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**FINAL REPORT – SRDC PROJECT BSS223
MANAGEMENT OF GREYBACK CANEGRUB
IN SUGARCANE: FROM RESEARCH TO PRACTICE**

by

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SUMMARY

The management of greyback canegrubs in the sugar industry had been by use of a single chemical control method. Deregistration of this insecticide and the development of controlled-released insecticides and bio-insecticides such as *Metarhizium*, now require management of canegrubs using an integrated pest management approach. This will involve the education of growers and industry advisors. Most of the major agricultural crops in Australia are also progressing along the integrated pest management (IPM) route.

Advances in research associated with greyback canegrubs has seen the development of biological control agents through to commercial production, crop management solutions in manipulating beetles, chemical control being strengthened, and plants being transformed with canegrub resistance genes. One key area that has not been fully exploited is the transfer of this information to, and the adoption of these research findings by the sugar industry. This project along with BSES internal projects 2106 (extension officer pest management) and 2083 (increasing adoption of greyback canegrub IPM in the sugar industry) provides a means through which this can occur.

This project was designed to involve and educate growers and advisory staff of the long-term benefits and increased profitability of greyback canegrub IPM systems. The project facilitated the adoption of IPM principles and strategies through a series of workshops. In addition, the project increased the knowledge base of BSES, CPPB and other sugar industry staff on the biology of greyback canegrubs and the strategies used to reduce their damage in order to maintain a sustainable industry. IPM relies on a good understanding of pest ecology, which may have not been necessary with the sole reliance on insecticides in the past.

The project produced an IPM manual detailing the strategies that growers can use to reduce the damage caused by greyback canegrubs. Workshops gave the participants confidence and experience in greyback canegrub IPM concepts and strategies.

This project has seen the development of a series of greyback canegrub management workshops that covered topics identified by the canegrub consultative committee, growers and research groups. Detailed discussions in relation to canegrub related topics, issues, facts and grower opinion and changes have been incorporated into the workshops, and grower and industry advisory manuals. The level of participation of Burdekin canegrowers and sugar industry advisory staff exceeded the objective of this project with 399 growers (greater than 70%) and over 90% of relevant industry staff attending the workshops.

After the completion of the grower workshops, the level of understanding of the principles of IPM and whole-of-farm management for greyback canegrubs has markedly increased since the inception of this project. Grower awareness of available control methods and the management of greyback canegrubs have improved remarkably. This is reflected in level of available control methods currently being implemented by growers.

Initial inspection of damage sustained from greyback canegrub in the Burdekin district indicated that after the completion of the first year of the project, the number of growers receiving grub damage experienced a slight reduction. However, total damage levels were still as high as the previous year, indicating that some growers were starting to adopt some best management practices (BMP) and some were not. During the following years, the level of greyback canegrub damage dropped from 6,743 hectares of damage in 2001 to approximately 1,279 hectares of damage for the year 2002. The reduction in grub damage can be attributed to the increased level of grub management strategies that growers implemented in 2001. In 2001, for the first time in a number of years, the level of chemical treatments applied by growers (8,855 hectares) increased above the level of damage (6,743 hectares) for that year. The treatment of high risk and vulnerable areas with control products has had the greatest effect on the reduction in greyback canegrub damage.

The flow-on effects of the large reduction in grub damage in 2002 has a financial benefit that has not yet been realised. The benefit of a reduction in grub damage allows growers to:

- maintain a crop rotation;
- spend less time replanting badly damaged blocks;
- improve farming efficiencies (no large gaps in blocks where stools could have potentially been removed during harvesting and could cause problems with weed control and harvesting the following year);
- reduce the amount of dirt (extraneous matter) going to the mill that potentially reduces grower payment received for crop;
- reduce cost associated with the milling process as a result of increased soil and extraneous matter in cane supplied to the mill.

1.0 BACKGROUND

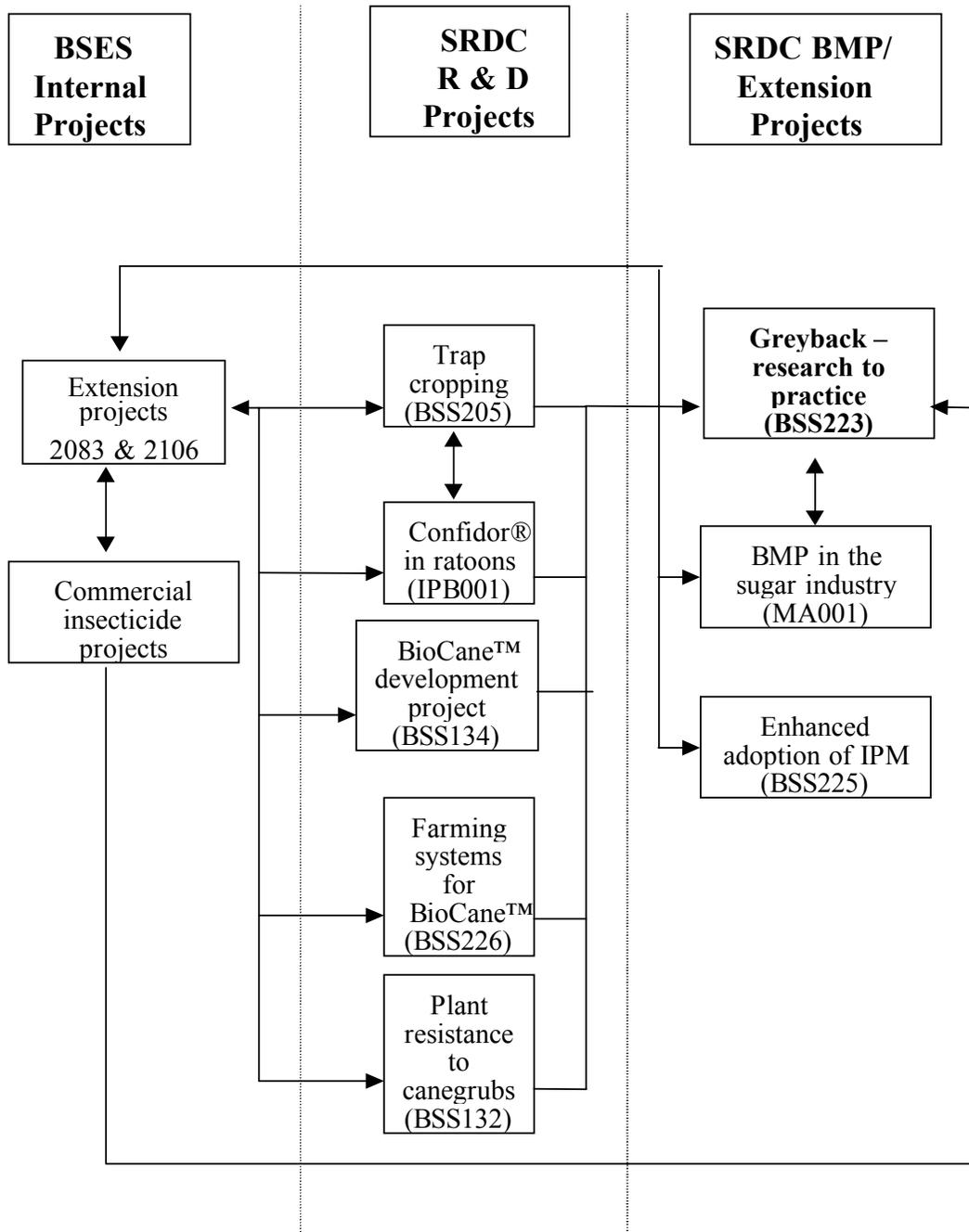
Management of canegrubs in the sugar industry has traditionally relied on the use of a single chemical control method. The deregistration and failure of registered insecticides in the control of greyback canegrubs, along with the development of new control products and strategies for the management of canegrubs, require the use of an integrated pest management approach. Key to the success of this new management system is the education of growers and industry advisors on the best management practices (BMP) for the control of greyback canegrub. Most major agricultural crops in Australia are progressing towards the BMP philosophy and program in relation to pest control. The cotton industry's successful adoption of integrated pest management (IPM) systems for the control of *Heliothis* sp. has centred on the use of programs that limit the potential for insecticide resistance building up. The grape and wine industries run IPM courses that provide information on strategic insecticide use accompanied with the use of beneficial insect species for the control of insect pests. Their program boasts an attendance percentage of above 70%. All IPM management systems share a common focus, being the control of a particular pest, while maximising economic return to the producer. In addition, all pest management systems utilise strategies that do not try to control a pest in isolation to other farming practices and crop management strategies.

