MacIntyre Valley	Grower participation.
MacIntyre Valley	Cost of control - pressure from growers. Nothing else.
MacIntyre Valley	Lack of soft chemical options. Lack of Area Wide Management support. Lack of growers support.
MacIntyre Valley	The IRMS.
MacIntyre Valley	No water - product not available.
MacIntyre Valley	Sucking pests early season - very high Heliothis pressure - outside use of broadspectrum chemistry.
Mungindi	High insect pressure.
Lower Namoi	Lack of predators, lack of soft option sprays, pressure to reduce costs in a heavy insect year by growers, effects from off-farm insecticide use (neighbours), climatic conditions.
Lower Namoi	Cost, rotation options, target pest.
Lower Namoi	Cost, grower requirements, beneficial numbers.
Namoi	WHP (particularly aphicides late season). Growers concerns (cost). Late season high pressure.
Namoi	The strategy has become too inflexible. Application timing because of drift, weather, not being able to get back the following day.
Upper Namoi	Less than satisfactory spray results, mixed population of sucking and chewing insects, grower insecurity.
St George	Nothing.
St George/Dirranbandi	High consistent egg pressure, or low pressure allowing range of grub sizes to be present. Also relatively low predator numbers.

Table 18. Area Wide Management Groups Are?

Brookstead	Essential for communication of IPM ideas.
Brookstead/Chinchilla	Very beneficial to IPM.
Darling Downs	Very useful in creating a large acreage that is doing the same activities.
Darling Downs	Useful in helping to keep to the strategy.
Darling Downs	Growing.
Darling Downs	Useful for helping share knowledge.
Darling Downs	Very useful.
Darling Downs	A great forum and support.
Darling Downs	Useful.
Darling Downs	Useful.
Gwydir	Groups of growers.
Gwydir	Groups of growers in an area.
Gwydir	Useful.
Gwydir	Good for local communication.
Gwydir	Underutilised.
Gwydir	Very important.
Gwydir	Good value.
Gwydir	Very helpful if well driven by growers.
MacIntyre Valley	All about communication.
MacIntyre Valley	Important to run IPM systems.
MacIntyre Valley	Fundamental to giving growers control in the decision making process.
MacIntyre Valley	Worthwhile.
MacIntyre Valley	Essential in an IPM system.
Mungindi	A good tool.
Lower Namoi	Good for communication and more are developing.
Lower Namoi	A useful communication tool.
Lower Namoi	Increasing.
Namoi	To be encouraged.
Namoi	Good but too big and need a driver in each group.
Upper Namoi	Useful but need more intensity.
Dirranbandi	Confined to our farm 14000 ha.
St George	Thought-provoking.
St George/Dirranbandi	Useful.

Consultants commented on the future of selective insecticides like NPVs. The comments listed in Table 19 suggest that they will continue to be very important in future management strategies. They fit well into an IPM scenario and, as the industry has become more experienced in their use, their position in the annual spray program continues to solidify.

Table 19. In the future, insecticides that are specific to certain pests (eg NPV) will be?

Brookstead	Able to be used with more understanding and hence more will be used.
Brookstead/Chinchilla	Very useful.
Darling Downs	Hopefully developed to help us maintain an IPM programme.
Darling Downs	More in demand if they do the job and are a reasonable cost.
Darling Downs	Used when suitable.
Darling Downs	Useful.

Darling Downs	Increasingly required.
Darling Downs	Important to the overall strategy but must remain compatible with other products and priced for the pest it removes.
Darling Downs	Easier to control.
Darling Downs - Dalby	More widely used and more useful in our management programs.
Gwydir	Very important if have low effect on beneficials.
Gwydir	Important.
Gwydir	Useful depending on efficacy and % availability of Bollgard II. Useful in other crops - non cotton.
Gwydir	A great help in improving IPM.
Gwydir	Still used as they are now.
Gwydir	Very useful and play a major role in IPM and spraying in general.
Gwydir	Dearer, more specific and more difficult to always get to work.
Gwydir	Handy but not essential. Depends on Bollgard II uptake.
MacIntyre Valley	Very important and likely to be expensive.
MacIntyre Valley	Our primary products.
MacIntyre Valley	Important and most likely more expensive so cotton growers will grow corn, etc.
MacIntyre Valley	Considered the norm.
Mungindi	Valuable, however I find it difficult to believe companies will continue to develop them with only 10 years patent.
Lower Namoi	Useful.
Lower Namoi	More important for maintaining IPM and resistance breakers.
Lower Namoi	Used more readily providing they are economical.
Namoi	More and more in demand.
Namoi	More important but you will have to understand what conditions they will work in which can be difficult if you are not on site.
Upper Namoi	More important to maintain a desired program.
Dirranbandi	No more useful than they are now.
St George	Not dominant.
St George/Dirranbandi	An important tool that hopefully may be more effective and readily available.

Beneficial insects were rated by respondents for their usefulness. The results are displayed in Figure 24. To assist in interpreting the data, the relative percentages for each insect were multiplied by a factor and summed to reveal an ordered list of beneficials that reflect the highest aggregate score across the criteria. The factors used are listed at the bottom of the figure. This shows that Lady beetles are regarded highly along with Red and Blue Beetle and Assassin Bugs. Comments are provided in Table 20.

CCA IPM Report Figure 25.