Advances in research associated with greyback canegrubs has seen the development of biological control agents through to commercial production, crop management solutions to directing beetles, chemical control being strengthened, clones being assessed for tolerance, and plants being transformed with canegrub resistance genes. One key area that has not been fully exploited prior to this project and BSES internal projects (2106 and 2083) has been the transfer of this information to, and the adoption of research findings by the sugar industry. This project, along with projects 2106 (extension officer pest management) and 2083 (increasing adoption of greyback canegrub IPM in the sugar industry), will provide a means through which this can occur.

Project 2106 is a BSES and local CPPB funded project that aims to improve the profitability of sugar production in the Burdekin by extending information and coordinating a program to manage greyback canegrubs. The objective of the program is to provide extension to the industry on the greyback canegrub program, invoke best practice for grub management, and to provide research and technical assistance to the local industry.

Project 2083 is a BSES project that has the main objectives of lowering grub damage, and increasing the awareness and adoption of canegrub IPM through a series of grower participatory trials. Further objectives of the project include an economic evaluation of IPM strategies, refinements of IPM strategies, and the formation of a series of options for greyback canegrub management.

The flow chart below shows how Project BSS223 fits in with other projects related to canegrub research and extension. Information and research findings generated by SRDC and BSES projects have been incorporated into BSS223 to develop the workshop presentations, and the grower and industry IPM manuals.



Integrated pest management as a means of reducing pest numbers is a more complicated system than the single strategy of insecticides. The sugar industry has relied on the use of a single insecticide for control of greyback canegrubs. Because of this, growers and advisory staff are reluctant to change to any new system of pest control, which is seen as being complicated and time consuming.

The project is designed to involve and educate growers and advisory staff of the long-term benefits and increased profitability of greyback canegrub IPM systems. This project will facilitate the adoption of IPM principles and strategies through a series of workshops and

the development of information booklets and fact sheets. Finally, the project will increase the knowledge base of BSES, CPPB and other sugar industry staff on the biology of greyback canegrubs and the strategies used to reduce their damage in order to maintain a sustainable industry. IPM relies on a good understanding of pest ecology, which may have not been necessary with the sole reliance on insecticides in the past.

The project aims at producing an IPM manual and associated workshop, detailing the strategies that growers can use, which will reduce the damage caused by greyback canegrubs. Workshops will give the participants confidence and experience in greyback canegrub IPM concepts and strategies.

This project offers an introduction for most growers to the system of IPM of greyback canegrubs. This will help educate growers and research staff on the concepts and strategies of IPM, and provide fundamental information on IPM and its use in reducing grub damage.

By running project BSS223 in conjunction with extension adoption projects 2106 and 2083, growers will have information detailing the management of greyback canegrub delivered through individual contact, group contact, on-farm demonstrations of management products and strategies, written information (newsletters, manuals, fact sheets, etc.), and through consultation with research staff and other growers.

2.0 OBJECTIVES

This project aims to reduce the growers' level of canegrub damage on farm through a better understanding and increased adoption of IPM strategies and understanding of canegrub ecology through a series of workshops. In addition, the project will become part of an integral link between BSES internal projects 2106 and 2083 and other funded projects that will involve greyback canegrub. The project objectives are to:

- actively seek growers and local industry ideas and decisions pertaining to the management of greyback canegrubs;
- involve growers and local industry in all aspects of grub management linked to both this project and BSES internal projects 2106 and 2083;
- create awareness and gain adoption of IPM for greyback control;
- package current research ideas and findings for greyback canegrub management into structured training workshops, where growers and advisers can assess the practical implications and economics of using new management techniques;
- produce an IPM manual for the management of greyback canegrub, which can be used by growers both at the workshop and in the field;
- review the current IPM canegrub strategies and continually upgrade the workshop manuals and course material;
- contribute to the success of the proposal on enhanced adoption of IPM submitted by Peter Samson.

Upon completion of the project, 70% of grub affected growers in the Burdekin district should have successfully completed the IPM workshop, and 90% of relevant BSES and CPPB staff should have completed the IPM workshop.

3.0 METHODS

The project's investigator created grower action groups involved with the construction of an Integrated Pest Management (IPM) Manual and associated workshop presentations, for the control of greyback canegrubs in both the Burdekin district and other districts affected by the greyback canegrub. The manual and workshop series provided growers and industry staff with information on the greyback canegrub's biology, information on identification of greyback canegrub, list of known natural canegrub diseases, and associated biological insecticides, current information on correct insecticide use for both larval and beetle management, and cultural controls that can be used to manipulate greyback canegrubs. Finally, the information brought together the different types of management options that can be used and detailed how these management options can be combined in an IPM program for greyback canegrubs.

Information collated from this project was used in conjunction with projects 2106 and 2083, to offer growers a complete package to manage the level of greyback canegrub damage. With the inclusion of this project, growers have readily available information that they can use when adopting farm management strategies to reduce the level of grub damage on their properties.