A Rating of the Usefulness of Beneficial Predators/Parasites for Pest Management

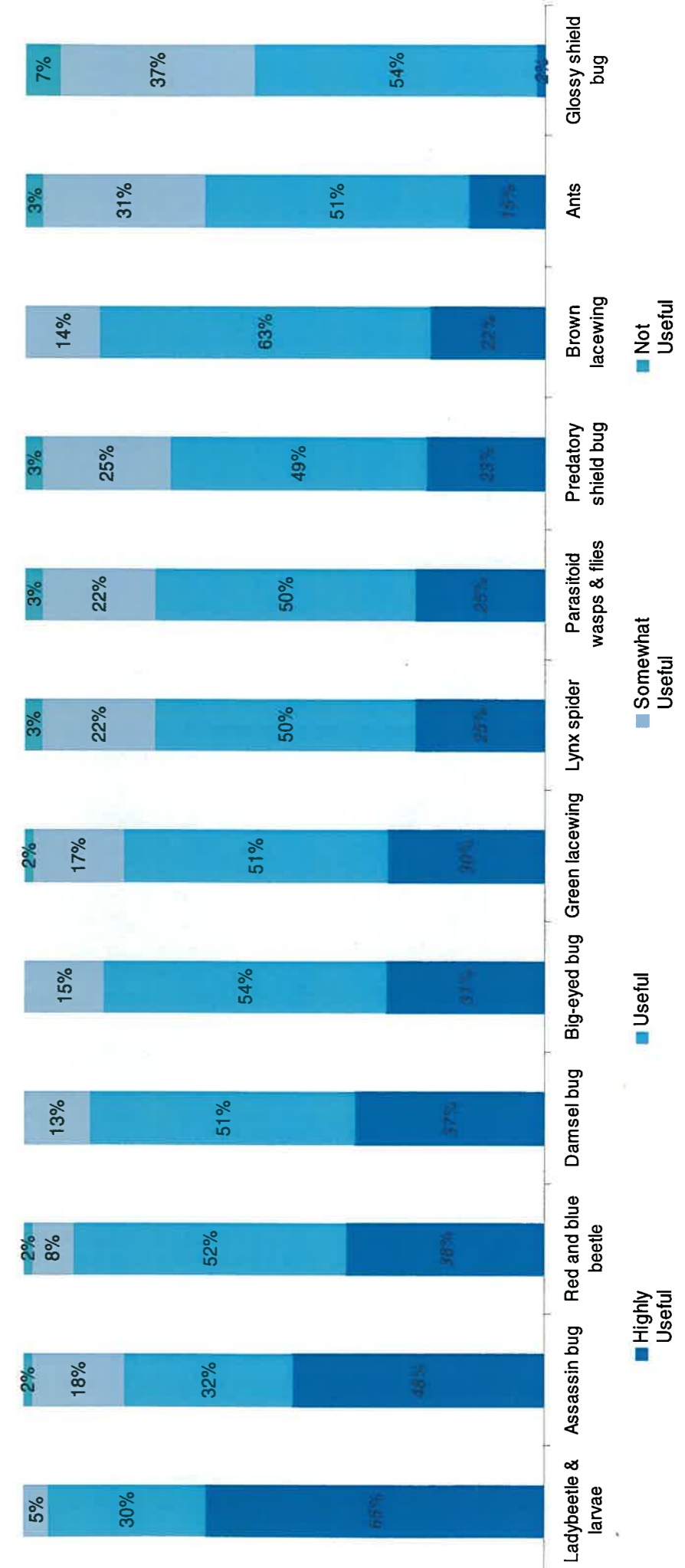


Table 20. Comments on ratings of the usefulness of beneficial predators/parasites for pest management in cotton.

Darling Downs	More research and more specialised checking methods need to be looked at when determining the benefits and usefulness of beneficials. Consultants know there are beneficials present, but do they know what actual numbers are in the crop and if these numbers present are enough to hold off spraying? Do they know when certain species are in the crop, how long they stay there for and if they are breeding up in the crop, flying in and out all the time?
Darling Downs	It would be more useful if we knew how much they would like to eat rather than just what they like to eat.
Darling Downs	There are at least 7 different spiders in our cotton fields all doing different jobs.
Gwydir	Microplitis wasps also very useful late season. The above ratings are a combination of predatory efficiency and proliferation.
Macintyre	We don't tend to see many bugs as predators in the field.
Macintyre	It is hard to determine the amount of work the beneficials are doing for you.
Macintyre	Predatory beetles and lacewings are often the most abundant and provide the most effective and reliable control.
Macintyre	All are important but vary with the pest.
Macintyre	I believe all predators play a very important roll in any IPM program. Abundance of beneficials and predatory insects is different during the different crop stages and they can be largely influenced by nonselective chemicals and climatic conditions.
Macintyre	All are useful in good numbers and for control on secondary pests. They are not highly useful on their own, or without the use of IPM
Macintyre	Our rating of usefulness is almost directly related to the abundance of the particular insect in our cotton fields, e.g. the more abundant they are the more useful you think they are.
Namoi	I think it comes down to a resilience thing. The more resilient predators are the better because they are in the highest numbers.
Namoi	All predators are useful. However, there have been very few Big Eyed Bugs, Lacewings and Shield Bugs around for me to be able to rate their usefulness. The Assassin Bug is also low in numbers but is known for its effectiveness.
Namoi	It is very hard to assess what predators are actually doing the bulk of the job. It is very easy to find some predators in the crop and I guess attribute the work to them.
Southern NSW	Do not have Assassin Bugs in this area.
St George/Dirranbandi	I have only commented on the predators I am familiar with in the field.

4.1. IPM Effectiveness and Outcomes

Consultants were asked to consider the effectiveness of IPM for Growers and Consultants. Their comments are listed in Table 21 and Table 22. In a general sense, notwithstanding the criticisms of the costs of soft chemistry, some of the practicalities of fitting in with periods of sustained high pressure, and difficulties with the IRMS from time to time, the comments are very supportive.

The methods and practices associated with good outcomes are however not delivered without a fair amount of effort on the part of the consultant and the grower. Typically, an IPM program can be technically difficult to implement and requires more work in scouting checking and re-checking to be sure that the beneficial balance is adequate to sustain the crop. Similarly gaining the confidence of the grower to wait and then spend a larger amount per spray can be difficult. In times of high pressure, consultants reported that growers can get very nervous, and for those clients who are less confident in the approach, "feelgood" sprays are still being applied from time-to-time when the grower insists on action.

Table 21. When you consider IPM personally, how effective do you believe it can be for Growers?

Capricorn	Quite effective. Better in an area where it's more isolated, but not in a valley situation and when you are managing a pest such as whitefly.
Capricorn	Moderately effective.
Capricorn	Very effective and relevant, on mixed farms especially.
Capricorn	IPM is an extremely broad term and is viewed by different people as different things. I believe it to be the only possible way to economically manage the crop pests in the present, while searching for improved pest management strategies to allow sustainable crop production in the future.
Capricorn	In tandem with emerging technology such as Bollgard II, it has the potential to be very effective.
Capricorn	Quite effective - can minimise costs by maintaining beneficials and reducing spray numbers.
Darling Downs	I believe that it can be very cost effective for growers to follow an intense IPM strategy in cotton growing. However, the grower must have a good understanding of what is to be expected, and what the potential limitations of IPM are. It is important for growers to understand that the major limitation of IPM is a lack of knowledge of beneficials, their effectiveness, and secondary pest thresholds and damage potentials especially. If a grower can appreciate this and work through the decision making process with his consultant, only then can IPM work to the best of its ability.
Darling Downs	Very effective. It does take more understanding and discussion than otherwise, but this improved understanding has increased growers overall management of the farm. We also see benefits of the softer approach overflowing into other areas and crops on the farm.
Darling Downs	Very effective. The problem will continue to be our research knowledge not being able to keep up with the different scenarios we are faced with every year. Initial indications are, however, that we can reduce resistance and can lower our overall Helicoverpa pest pressure.
Darling Downs	Good under low to moderate pest pressure, where frequency of sprays is reduced and intervals between sprays are lengthy. Otherwise the chemical bill climbs rapidly and cotton growing is no longer economical.
Darling Downs	Great if you can avoid using broad-spectrum chemicals, but it is a case of spending more early in the hope of saving more later. Can be beneficial short and long term for growers. The way to go but may cost more.
Darling Downs	50% of growers are aware of the effectiveness of IPM, and 50% either aren't aware, or are not educated to its potential. It is effective in allowing growers to save money, control resistance, and benefits the environment.
Gwydir	Very effective, but can be seasonal depending on pest spectrum for that season.
Gwydir	Effectiveness will be gauged on yield and profit.
Gwydir	Very effective because of the cost savings and fit in the environment.
Gwydir	Being a Farm Agronomist, I'm speaking as a Grower and a Consultant. Generally speaking, the variety of pests is low along with the abundance of beneficials being low as well. That's not to say they are not there, but unfortunately the numbers are high enough to prevent sprays. But early in the season, we take them into account when we do spray by using the new technologies that are available to us. I think the beneficials do have some impact on the pest populations in the field.
Gwydir	Economics now need to be investigated.
Gwydir	Can be very effective when enough information is held by the grower to be able to understand and make decisions regarding the dynamic nature of pest management. When there is not enough information available to the grower i.e. poor scouting records, then following an IPM program can be very difficult.
Gwydir	Can be a negative .i.e. net return possible is reduced.
Gwydir	It can be a very effective tool when it is used on an area wide system. There is no use if a grower follows IPM when the neighbours don't. The use of beneficials as an effective way of handling insects can be enhanced when IPM is approached on a wider perspective. I believe it gives you a better effectiveness