Two surveys were sent out to growers to gauge their level of understanding of IPM principles and management strategies used to reduce greyback canegrub damage. The first survey was sent out at the beginning of the project (1999) and the second survey near the completion of this project (2002). These surveys were used to assess changes in the growers' knowledge and practices during the course of this project.

As new information was received, and new management techniques were developed the greyback canegrub IPM manual and associated workshop material were continually updated to contain these strategies for canegrub management. As new information becomes available, growers will be encouraged to attend additional refresher canegrub management workshops.

4.0 RESULTS

4.1 Greyback canegrub consultative committee, grower groups and area-wide management

Greyback canegrub consultative committee

Intrinsic to the success of BSS223 was the development of a program of works that allowed for industry ownership of the project. To aid industry in developing a sense of ownership of the project, a greyback canegrub consultative committee was formed. The composition of the consultative committee was developed with the main aim of showing growers that the project had whole-of-industry support. Industry participants in the committee included BSES, SRDC, CPPBs, mill suppliers committees, Burdekin CANEGROWERS Executive, CSR mills and ACFA. General community representation from local council, environmental groups and local business was also sought; however, these groups were not often present at the committee meetings. The committee's task was to:

- provide industry support in relation to the IPM strategies for the control of greyback canegrub;
- identify and discuss key issues and policies relating to canegrub management;
- identify and liaise with industry funding bodies to access funds that could improve industry sustainability through improved grub management;
- provide feedback in relation to the content, layout and delivery of the greyback canegrub integrated pest management workshops and grower manual.

Grower focus groups

In addition to the greyback canegrub consultative committee, project BSS223 developed what was termed “canegrub focus groups”. Canegrub focus groups are grower groups that met to discuss and implement grub management strategies to reduce grub damage. The objective of the groups was to devise a grub management strategy for both the short and long term while maintaining farm profitability and sustainability. Focus groups were dynamic and open to discuss a whole range of sugar industry issues. Focus groups provided an excellent opportunity to recruit growers for demonstration trials. Furthermore, established demonstration trials provided a discussion point for the focus groups. By involving growers directly in the process, it is more likely that they will take ownership of the IPM practices. This in time should lead to greater adoption of practices proven to be beneficial through the on-farm trial process. These groups were designed to provide growers with a format through which they could openly discuss and implement new IPM strategies to reduce grub damage with both advisory staff and fellow growers. The reasoning behind the focus groups approach is that it identifies that most growers are far more accepting of new information if it has been identified that it works by a fellow grower. Development of IPM systems in conjunction with grower groups allows for the further development of what is termed area-wide management (AWM).

In total there were 16 grower groups, with approximately 20 growers per group, running in the Burdekin district from 1999 to 2001. In 2002, the Burdekin sugar industry embarked on a productivity initiative that also utilizes a grower group process for extending information. This initiative uses 46 groups with 15 growers per group through the Burdekin district. It was therefore decided that the canegrub focus groups should be rolled over into the newly developed productivity grower groups.

Area-wide management (AWM)

In addition to managing canegrub populations on a farm basis, growers should look at the option of an area-wide management plan. Area-wide management is simply combining growers and farms in the management of greyback canegrubs.

The reason for undertaking AWM for the control of canegrubs is that the level of grub infestation on any one farm is dependent on the size of the grub population in a given area. In addition, every action that an individual grower takes to minimise grub damage on their own property directly affects the damage that may occur on a neighbour's farm and vice versa.

For example, it has been common practice in the Burdekin over the last few years to hold sugarcane back and to plant sugarcane late to minimise grub damage. What this has done is to move grubs on to a neighbour's farm. This grower suffering from grub damage now

in turn adopts the same management tool of late planting and slowing cane growth, which results in the further spread of grub damage to the next farm and so on.

Observation of the spread of grub damage within the Burdekin indicates that through the adoption of late planting and the holding back of early harvested sugarcane, growers have inadvertently moved grub damage into first and second ratoon blocks of cane. At present these areas do not show significantly reduced grub numbers and therefore help to keep grub numbers at a high level.

With the aid of BSS223 and internal projects 2106 and 2083, it was possible to develop a strategy for IPM which utilised individuals, groups, areas, and regional dynamics which all had a common goal of reducing the impact of greyback canegrub. In addition, the system developed allowed for industry to have ownership of the identified strategies relating to IPM.

4.2 GrubPlan Manual and Greyback Canegrub IPM Manual

The GrubPlan Manual (see Appendix 1) was developed in conjunction with BSS225, Enhanced adoption of integrated pest management in sugarcane. The manual provides growers with the base material that can easily be used in the field to distinguish greyback canegrub larvae from other related canegrub species. The manual describes in detail each stage of the greyback canegrub's life cycle. The GrubPlan Manual provides the user with information on the products available for the control of canegrubs in both plant and ratoon crops. Available control products are discussed in detail within the manual to include information that is vital for the correct application and placement of the product to maximise its performance and longevity. The cultural practice of trap cropping is also explained in depth within the manual. Trap cropping has been shown to be effective in manipulating the flight patterns of adult beetles, and corresponding grub damage, to areas where growers can have a greater influence in controlling grub damage. Finally, the manual provides growers with guidance on how to set out a whole-of-farm management plan to minimise grub damage and maximise the effectiveness of available insecticides. Critical to the development of the farm management strategy is the development of a risk assessment plan that takes into consideration the risk associated to a block, field, farm and area growing sugarcane and sustaining grub damage.

In addition to the GrubPlan Manual, a more in-depth manual has been completed for industry advisory staff, Greyback Canegrub Integrated Pest Management Manual (see Appendix 2). This manual contains the following sections on the management of greyback canegrubs.

- Introduction to the biology and identification of greyback canegrubs.
- Available insecticide products for the control of greyback canegrubs, correct application methods and benefits of use for each of the products.
- Biological controls and natural diseases (pathogens) of greyback canegrubs.
- Cultural management strategies, trap cropping, light trapping, minimum tillage planting, green cane trash blanketing.
- Existing variety tolerance to grub damage.
- Genetically modified cane plants for tolerance and resistance.
- An introduction to IPM and greyback canegrub IPM, farm risk assessment and whole-of-farm planning for canegrub management.

- Case study scenarios to aid in the arrangement and implementation of farm plans.
- Cost-benefit analysis of various canegrub management options compiled by Macarthur Agribusiness and BSES.

4.3 GrubPlan workshop and Greyback canegrub IPM workshop

In conjunction with the grower and advisory manuals, a series of workshop presentations was developed. The workshops were designed to provide a summary of information to growers and advisory staff that is covered in the manuals. The workshops also allow for both growers and advisory staff to interact in an adult learning environment, and for open discussion in relation to canegrub management strategies. It should be remembered that the strategies put forward in the manual and workshop series are not designed to be the only possible solution to reduce grub damage. It is often the case that growers and advisory staff can identify new or modify already existing strategies to reduce grub damage.