	with your chemical application especially when broad spectrum insecticides are rotated with selective ones.
Gwydir	It looks to have made insecticide control no longer a big variable cost in the production unit. I am not sure how effective it can be, but if you look at where the industry was in 1998-99 season with 20 sprays to now only 4, you would expect that in another 4 years growers will only be spraying once or twice a season.
Gwydir	IPM has the ability to relieve some of the stress associated with drift issues etc. that growers have to take into consideration.
Gwydir	The idea of IPM is to reduce the chance of resistance building up and to prolong the life of the chemistry we now have. The benefit of this to the grower can be measured in how much he ultimately saves by using less spray, even though they may cost more individually.
Gwydir	IPM is effective in lower pressure years, but the cost of the chemical limits many growers desire to run with a complete IPM program.
Macintyre	Very.
Macintyre	It will generate the highest gross margin for growers of any pest control system.
Macintyre	Very effective if area wide is strongly adopted.
Macintyre	Very.
Macintyre	It is highly effective.
Macintyre	IPM can be very effective in reducing the overall number of sprays and thus the cost of growing the crop.
Macintyre	I believe that it can be very effective if we look at it as a long term goal.
Macintyre	It can reduce the number of sprays and reduce cost of pest control.
Macintyre	Very effective: for the community, for the environment, for yield, for resistance, for sustainability, for the industry
Macquarie	It can mean a lot for growers in terms of dollars spent on chemicals; the management of resistance levels especially SP's; reducing the amount of "spraying" in terms of the environment and the local community. Removing the total reliance on chemicals to achieve the end result.
Macquarie	Conservation of beneficials can be quite valuable in reducing Helicoverpa damage and limiting secondary pest numbers.
Macquarie	IPM for Helicoverpa management is effective and achievable. I'm concerned with achieving IPM for secondary pests.
Macquarie	Can reduce the frequency of sprays. When we have to spray, beneficials are present to help insect control in conjunction with the insecticide used. Hence a reduction in growing costs.
Macquarie	I believe it can be very effective in controlling pests and reducing both costs and negative impact on the environment.
Macquarie	Very effective. A steep learning curve with much uncertainty for many growers, but experience is producing even better results.
Macquarie	Allows growers to see better results from a spray application by minimising the risk of resistance.
Macquarie	Effective in a favourable season where Heli numbers are low, conditions are dry and the beneficial populations flocks to cotton crops. Warm weather allows compensation. These things need to happen to benefit growers in the Macquarie. The introduction of Bollgard (>40%) will mean growers can adopt an IPM program; this I believe will benefit growers enormously.
Namoi	It can be effective in managing all above listed issues & maintaining Growers 'Right to Farm' in the current 'Green is Best' political environment.
Namoi	Eventually it will be totally effective.
Namoi	The last two seasons have opened the eyes of consultants and growers to the potential IPM offers. As more growers are convinced of this potential, a total area wide involvement can be achieved, possibly resulting in a chemical usage, similar to the season just experienced, every season.
Namoi	I have seen IPM work very well in our unsprayed cotton, whilst I believe the success of IPM is determined by the level of beneficials and more importantly the species of beneficials present within the crop. Whilst working in QLD I saw 30 eggs/m reduced to 2eggs/m by trigogramma. In the Namoi valley I don't believe we have the diversity of beneficials to obtain the success achieved in QLD, however the use of selective chemistry and nurturing of beneficial

	populations has a large effect on the overall yield and insecticide use.
Namoi	Very.
Namoi	It can be a great tool if the process is followed right the start, maintaining and building the correct infrastructure to grow a crop from.
Namoi	In a heavy insect year not effective enough, saves costs in an average season. A lot of hidden costs like organising sprays etc then get loaded into the checking costs. It depends also on the area you are in or region, to maintain beneficials because over time they will start to be maintained in your area.
Other	For growers it can help break the resistance cycle and extend the time between sprays which can lead to fewer applications of chemicals. Also using softer chemicals provides a safer working environment for employees on the farm.
Southern NSW	Effective as can reduce costs and no. of sprays, therefore reduce workload and logistics.
Southern NSW	Extremely.
Southern NSW	IPM is generally effective if the sprays are timely. With the shorter day degrees and with high Helicoverpa pressure in the south, it is important to choose a insecticide that is effective quickly to limit plant damage.
Southern NSW	Very effective if used by other growers in an area, i.e. all crop producers for that season.
St George/Dirranbandi	IPM can produce a more economical and environmentally sustainable form of cotton production.
St George/Dirranbandi	Very effective, particularly in a light pressure year as we've just had
St George/Dirranbandi	Very effective, and it doesn't require neighbours to follow IPM programmes, but is effective as long as spray drift is managed.
St George/Dirranbandi	IPM has the ability to reduce growers' costs and in turn gain a greater profit depending on the region. I think IPM could be of great benefit to the grower if the valley or neighbouring growers are taking similar approach.
Upper Namoi	IPM can be a very effective tool for growers, especially those in environmentally sensitive areas. The use of soft options & cultural practices to reduce the need for harder chemistry is becoming more effective, as the tools & the ability to use them improves. Growers are aware of the economics involved, & need to balance the effectiveness with the economics in order to achieve best results.
Upper Namoi	Very effective.
Upper Namoi	Fair-problems and cost getting usual. Back under control.
Upper Namoi	Very.

Table 22. When you consider IPM personally, how effective do you believe it can be? For Consultants?

Capricorn	Keeps growers happy, maintains resistance management.
Capricorn	Effective if implemented on an area wise basis.
Capricorn	An excellent tool, I have some minor doubts on how the systems would stack up in a heavy pressure year like 1998/1999.
Capricorn	Despite the obvious extra effort required presently, I am certain in a few years when Bollgard II is fully implemented and we are spending less time looking for grubs, and can focus on these new ideas, it will be more effective and less time consuming than ever before.
Capricorn	Quite effective. Maintains a better balance in the crop by reducing disruptive inputs and preserving beneficials. Reduces costs by reducing spray numbers.
Darling Downs	For Consultants, IPM can help not only produce a potentially more cost effective crop, through reduced spraying, but a more environmentally friendly crop through reduced loading of the environment. It can also provide for good relationship building with clients through decision-making and cooperative experimentation. It is also important for consultants to recognise the limitations of knowledge on IPM, especially in relation to secondary pests, and the effectiveness of beneficial insects.
Darling	I feel it can be very effective, and so far we have seen it work but they have not

Downs	been big insect years so who knows what will happen then. It is safe to say that the consultants are a lot more comfortable with it now than they were a few years back.
Darling Downs	Very effective but more work.
Darling Downs	Very effective in the management of the pest complex. There are still a few gaps in the selective product range and some very expensive new products, that are hard to find a place for in a short water year, but we have come a long way in the right direction.
Darling Downs	Consultants need to be wary of the lack of support currently available about IPM. More time and money will be required to do the job effectively.
Darling Downs	Seems to be very effective in seasons where the pressure generally is low. We haven't really tested it under high insect pressure.
Darling Downs	Can be very effective in low-pressure years.
Darling Downs	Good under low to moderate pressure. It is quite effective. No difference in yield, quality or maturity.
Darling Downs	More rewarding but more work for the same money.
Darling Downs	Will depend on the season but in most cases it will be highly effective.
Darling Downs	For BT cotton it is extremely effective (must be practiced). 20 % of years; high pressure; less beneficial. 60% of years; moderate pressure; can reduce cost but big benefit is environmental. 20% of years; low-pressure; extremely high benefit. This applies to Conventional- and Ingard-cotton to a lesser degree
Gwydir	Very effective, buys time and spreads out chemical applications, reduces chemicals in the environment.
Gwydir	To have an agreement with the grower, to maybe allow higher levels of damage with sustainable yields.
Gwydir	Maybe a little more work in the way of monitoring but well worth it because of the results.
Gwydir	I personally believe that IPM can be very effective.
Gwydir	The extra time spent in the crop increases workload; this might need to be taken into account for true gross margins.
Gwydir	Is more time consuming but also a more interesting and responsible method of managing pests. Time consuming generating the data, but also gives you more time to make decisions as you monitor pest populations over time.
Gwydir	A more definite scenario for decision making, sampling and analysing, but avoids the 'massive blow-out' scenarios of more disruptive strategies.
Gwydir	IPM has the ability to take a more holistic approach towards pest management.
Gwydir	Any way possible to slow the rate of resistance is beneficial to the consultant as this results in greater returns for the grower and a greater chance for the consultant to retain their job in a sustainable industry.
Gwydir	In an IPM program consultants must be more aware of secondary pests. It is effective, but each year is different and I don't believe it is as effective in high pressure years (maybe consultant stress factor).
Macintyre	For the thinking consultant it will produce a way of life and a professional challenge second to none.
Macintyre	Good, but growers need to understand what you are doing.
Macintyre	It is highly effective.
Macintyre	From a consultant's point of view it can also be very effective as it provides a range of options to control insects apart from the standard chemical practices.
Macintyre	There is increased consultant confidence in the IPM system.
Macquarie	I believe it can be very effective in helping to reduce resistance levels, especially if used in conjunction with area wide Management groups. It gives us the chance to let nature work it out; reduce the reliance on chemicals use softer options when required.
Macquarie	If Helicoverpa pressure is low enough to allow genuine conservation of beneficials

	then it can be effective in reducing spray application and resistance build up, as well as keeping secondary pest numbers down.
Macquarie	Takes the pressure off the insecticide doing all the work on insect control. Can potentially reduce the total number of sprays for the season, which is better for us in the long run.
Macquarie	Same for consultants as it is for growers.
Macquarie	Tends to place more workload on consultants. In turn, growers place more value on consultants rather than just checking and sprays. Growers now place value in having extra information such as plant mapping data.
Macquarie	Gives consultants guidelines to follow so that they can adopt the same approach on a number of farms.
Macquarie	Not necessarily effective for consultants. Accurate scouting becomes vital, plant and retention monitoring will also take time. Growers may struggle to see the benefits of paying for that time. In terms of checking, IPM and a beneficial population allows consultants to continually recheck fields and focus on fruit loads in decision making.
Namoi	An opportunity for increasing skills for IPM management, and an opportunity to assist growers to manage this more complex, demanding, growing management strategy.
Namoi	There will not be any cotton without it. No cotton. No consultant.
Namoi	The introduction of IPM strategies into this business has certainly complicated checking and recommendations. At the same time has relieved stress with the reduced pressure (seasonal influences have obviously contributed to this). IPM strategies have illustrated the need for more in-depth information on secondary pests. Getting a grip on IPM strategies in Conventional and Ingard cotton has set us up well for pest control in Bollgard.
Namoi	Very effective in the right conditions. Close monitoring of insect populations is important.
Namoi	Very.
Namoi	This can lead consultants into new ideas and paths that fall away from the traditional methods of cotton growing.
Namoi	I like to walk in fewer chemicals. Also, IPM works better than growers know about because the grower won't take the risk.
Other	Very effectively.
Other	If beneficials are in the crop then they can become an important tool in helping with management decisions.
Southern NSW	I believe an IPM program can be very effective, especially earlier in the season. The preservation of beneficials is very important in the system and relies on growers accepting some damage, allowing for plants to compensate. Further south, the window for plant compensation is limited and I believe this does not allow us to achieve the full benefits of IPM that may be achievable in northern valleys.
Southern NSW	Ability to sleep, assurance of residual activity. Increased work per farm therefore increased time. Reduces resistance, therefore improving effectiveness of all chemical control options.
Southern NSW	Extremely.
Southern NSW	IPM is generally very effective in stage 1 and early stage 2. When high Helicoverpa pressure occurs late in stage 2 and 3 we need to use harder insecticides to control Helicoverpa and limit damage.
Southern NSW	Growers and consultants should have similar objectives, it is more difficult to accommodate the wishes of growers who have different aims for IPM on their farms.
St George/Dirranbandi	I believe it can be very effective at achieving the above results.
St George/Dirranbandi	IPM can assist with the management of chemical resistance and consequently improved insect management options via a combination of means.
St George/Dirranbandi	Very effective in helping with resistance management, and also reducing the amount of chemical used. Cost wise doesn't have a big advantage all the time.