In total, 399 Burdekin growers took part in the GrubPlan initiative undertaken in 2001. The total included more than 90% of growers who were affected by greyback canegrubs at that point in time. As part of that initiative growers were run through the workshop documenting IPM strategies for grub control. Prior to the GrubPlan initiative some 150 Burdekin growers and 50 advisory staff had also been through the more detailed greyback canegrub IPM workshop. These represented more than 70% of relevant industry advisors who were working in greyback canegrub affected areas within the state.

4.4 Grower and advisory staff workshops

During the course of this project over 90% of industry advisory staff and 399 Burdekin canegrowers attended the GrubPlan series of workshops that were conducted in 2001 to inform growers of the principles of greyback canegrub integrated pest management and the methods that are currently available for the control of greyback canegrubs. The presentations that were given to the two groups (growers and industry staff) contained similar information topics but growers were given an abridged version (see Appendix 3, Grower workshop and Appendix 4, Advisory staff workshop). The major focus of the workshops was to complement the growers' knowledge of the greyback canegrub and develop the concept of whole farm management for the control of greyback canegrubs.

The GrubPlan workshops also covered introductory material pertaining to the biology and life cycle of the greyback canegrub, which gave growers the ability to identify whether the canegrubs in their fields were actually the greyback canegrub and not another species. Information was also presented on currently available products and cultural practices used for grub control, eg insecticides and trap cropping. Trial results of these chemical and cultural controls were also used to illustrate to growers the benefits of utilising these treatments in relation to not treating areas that have an inherent high risk for receiving grub damage, eg early plant cane blocks along the Burdekin River. Finally, the workshops ran through a demonstration farm map that provided growers with the opportunity to develop a plan to manage grub damage on a farm scale. This process gave growers practical experience in developing grub management plans so that the knowledge gained from the workshops could then be implemented on their own farms.

The feedback from growers after the first series of workshops was quite positive with the majority of growers indicating that the content covered during the workshop was interesting and very useful for the future management of greyback canegrubs. Growers also indicated that they would appreciate follow up workshops to keep them informed of any new management techniques and/or chemicals that may come through in the future that will help them in continuing to reduce their level of grub damage.

The GrubPlan workshops have continued to be conducted in greyback canegrub prone districts in 2002, the first series of workshops conducted in the Burdekin district involved growers from the Inkerman milling area. The focus of these workshops was to get growers to express any concerns that they have or have had with the management strategies they adopted in 2001. The final aim of the 2002 GrubPlan series of workshops was to get growers to develop canegrub management plans (whole-of-farm management plans) using their own farm maps.

Allowing growers to use their own farm maps to set out a management strategy provided them with the ability to see how different management strategies can be implemented on their farms and what management options would best suit their farming operations. Growers can assess what fields are potentially at a high or low risk of sustaining grub damage and treat those areas accordingly. By developing a personalised grub management plan growers are actually learning by doing, thus constantly increasing their knowledge and management of the greyback canegrub. By developing and implementing a personalised farm management plan, the grower is going to potentially reduce grub damage, minimise the cost of insecticides over an extended period of time, maintain or increase productivity, and maintain a crop rotation pattern that allows for more time to be spent on other activities besides having to replant badly grub damaged blocks.

4.5 Comparison of the results from the 1999 and 2002 greyback canegrub management surveys

As part of this project, two surveys were sent to Burdekin canegrowers affected by greyback canegrubs in 1999 and 2002.

Comparing the grower responses to the grub management questionnaires sent out in 1999 and 2002 some significant changes were noticeable. The majority of canegrub damage in 2002 has been confined to a smaller proportion of individual farms in comparison to 1999. In 1999, 51% of growers had grub damage on more than 40% of their farms. In 2002, this has dropped to 38% of growers with more than 40% grub damage on their farms. Growers in 2002 have said that canegrub damage is causing an average production loss of 23 t/ha, this has increased since 1999 with more growers becoming aware of how much canegrubs can affect productivity. The majority of growers in 1999 estimated their loss from canegrubs to be between 0-20 t/ha.

The use of canegrub control methods has continued to increase in 2002 with growers treating crops with suSCon® Plus, BioCane™ and/or Confidor®. In relation to tackling the canegrub problem, most the growers mention the need for a cheap "silver bullet" in 1999. Growers also mentioned in the 1999 survey the need to have a chemical to treat ratoon crops; that option is now available with the use of Confidor®. In 2002, growers expressed interest in a costing analysis that would highlight the costs and benefits of their grub management strategies. This option is now available with the completion of the Macarthur Agribusiness Best Management Practice Model.

Growers were asked in 1999 and 2002 how the grub problem could be reduced in the Burdekin. In 1999, growers were more concerned with having new chemicals to target the problem. The major response in 2002 was to increase the level of adoption of grub control techniques throughout the Burdekin district and having every grower affected by canegrubs treating their plant and first ratoon crops.

4.6 Summary of the 1999 greyback canegrub management survey

Of those growers who returned questionnaires, 7.6% denied having grub damage on their farms. While it's a concern that some growers will not admit that they have grub damage, this figure is a vast improvement on previous survey results conducted by local CPPB where estimates as high as 25% of growers not admitting the presence of grub damage have been recorded. At the time of the 1999 survey many growers believed that the presence of grub damage was a reflection of poor farming practice. For the full report see Appendix 5.

Previous surveys of grub damage in 1998 indicated that on average approximately 23 hectares of damage were found on each grub-damaged farm. Additional information from the survey showed that damage on most farms by grubs ranged from 0 to 20 hectares. Given that the average size of a delta farm is 70 hectares this equates to 29 % of a farm being affected by grubs on an annual basis.

There has been criticism from growers that the local CPPB estimate for the reduction in tonnes per hectare due to grubs is too low. This survey is the first to gauge what growers believe is the loss in tonnes per hectare from grub damage. Most estimates from growers of cane loss attributed to canegrubs ranged from 0-20 tonnes per hectare. Burdekin CPPB estimates have in the past been set at 30 tonnes per hectare and are now as high as 55 tonnes cane per hectare for moderate to severe infestations.

Analysis of the treatments used to reduce grub damage indicated that 87.6% of growers used an insecticide to reduce grub damage. Of the insecticides used, suSCon® Blue equated to 82.6% of use followed by Carbaryl® 51.2 % and then *Metarhizium* (BioCane™) with 6.7%. It was thought that many growers had the belief that replanting was more cost effective than using an insecticide (suSCon® Blue, Carbaryl® and BioCane™).

Growers indicated that management strategies involving cultural controls had been used as a tool to reduce grub damage. The use of strategies such as late planting either by itself or in conjunction with other cultural control practices totalled 80% in previous years. Of the major cultural controls used to reduce grub damage, late planting, trap cropping and irrigation management were the main strategies used, totalling 85% use by growers.

In growers minds, suSCon® Blue offered control of canegrubs in plant cane and first ratoon with little planning needed and ease of operation compared to IPM strategies. Many growers expressed dissatisfaction with the results they received when using cultural based controls. Many growers commented that the use of cultural controls only reduced grub damage not grub numbers.

An interesting point from the survey was the fact that although many growers were late planting, there was still a large amount of insecticide being applied to the late plant. Given the expenses associated with the application of insecticide products (\$400-\$500 per hectare), many growers were spending large sums of money for the control of canegrubs.

In addition, many of the late planted areas that were treated with suSCon® Blue were not being targeted by canegrubs. BSES trials indicated that growers would find it more cost effective if they were to get back into an early plant crop strategy, thus concentrating grub numbers in early plant cane and then treating the early plant with insecticide products.

Reports from past BSES/SRDC projects (Project BS120S Key factors in the control of greyback canegrub populations, Robertson *et al.*, 1998) have given evidence supporting the use of green cane trash blanketing (GCTB) as a management tool for the reduction of grub numbers. Despite these findings, results from the survey indicate very few growers in the Burdekin have used or will use GCTB as a tool for the management of canegrubs. The principal reason for this is linked to difficulties associated with irrigation, harvesting, farm development, and the perceived decrease in crop productivity when using a GCTB system. If these associated problems cannot be managed, the use of GCTB in the Burdekin will never eventuate. The number of growers who use GCTB in an attempt to reduce the level of grub damage is quite low, only 23% of growers having used GCTB. The majority of the farm area that is being harvested green is between 10–30 hectares.

Another facet of SRDC project BS120S was experimentation with reduced cultivation and its effect on grub numbers through the buildup of canegrub diseases. Initial trial results indicated canegrub disease levels were higher in soils where reduced cultivation, particularly in the plough-out, were practised. In addition, the technique of reduced cultivation during the plough-out dramatically reduces the cost attributed to replanting sugarcane.

Given these results, Burdekin BSES has encouraged growers in the last two years to use the technique of reduced tillage planting and the reduction of cultivation during the cropping cycle. Results from the survey indicate that adoption of this strategy has been encouraging with 28.3 % of growers using minimum till planting and 67.5 % of growers reducing cultivation during crop growth.

Over the last four to five years, BSES and the local industry have been researching and developing the biological insecticide BioCane™ (*Metarhizium anisopliae*). Development of BioCane™ has given reductions of grub numbers in the order of 50% to 60% in both plant cane and first ratoon crops. Despite the results, some grower groups have been disappointed in the product. The survey conducted in 1999 indicated that 82% of growers said they would be willing to use BioCane™ when the product became commercially available.

Results from the 1999 survey indicated that 62.8% of growers have used light traps; however, due to less than convincing results, many chose not to use them as a control method. In 1998, some 31.9% of growers were using light traps, with most growers only having a single light trap for use in indicating when beetle flights were occurring.

The survey asked growers to identify any areas of research regarding the management of greyback canegrub that was either not currently being done or needed further emphasis to give a result.

Most growers highlighted the need for further research work on the identification of new, improved chemical insecticides to replace suSCon® Blue. Further comments along the same line of thought included the fact that BSES is putting too much effort into “green” techniques for reducing grub numbers. General consensus also spoke of the need for research work into the use of chemical insecticides in ratoon cane crops.

Within BSES and some sugar industry and research funding bodies it was believed that growers had no understanding of the term IPM and the strategies involved in the control of greyback canegrub. Because of this, research and extension services have gone to great lengths to simplify the way in which information concerning IPM for the control of greyback canegrub is distributed to growers.

While most of them were aware of IPM strategies for the reduction of grub damage, many found BSES ideas lacking credibility through either ignorance or a lack of want for experimentation, preferring to let the neighbour trial the strategies first. Many of the replies also intimated that to reduce grub numbers a chemical is needed now and IPM strategies can then be used once grub numbers are brought back down to manageable levels.

In relation to the question of how to reduce the level of grub damage in the Burdekin, most growers still wanted the “silver bullet”, that magical chemical control which would eradicate all the grubs from a particular block of cane. While many of the growers surveyed fully understood the concepts and control strategies of IPM, most were of the opinion that a chemical control would be better. In addition, most believed that while IPM of greyback canegrubs had a place, the only way to bring grub numbers down successfully was to use a chemical insecticide.

Grower attitude seemed to be one of frustration and anger over the damage being done by greyback canegrub and the supposed lack of research results in identifying a strategy to solve the current grub problem.

4.7 Summary of the 2002 greyback canegrub management survey

In 2002, a final survey of Burdekin growers was conducted to determine if grower practices in managing greyback canegrub had altered from that in 1999. In addition, the survey tried to quantify the beliefs and thoughts of growers in relation to grub management and the IPM plans that BSES and the industry were trying to sell to growers. For the full report see Appendix 6.

Results from the survey indicated that 94% of the growers received canegrub damage on their farm prior to 2002. The average area affected by canegrubs was approximately 41 hectares (or 40%), with an associated cost to the grower of approximately \$40,000. Some growers could only give the cost of the chemical control treatments they used and not the overall cost of lost production. This is often the case because most growers have a poor understanding of their overall costs of production.

The canegrub damage levels were approximately 17% heavily damaged, 15% moderately damaged, 20% had light damage and 48% of the cane production area on average was not damaged. Thirty-two per cent of growers expect less damage this season, 31% said that it was too early to tell, 28% expect damage to remain the same, and only 8% expect to receive more canegrub damage this year. These results suggest that the majority of growers have faith in the grub management options that they have adopted and those being developed by BSES.

Seventy-seven per cent of growers had attended the GrubPlan workshops held in 2001. The adoption level of farm management plans developed during the GrubPlan workshops was high, with over 55% of growers implementing more than 80% of their grub

management strategies. The major reason why growers attended the workshops was to receive the latest information on new developments in canegrub management, and to learn about Confidor® and its application.

Eighty-five per cent of growers are using chemicals to minimise canegrub damage. The most widely used insecticide was suSCon® Plus, with 74% of the surveyed growers using this product in plant crops. The most popular cultural practice used by growers is trap cropping, with 48% of growers manipulating the adult beetle's flight behaviour to their advantage.

The survey highlighted that a large number of growers did not know the cost or benefits of the canegrub control strategies that they were using. Only 14% of growers knew what their return on investment was for grub control. The survey also highlighted that the vast majority of growers believed that the following services would be of high value to them in relation to canegrub management. These include beetle and grub number recording, product monitoring, damage recording, and farm risk assessment. In addition, 30% of the growers said that they would be willing to pay for the above services.