St George/ Dirranbandi	IPM for a consultant in Bourke is very hard especially early season with high Helicoverpa infestations. Also, winter crops vary from none to some depending on the season as we are generally a summer rainfall area which means lower number of beneficials at start of season.
St George/ Dirranbandi	I feel it's very effective in managing resistance, reducing chemical costs while maintaining yields, with less impact on the environment.
Upper Namoi	IPM can be very effective. Consultants have been given permission to think outside the square with IPM. The use of soft option management, however, seems to be taking the place of integrated pest management and consultants need to be careful not to fall into the trap. This season we saw many less than satisfactory results from Tracer, Affirm & Steward during the very hot conditions of January & February. Many of these "spray failures" were followed up with more of the same - the result was more crop damage & more cost to the grower. IPM should balance best practices for a positive economic result. Unfortunately under the new thinking organophosphates & SP's have become dirty words instead of being viewed as useful tools in the IPM tool box.
Upper Namoi	A lot more work in checking.
Upper Namoi	More work. Put at more risk of being sued because of unusual damage.
Upper Namoi	Very.

4.1.1. Insecticide Strategies in Conventional Crops

Respondents were asked to consider selectiveness, effectiveness and cost per hectare together when evaluating products with regard to treating Helicoverpa in Conventional crops. Endosulfan was ranked highest along with Indoxacarb, Emamectin and Spinosad. In focus groups with growers and consultants, these results were confirmed with Endosulfan being seen as an essential and cost effective tool, considered soft on beneficials and effective on sucking pests when used in stage one.

When asked to consider the most important criteria that were used when selecting insecticides for Conventional cotton between flowering and planting, the factor that rated highest was selectiveness, or ability to target specific pests. This was followed by reliability and cost. It is clear that there is a trade off between using expensive selective sprays and cheaper knockdowns. Generally, the focus groups suggested that when beneficials are present in the crop, products like foliar BT's and NPV are worth investing in. Interestingly, they are perceived as being less reliable than some of the less specific chemicals.

Surveyed consultants were asked to indicate what was the single most important negative factor for not using a product on conventional cotton varieties during planting to flowering. The two factors that rated highest were cost and reliability. This reflects the comments that were being expressed in relation to following IPM and expensive early options. These were followed by selectiveness and other reasons which included environmental concerns and resistance strategy or rotation of chemicals. In aggregate, residual benefits and speed of action were seen as the least important factors for chemicals between planting and flowering.

4.1.2. Insecticide Strategies in Ingard

Consultants were asked to rate the value of products for Ingard cotton between planting and flowering. Considering selectiveness, effectiveness and cost per hectare, Spinosad was ranked highest, followed by Indoxacarb, Emamectin and Endosulfan.

The highest ranked attributes for choosing a product were selectiveness and reliability, while the cost of chemistry and lack of reliability were the highest ranked negative factors. Discussions with consultants and growers revealed that for these reasons, cheaper chemicals that are viewed as 'being only a bit disruptive' were the product of choice to control sucking pests during the planting to flowering period. Endosulfan was widely acknowledged as being

in this class of chemical and in general terms expected to remain an important tool for the foreseeable future.

In order of importance cost followed by speed of action and reliability are the criteria that agronomic managers have to be mindful of in the second half of the season. In the focus groups, the opinion was expressed that economics (or a poor economic outlook) has the effect of forcing growers into chasing cheaper short term solutions in the hope that pressure will not be sustained. Invariably, this strategy does pay off at times, but generally it was acknowledged that cheaper chemistry meant problems 'down the track' unless their usage was particularly well managed to avoid mite flares and resistance problems. Both growers and consultants were starting to talk in terms of dollars per day as a methodology for justifying dearer, softer products. There was a general feeling that working out a dollar per day rate was fine, but you needed to have the reserves if the estimated duration of effective control ended up shorter than expected. Tension was observed in focus group situations where the financial position of a grower might 'make that risk too large for his bank manager to bear!'

4.1.3. Soft versus Hard Chemistry

Consultants were canvassed for their views on the opinion that 'insecticide use in cotton (for any pest) suggests that new chemistry with reduced impact on beneficial insects is preferred over "traditional" chemistry (i.e. OP's, Carbamates, SP's).'

It was put to respondents that industry sources believe that use of "traditional" chemistry would increase and newer, softer products such as Tracer, Affirm, Steward, etc decrease when high insect pressure and low cotton prices prevail. When asked whether they agreed with this belief, 11 per cent said that they did agree and 89 per cent of respondents disagreed. Their comments can be found in Table 23. Responses to the open ended statement 'I will recommend a more selective but more expensive product ...' follow in Table 24.

Table 23. The Use of Traditional Chemistry Will Increase when Insect Pressure is High and Cotton Prices depressed. Comments.

Central Qld	With risk management, we need to evaluate the cost per day not the cost per spray.
Central Qld	Traditional chemistry although cheaper, is far less efficacious. The newer 'softer' products provide better value for money in any circumstances, i.e. with longer residual, reduced impact on beneficials and softer for purpose and environment.
Darling Downs	We need all options. At present more expensive tends to be used early on a band. If pressure stays, lesser products will work well and beneficials will be of help later. Bench marking has shown this approach to consistently work with lower overall pests and best end profit for this work.
Darling Downs	The softer products such as Tracer, Affirm, Steward etc would still need to be used under higher pressure seasons, more for resistance management and chemistry rotation instead of for their softer characteristics, particularly in stages II and III.
Darling Downs	Pressure from the community.
Darling Downs	Most field experience to date indicates best chance of increased beneficials with use of low impact softer products early in the season. With bonding techniques, growers are prepared to use these dearer products at least till mid season. They give us the best chance of (A) minimising resistance: the older products will work better later in the season. (B) Allowing natural control methods to impact on pest populations, hopefully dampening high pest pressure situations.
Darling Downs	A soft program can be cheaper in the long run as there will be less overall sprays. This is providing soft chemistry prices do not continue to rise as they are.
Emerald	The newer products have proved their worth over the last few years. In general, the cost per day of control is no higher than traditional chemistry as

	the residual benefits are longer, not just in direct Heliothis control but in beneficial preservation.
Emerald	Individual costs of sprays are important, but the total overall costs of spray program is most important. Therefore, total numbers of sprays and any flaring of secondary pests that need control and possible targeting issues will favour a more managed approach.
Gwydir	With increased use of ground-rigs, early use of even expensive selectives is possible through band spraying. More of our clients are either purchasing or aligning themselves with reputable ground rig contractors. It is now proven that by delaying non-descriptives at least to the end of Jan, overall pesticide use is down through reduced spray numbers. It is through band spraying and reduced total spray numbers that lost control can be affected.
Gwydir	Selection of chemistry should not have too much to do with the price of cotton, yield is too important.
Gwydir	Resistance management issues, efficacy, selectivity benefits for assisting IPM Strategies.
Gwydir	I wouldn't change current soft strategy on cotton price, because insecticide costs aren't increasing. If we get a very high insect year (e.g 98/99) then it may change only if current strategy wasn't working.
Gwydir	I think consultants will continue to try to maintain beneficials and stay soft early by using selective "soft" chemistry. Only once they get into late Stage II and Stage III will they start using broader, harder chemistry.
Gwydir	Better efficacy in combination with preserving beneficials. Beneficials are cheap resistance breakers. Possibly longer spray intervals.
Gwydir	Because the other products (newer) are performing under high pressure and although they may be slower they don't have as many adverse effects as the older more non-selective chemistry. I.e. don't flare mites, take out beneficials etc. Also, IPM is fairly well established and will continue to be used, and this is where most of the newer insecticides fit.
Gwydir	In high pressure times, Tracer Steward and Affirm are very strong products. Stronger than old chemistry with longer residuals.
Macintyre	Traditional chemistry takes out beneficial predators, which are needed when high insect pressure and low cotton prices prevail. Pest control becomes expensive when beneficials are gone.
Macintyre	Resistance levels in traditional chemistry is an issue, especially under high pressure. Newer products such as Tracer, Steward and Affirm provide good control and have good residual, as well as preserving beneficials. Heavy pressure years quickly spiral out of control with older chemistry due to resistance and lower residual impact. Heavy pressure years are when you need your beneficials the most.
Macintyre	Because all the benchmarking work done shows as BDI increases so does insect control cost and profit decrease.
Macintyre	Use of soft products enable beneficials that are free to work for you as well. Under high pressure it is about dollars per ha per day not about initial spray costs. Under high pressure the poor resistance profiles of traditional chemistry will be exposed and treating the same population 2 or 3 times is what gets really expensive.
Macintyre	Under extremely high insect pressure, I might consider reverting to traditional chemistry if all newer options were exhausted.
Macintyre	There are indications that using a 'soft approach' is no more expensive than using traditional chemistry.
Macintyre	The softer products are providing the better levels of control and residual.
Macintyre	The newer products are being used as an important part of our IPM program and will always be used first to preserve beneficials. Traditional products will only be used at the end of the season.
Macintyre	Industry is driven to utilise IPM for the benefit of the environment. In a high pressure year we would still follow the softer products. Would be first used until exhausted. If pressure continues, harder products would be used late season only.

Macintyre	I believe that the use of softer products is economical for several reasons: Even if the price of new products is high, the control of Heliothis is better due to no resistance to new chemical groups. Softer chemicals allow beneficial insects to control any other larvae missed by the chemical application.
Macintyre	False economy - soft approach with beneficials will ultimately be more (or as) effective but cheaper.
Namoi	Then this will also maximise the effectiveness of the products.
Namoi	Resistance continues to increase. Newer products generally work better, irrespective of the cotton price or insect pressure. Also flaring of secondary pests now means that a soft approach for as long as possible is essential.
Namoi	Old chemistry is stressful to the cotton plant itself without insect control. This has been born out in the last two years.
Namoi	My own past experience has shown that the use of old ("hard") chemistry appears to sterilize the field, which possibly results in 1- 3 more sprays and thus not a great cost difference. The only difference with "soft" chemistry would be the way in which we use it.
Namoi	At present resistance levels, in a high insect year, reliability of older insecticides would not last too long, and people would need to use products that would get results. If however the older chemistry did work, it would get used.
Namoi	All products are useful in a high-pressure situation and it is most important to maintain a program that will not increase the resistance of the Heliothis to the older more traditional chemistry as well as the newer chemistry. In some cases, the newer chemistry may suit the situation better. It must be a decision made for the specific situation.
Namoi	1) An IPM program can reduce costs and increase profits. 2) Less OP burn and higher yields. 3) Less smell and community issues. 4) Less residual and this makes more application and organisation for such, which is often difficult.
Other	In a low pressure year (Heliothis) convention chemistry is cheaper and gives a satisfactory result. There is no question however that these chemicals don't stand up under consistent heavy pressure. I believe new chemistry is by far the most effective approach. Also due to environmental awareness it is harder to use conventional chemistry.
Other	Benchmarking would suggest that a softer overall approach is still the cheapest insect control program available. I would suggest that adherence to researched thresholds and the use of soft products when necessary would result in the cheapest control strategy. Often traditional programs every season create problems late season.
Southern NSW	We have chosen to adopt a "soft option" approach in order to preserve beneficial insects. This worked well for us over the past season, and so we will continue with it.
Southern NSW	Traditional chemistry often causes secondary problems which will cost you later i.e. crop phyto, mite flaring.
Southern NSW	The softer products mentioned above offer excellent residual control and under heavy insect pressure would be more cost effective than traditional products. In a lot of situations, the use of soft option products with the inclusion of some traditional products at times will be cheaper than a straight traditional program.
Southern NSW	Some of the newer softer chemistry gives good residual and relief under high pressure. They are also quite UV tolerant under higher radiation conditions.
Southern NSW	Newer products are more selective but also offer more residual, therefore the cost per day is better. I am concerned how each new chemical is priced on the most expensive product on the market.
St George/Dirranbandi	Use of newer chemistry would not decrease; rather if pressure is high they would be used in rotation with older chemistry.
St George/Dirranbandi	The new products work with good residual lengths. Look at dollars per day.
St George/Dirranbandi	I believe that we are getting better results from using the new chemistry, therefore reducing the number of traditional sprays.

Table 24. Focus Group Answers from Consultants to the question 'I will recommend a more selective but more expensive product

Brookstead	If I feel I can get more days out of it, and it will work out cheaper in the long run.
Brookstead/Chinchilla	If the grower wishes to be selective.
Darling Downs	If I think it will do a good job for a reasonable length of time.
Darling Downs	If it does the job and does not cost too much.
Darling Downs	Early when there is a chance of building beneficials.
Darling Downs	Usually early in the season if possible to retain beneficials.
Darling Downs	If it fits into the current crop pest management program.
Darling Downs	If I feel the overall benefit (eg contribution from predators left alive) will be higher.
Darling Downs	To minimise effect of beneficials in a field.
Darling Downs - Dalby	To preserve beneficial insects or for chemical rotation in resistance management.
Gwydir	When beneficial numbers are high, only one pest.
Gwydir	When beneficial numbers are high or if crop has good fruit retention.
Gwydir	If beneficial numbers warrant saving.
Gwydir	Mid season.
Gwydir	If I suspect or am concerned about resistance.
Gwydir	If I am trying to preserve other beneficials or pests that are not over threshold.
Gwydir	When it will specifically do a desired job and when it will keep the good guys a bit longer.
Gwydir	If the benefit outweighs the cost, ie don't flare other pests which could cost more to spray.
MacIntyre Valley	To keep IPM going - if getting value in terms of dollars.
MacIntyre Valley	If I see value for money and cost per day control is justified.
MacIntyre Valley	Yes, it is important to value the role of beneficial insects.
MacIntyre Valley	Always.
MacIntyre Valley	Depending on the pest range and beneficials present.
MacIntyre Valley	To maintain beneficial insects and continue a soft strategy.
Mungindi	In the early stages of cotton development.
Lower Namoi	Where it best fits a situation.
Lower Namoi	If sufficient predator numbers are observed (decreased disruption). Grower wants to maintain IPM system, rotation of chemistry, neighbour concerns (odour).
Lower Namoi	If it is IPM compatible and will ultimately be economical to the grower.
Namoi	Early in the season. In an IPM context.
Namoi	Because it will not flare another pest and it will preserve beneficials.
Upper Namoi	When insect population and spectrum warrant.
Dirranbandi	When required.
St George	If necessary.
St George/Dirranbandi	If I know it will do the job required in a certain situation.