Generally growers understand the concepts behind whole farm management in reducing the potential level of damage caused by canegrubs. With a large majority of growers believing that the only way to reduce the canegrub population at present is to get as many growers as possible implementing some form of grub management. But the greatest deterrent for growers in using some of the products available is the initial cost. In addition, growers commented that there is no guarantee that the product will effectively control all greyback canegrubs present in the crop.

4.8 Macarthur Agribusiness cost-benefit analysis of canegrub management options

In conjunction with Project BSS223, Macarthur Agribusiness developed a best management practice (BMP) model that can be used to determine the approximate financial costs or benefits of utilising various management strategies for the control of greyback canegrubs.

The Macarthur Agribusiness BMP model was used to develop the following cost-benefit analyses for a variety of canegrub management options currently used and promoted to the industry. These management strategies include the use of suSCon® Plus in early plant cane, BioCane™ in early plant cane in areas with a low to moderate risk of receiving grub damage, the use of Confidor® in early harvested first ratoons and also in ratoon trap crops.

The cost-benefit analysis worksheet in the Macarthur model provides the following outputs: net present value comparison between no damage, damage and treating; and cumulative net cash flow over the cropping period, comparing no damage, damage and treating. The final analysis table in the cost-benefit worksheet illustrates the total benefits and costs comparison between treating and not treating.

Below are the cost-benefit analyses of different canegrub management scenarios that were developed by Macarthur Agribusiness in conjunction with BSES. The examples illustrate the costs and benefits of using various management options to reduce the impact of greyback canegrubs on the productivity and profitability of canegrowers, particularly in

the Burdekin district. The scenarios included in this final report make the following assumptions that remain the same no matter what management options are implemented. The model used a calendar of operations commonly used to grow a crop of cane in the Burdekin district. The cost of harvesting, time of harvesting, price of sugar, and overhead costs all remain the same no matter what management option is implemented. The only operations that will change are the application of various insecticide treatments, and the level of damage caused by canegrubs at different levels of grub pressure (high and low grub pressure).

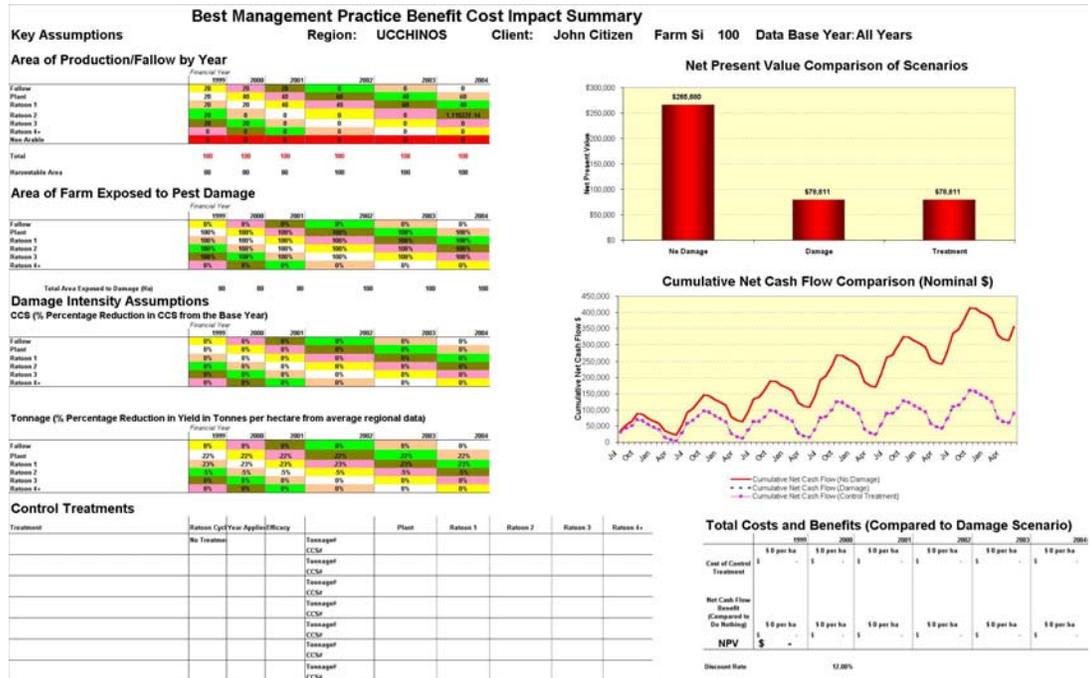


Figure 1 – Cost-benefit analysis worksheet illustrating the cost of replanting grub damaged blocks.

A majority of growers, particularly in the Burdekin district, have the impression that ploughing out and replanting a canegrub affected block is more cost effective than outlaying dollars for insecticides treatments in plant cane. The first cost-benefit analysis worksheet (Figure 1) illustrates the cost to a grower of having to replant first ratoon blocks that were severely damaged by greyback canegrubs in both the plant crop and first ratoon crops. The key assumptions made in this scenario are different to the scenarios represented by Figures 2 to 4. This difference is due to replanting; the grower can no longer maintain a crop rotation cycle similar to the other scenarios. The grower in this scenario harvests his plant and first ratoon crops. After the first ratoon crop is harvested, it is ploughed out due to heavy grub damage and poor ratooning. These ploughed out blocks are later replanted (not fallowed). The key assumption in regard to the ratoon structure of this example shows that as the first ratoon crop is harvested it is ploughed out. In the first year (1999) of the model's prediction, the normal ratoon structure exists. As the model runs through the years, the second ratoon block is allowed to go through to third ratoon and will be ploughed out the following year. This practice or management strategy is quite costly in comparison to utilising other management treatments that are illustrated in the following examples.

In some circumstances in the year 2001, growers in the Burdekin district treated all their early cut ratoons with Confidor®. The following scenario (Figure 2) illustrates the cost benefit of utilising suSCon® Plus in plant cane and Confidor® in first ratoons as a management option for the control of canegrub damage. The ratoon cycle is maintained from plant through to third ratoons for the scenarios that are treated with some form of chemical. The total benefits and costs comparison table (see Figure 2) illustrates that for this particular scenario the grower would not be financially better off using these two treatments in combination as a management option. The main contributing factor to the problem with implementing this treatment as a management option is the total cost of the combined canegrub insecticide treatments. However, if the grub pressure or loss from canegrubs damage were to increase above that used for this scenario (see key assumptions, Figure 2) then this management option could result in a positive return to the grower. At the current level of grub damage this canegrub management strategy is not a financially viable option.