4.2. Changes to Pest Management Over the Last Five Years.

Consultants were finally asked to reflect on how their management of pests **has actually changed** over the last five years and the key reasons for any changes. The responses are listed in Table 25. The changes listed reflect the sentiment expressed in the previous section of this report.

Table 25. Changes in Pest Management Over the Last Five Years

Compared to how you managed pests 5 years ago, how is your current approach different?	If it has changed, what factors have influenced you most to make these changes?
Now manage fruit levels (Top 5 retention, full plant 1st position of fruiting factor) to establish correct spray decisions in combination with pest threshold.	Research in fruit levels and their effect on crop yield. Push for IPM.
Tighter thresholds, closer management of secondary pests. Softer, more reliance on beneficial activity.	Higher yield demands by industry. Change in pest spectrum due to new chemistry. Environmental sensitivity. Predator activity. Costs.
Going all soft option wherever possible. Have time to keep a sharp check on sucking insects.	Insecticides more 'soft option'. Benefit from plants that are not stressed by chemicals. Bottom line not changed.
Reduce the number of insecticide sprays of high spectrum impact. Increase the frequency of insect checks per field/week. Learn to value and appreciate the role of beneficial insects. Lot more concentration on predator numbers. Specificity of sprays.	Increase resistance levels to common use chemicals. The need for a more sustainable and profitable industry. Cost. Environmental impact. Sustainability.
High emphasis on IPM and insect interactions, high emphasis on chemistry selectivity.	Increasing chemical costs/better IPM chemistry availability. Lower pressure years/higher predator numbers. Increased knowledge of IPM and interactions.
The use of more 'soft' insecticides. Treating conventional cotton like Ingard towards the end of season. Making decisions based on damage as opposed to numbers. More emphasis on secondary pests and beneficial insect maintenance.	Availability of new chemistry.
Instead of calendar sprays, pest thresholds are being attained and even stretched under highly IPM system. Therefore less chemical application in general being applied onto cotton fields (especially Ingard). More soft chemistry available.	Available selective chemistry. Experience with beneficial insects. Introduction of transgenics.
More precise - less reactive - more consideration of AWM/IPM.	Introduction of Ingard and in the future Bollgard. IPM (grower awareness of beneficial insects). The release of highly selective pesticides which are softer on beneficials.
More selective insecticides available - so more focus on IPM systems.	Legislation. Litigation. Information.
IPM - focus on soft insect control. Reduced use of broad spectrum insecticides.	Chemical selection. Area-wide focus. Rising costs and resistance. High toxicity of chemicals used in conventional program. Potential demonstrated of IPM.

Compared to how you managed pests 5 years ago, how is your current approach different?	If it has changed, what factors have influenced you most to make these changes?
Know more about the pest in the field. Treat on damage levels to the crop rather than pest numbers per metre.	Products with good efficacy. Products that are selective. Understanding of the importance of beneficials.
More use of soft pesticides, limited use of broad spectrum pesticides. Tend to make spray decisions more on damage levels than insect numbers per metre.	Grower attitude. Long term sustainability of IPM. Personal and industry experience/research.
Softer approach - used to not seeing 100% lull - used to seeing sick grubs a lot more and preserving beneficials.	New helpful soft products out. Realising beneficials do help. Better for environment/neighbours etc.
More emphasis on beneficials. Not so much panic as there are more options without high resistance levels.	More softer options - more products in general. More education to growers i.e beneficials made it easier to get them to accept some changes.
Greater range of target specific chemistry is now available. Now there is the ability to manage individual pests and treat insects as a diverse dynamic ecosystem.	Greater range of target specific chemistry. Greater understanding of beneficials. Resistance issues.
More tolerance to thrip. Less tolerance to aphid. More thought given to preserve beneficials.	Cost of Heliothis spray. Clear observance of good guys being the dominant control mechanism. The general grind of using heavy insecticides.
Much the same but it is easier with better selective products - my thresholds have hardly changed.	New products. AW Management.
New chemistry has made a very big difference - it has allowed people to use IPM programs. Beneficial preservation.	Chemistry. Environment. Ingard/BG2.
Manage secondary pest and primary pests differently.	Increasing importance of secondary pests.
We now have the tools to use soft products all season preserving beneficials. And the use of trap crops.	Reducing sprays with IPM. Maintaining yields. Increasing gross margins. More environmentally and socially acceptable.
Using softer chemicals but going in harder.	Yield increases when pests are taken out of the scenario.
Use less broad spectrum products. More focus on preserving beneficials. Use dynamic thresholds and tools for decision making.	Sustainability. Increasing resistance. Increasing cost of control.
Very soft approach with nil SP & OP's.	Cheaper/Ha. Less product in the environment. Looked for an alternative to GM cottons.
More aware of beneficial insects in product selection.	Old chemistry was not fully working. New chemistry that is effective. Grower - consultant experiences particularly from Goondiwindi area.
Now 'managing' various populations of insects and 'balancing' a system, rather than trying to eliminate some species.	Increasing insecticide frequency. Increasing insecticide cost. Better information on alternative methods.
More emphasis on area wide. Keep soft longer.	Area wide responsibility. Sustainability. Environmental impact.
Very. Awareness of selectivity and effects on beneficials in competition with pest now, and plant mapping data.	High ineffective insect control costs. Yield caps from lack of water. Yield caps from Fusarium.
More beneficial-friendly, More economic rationalism.	Resistance. Community concerns (grower lead). New products.

Compared to how you managed pests 5 years ago, how is your current approach different?	If it has changed, what factors have influenced you most to make these changes?
Consider insect pressure and spectrum over the whole farm, and not just in the field in question, particularly when considering controlling chemistry.	Public perception of the industry. Increasing growing costs.
Use of more softer products because they are available. I was using Envirofeast and PredFeed from day 1. I have avoided hard product for as long as possible for the past 20 years.	Used more 'softer products' and limited SP use.
IPM.	Research. New chemistry that is soft. More profitable.
Selective chemistry use early. Delayed SP usage. Monitor beneficials.	Ingard. Resistance. Products available to preserve beneficials.
Tolerance of damage yields. More attention to aphids and mirids. Very conscious of area wide influence of populations.	Unsustainable practice of using constant heavy insecticides. Economics of well managed soft approaches. Excellent research on IPM approaches.