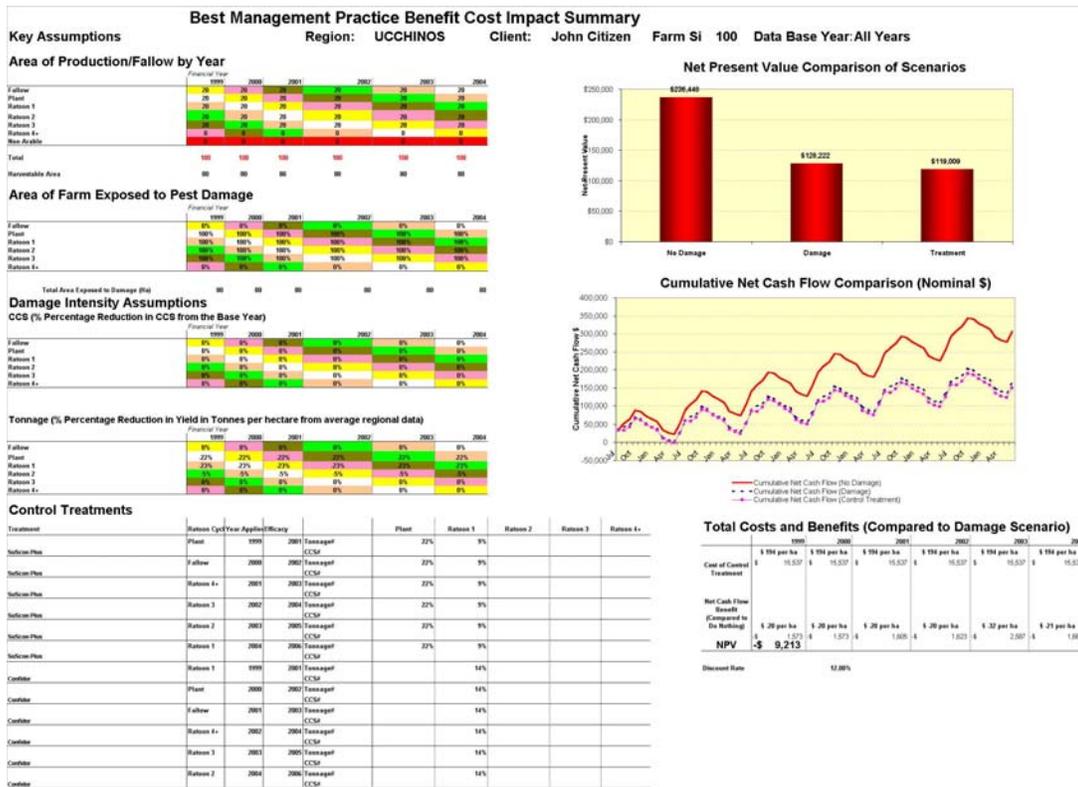


Figure 2 – Cost-benefit analysis of utilising suSCon® Plus in plant cane and Confidor® in first ratoon blocks.

Figure 3 shows that the benefit of using suSCon® Plus as a sole management option is more financially beneficial than using the combination of suSCon® Plus and Confidor® as shown previously in Figure 2 (only when using the same key assumptions for all canegrub management scenarios). The total benefits and costs comparison (see Figure 3) of using suSCon® Plus in this particular scenario provided the grower with an approximate net return of \$14,400 compared to not treating. This management scenario provided the grower the best net return when only using a single management technique (the application of one insecticide treatment) to minimise damage for this particular level of canegrub pressure.

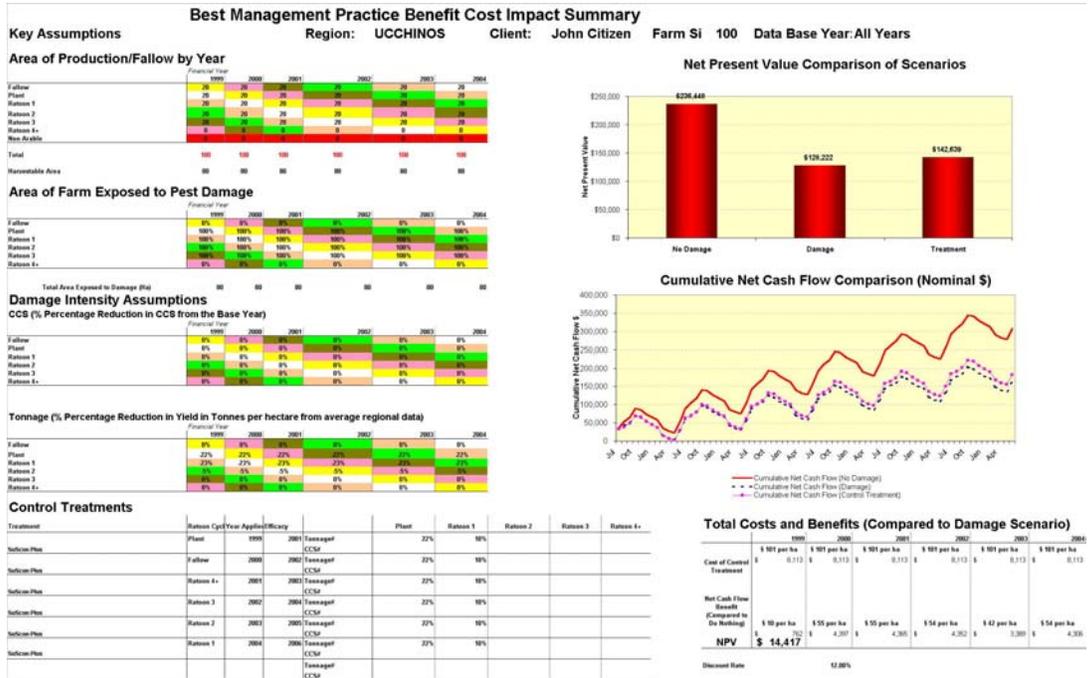


Figure 3 – Cost-benefit of using suSCon® Plus as a management option for the control of canegrubs.