4.2.1. Conclusions

This section of the report has outlined the views of Consultants to the cotton industry with respect to IPM. Consultants have reported a steady increase in the application of IPM principles across the industry over time to the current season where it is estimated that 50 per cent of growers follow IPM guidelines totally. It follows that 42 per cent of growers follow the guidelines most of the time and approximately one in ten growers only some of the time. In order of importance, the reasons stated for following IPM guidelines are managing resistance, maintenance of beneficials, reducing cost and reducing chemical in the environment.

One of the main activities used to facilitate IPM is Area Wide Management Groups. When working well, these groups were viewed as being vital to the success of IPM across an entire season. Problems with AWMs were mentioned frequently. Problems centre on the lack of communication when the season gets busy and the lack of commitment when insect pressure is high. These problems were generally not seen as being insurmountable; however there is a need for improvements to the workings of AWMs in a general sense if IPM is going to be continued with for the whole of the season. Regions where cotton production is interwoven among other summer crops and where the majority of farmers in a region were not "cotton growers" are suggested as being the most challenging for collective decision making to be implemented.

The effectiveness of IPM was judged to be very high, although challenging at times. Typically, an IPM program can be technically difficult to implement and requires more work in scouting checking and re-checking to be sure that the beneficial balance is adequate to sustain the crop. Similarly gaining the confidence of the grower to wait and then spend a larger amount per spray was viewed as being difficult at times.

Consultants listed benefits that would accrue to an IPM program; these were thought to outweigh costs even when cotton prices were low and pest pressure high. When asked to consider changes to pest management over the last five years, virtually all consultants listed IPM type modifications to their approach. The primary reasons given were improved environmental impacts, increased confidence in the approach, availability of new products, a better understanding of beneficial insects, biotechnology and a greater acceptance by growers.

5. SUMMARY AND CONCLUSION

This report has revealed a benchmark that is the state of the Australian Cotton Industry in relation to IPM as at the start of season 2003-2004. The data used have been drawn from the research activities undertaken by Cotton Consultants Australia in surveys and focus groups over the previous two seasons. Generally, responses from consultants can be attributed as covering around 80 per cent of the productive area for each season, and grower involvement is contributed by managers of approximately 20 per cent of the annual crop.

The findings of the report were split into the thoughts of growers and those of consultants. Growers were canvassed in the first annual CCA Grower Context Survey, and in two rounds of focus groups conducted with growers in most of the production regions.

As an industry, it is clear that pest management strategies have continued to evolve with the technology available in the field, and the desire and motivation to find solutions that encompass environmental stewardship. The will of growers and their consultants to push the boundaries and risk financial loss and in some cases litigation in the pursuit of a more sustainable industry have to be admired.

Not all growers have this positive view of IPM however. There are approximately a third of growers who responded to the Grower Context Survey who were classified as being uncommitted or non IPM growers. Anecdotally, it would appear that these growers are less likely to have BMP accreditation and have had bad experiences with hard chemistry on neighbouring farms adversely affecting their expensive soft chemical programs.

This same group of growers have a lower threshold when it comes to accepting risk associated with new products. These growers may accept more IPM strategies in the future due to further proof such as economic studies that clearly enumerate the financial pay-offs. Regional differences and production context differences between growers mean that BMP champions who might be publicised to aid adoption need to span geographic and growing context stratum. These growers may also need to see improvements in the methods used to assist growers to make decisions that are consonant with the pest pressure for a growing district. Their disillusionment with Area Wide Management Groups needs to be addressed.

Problems with adoption aside, from Emerald to Hay there has been a mind-shift in approaches to how insect pests can be managed. In summary, insecticide use is reducing over time due to advances in Biotechnology and under the influence of IPM practitioners both growers and consultants. For those growers who have experienced good results with IPM, their commitment to the philosophy is strong. The mitigating factor that has been seen to assist the increased adoption of IPM has been unseasonably light insect pressure. A number of consultants and growers who are vocal in their support of the IPM approach to insect management also question just how effective it will be if pressure is heavy for a sustained period.

Notwithstanding these doubts, an examination of the changes to management over the last five years as stated by consultants reveals that the focus on the use of soft chemistry pervades almost all strategies. This commitment has seen innovative responses to periods of higher pressure and a radically improved perception of how effective beneficial insects can be. Consultants frequently list the changing attitude of growers as being important in progressing IPM as it was first promoted, further they credit growers with pushing the boundaries.

This study has shown that the impetus behind IPM spans the majority of growers and their consultant advisors. To date, the many benefits associated with IPM are well regarded by the industry and the communities where cotton is grown. History has shown that nature is adaptive, and that the same can be said for the insect pests that quickly develop resistance. The challenge for the short term is for the industry to support the current IPM approach and long term, look to test and support innovative strategies as they become available.

6. REFERENCES

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7. APPENDIX 1 – GROWER CONTEXT SURVEY TOPICS

The Grower Context Survey was commissioned by Cotton Consultant Australia Inc. in response to a need for detailed information about the production base in the Cotton Industry. The CCA holds a wide range of production data in terms of product usage and associated management practices, but these data are aggregated and reported at the “consultant area level” or as reported by consultant members in summarising the actions of a number of growers by each consultant. The data collected and presented in Grower Context Survey Report details the responses from individual cotton growers. Addresses were supplied by consultants who had sought approval from their clients to forward their addresses to IRF Cotton Research.

Data were collected for a range of demographic, contextual and attitudinal variables, the range of areas investigated are presented in the table below. Contact the Executive Officer of the CCA if you have further enquiries about the GCS data or report.

Table 26. Data in the CCA Grower Context Survey

Demographic	Situational (Context)	Attitudinal
Decision making status.	Farm size and distribution of crops for the 2001/02 and 2002/03 seasons.	IPM
Respondent age.	Cotton yield for the 2001/02 and 2002/03 seasons.	Area Wide Management Groups (AWMs).
Respondent Education level.	Staffing Levels 2001/02 and 2002/03 seasons.	Disruptive chemical use by neighbours.
	Water supply sources (percentage breakdown).	Innovation and Risk.
	Irrigation scheduling information.	Biotech innovations.
	Spray application methods and trends.	Soft versus hard chemistry.
	Production Context – BMP accreditation, farm equipment, irrigation systems.	Insecticide action (residual and speed).
	Consultant services used.	Decision making assistance (weeds).
		Active ingredient versus brand name recommendations.
		Farm orientation (is the farm oriented towards cotton).
		Response to more scarce or expensive irrigation water.
		Opinions on:
		Company reward schemes.
		Crop nutrition in a GM environment.
		Advantages and disadvantages of Roundup Ready Technology.

Questions were drafted by IRF Cotton research and the final survey questions and format were arrived at after consultation with growers, consultants, clients of the CCA and other industry organisations. Three sections were identified in the survey:

1. Your Farm and You,
2. Your Consultant, and;
3. Companies and Suppliers.