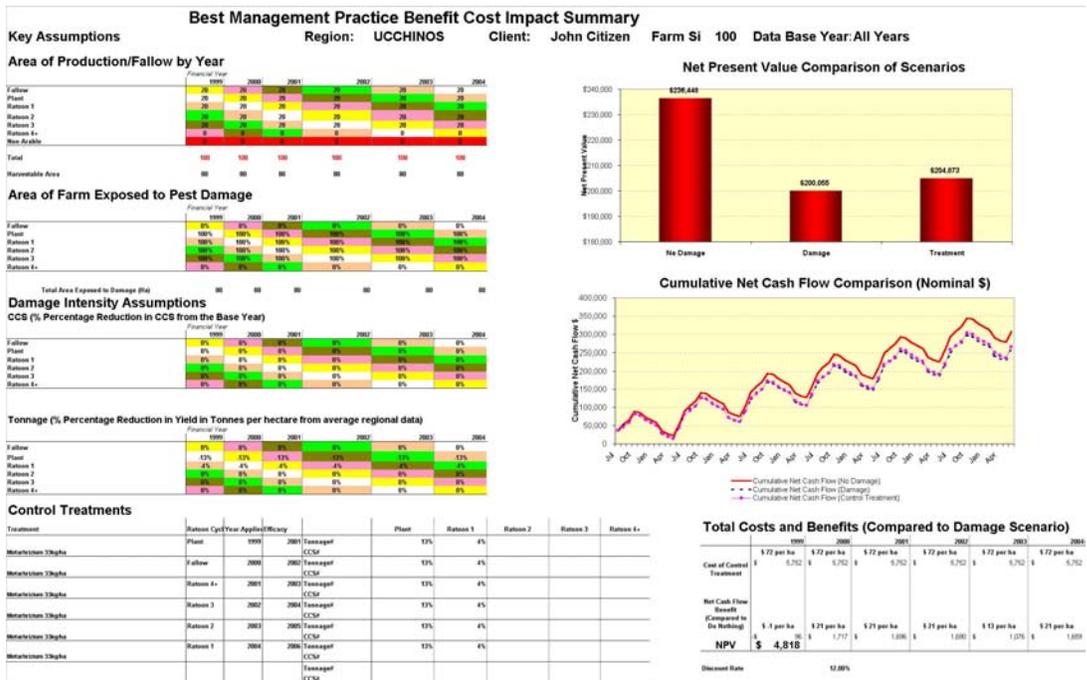


Figure 4 – Cost-benefit analysis of using BioCane™ in a low risk area for the management of canegrubs.

BioCane™ is recommended to the industry for use in areas that have low to moderate risk of receiving canegrub damage. For this scenario, the key assumptions made in the model regarding grub damage (grub pressure) were altered to simulate a low grub risk situation. Figure 4 shows that the key assumptions associated with the tonnes lost from canegrubs were lowered to 13% loss in plant cane and 5% loss in first ratoon crops. By simulating the low grub risk scenarios, the model has shown that treating early plant cane with BioCane™ produced a net benefit to the grower of \$4,800 in comparison to doing nothing. The use of suSCon® Plus as a management tool at this particular level of grub pressure does not warrant the expense. The total net cost or benefit of using suSCon® Plus in a low risk area ends up becoming a financial burden to the grower.

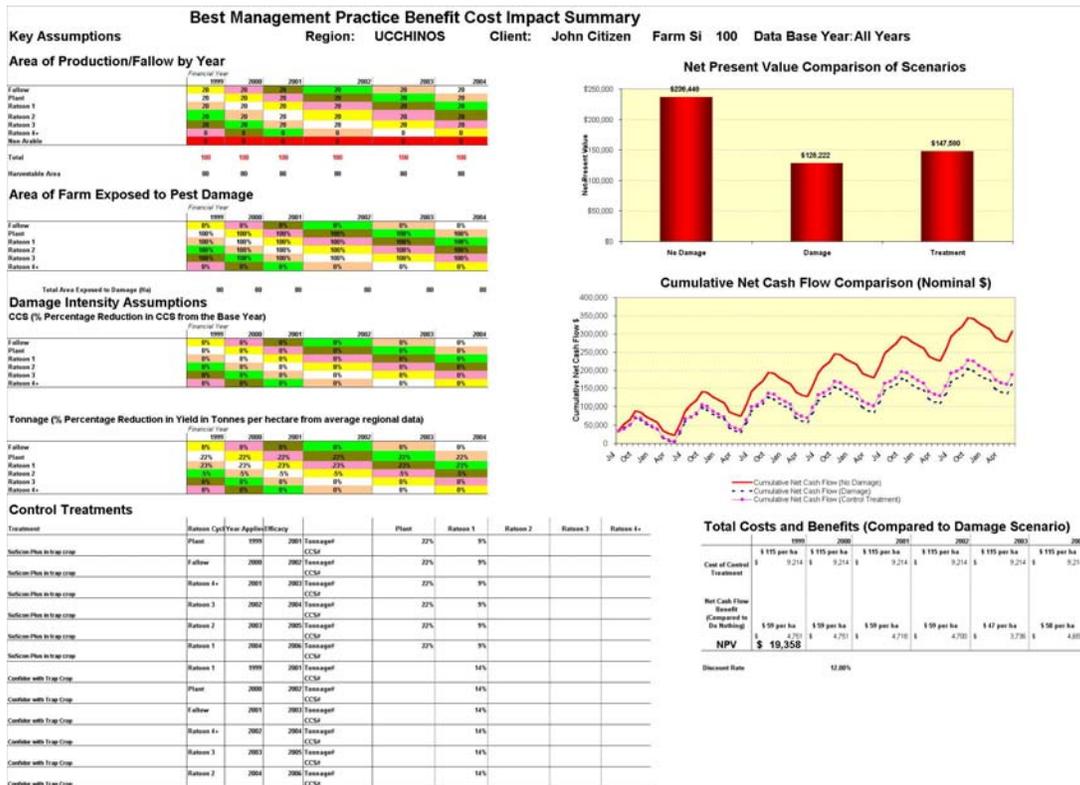


Figure 5 – Cost-benefit analysis of using suSCon® Plus in plant cane and Confidor® in conjunction with trap cropping in first ratoons.

The use of a more integrated management approach to minimise canegrub damage is being promoted to the industry through the GrubPlan workshops. With the increased movement of growers back into an early plant cropping rotation, growers in a high risk canegrub area are treating all their early plant cane with suSCon® Plus. Another canegrub management strategy that is now becoming widely adopted by Burdekin canegrowers is the use of ratoon trap cropping and treating these trap crop areas with Confidor®. Figure 5 illustrates the management scenario of using suSCon® Plus in an early plant crop, utilising a trap crop in early cut first ratoons and treating this trap crop area with Confidor®.

The trap crop is 10% of the total area of first ratoon block, which for this scenario represents two hectares. Utilising trap crops for canegrub management in ratoons reduces the overall costs associated with chemical treatments, and potentially increases the net return to the grower by reducing the level of expenditure. The other main assumption used by the model in this scenario was, when allocating an area to be treated as a trap crop, the remaining 90% of the first ratoon block will yield the same as the trap crop (ie no reduction in yield from trap cropping).

According to the outputs derived from the BMP model, the implementation of this management strategy has the potential to return the greatest benefit to the grower. The total cost-benefit comparison table (see Figure 5) for this scenario shows that the grower could receive a potential net benefit of approximately \$19,300. This is an increase of approximately \$5,000 compared to the use of suSCon® Plus alone as a management option.

The greyback canegrub management scenarios developed by the Macarthur Agribusiness Best Management Practice Model show that implementing various strategies provide growers with financial benefits compared to not treating. The model's versatility allows the user to customise the inputs so that the end result is more likely to represent the grower's situation and allows the grower to make more accurate decisions relating to the management of greyback canegrubs for future cropping cycles.

5.0 OUTPUTS

- Project BSS223 worked in association with other SRDC and internal projects relating to greyback canegrubs, which led to the development of and inclusion of products such as Confidor® as an additional tool for the management of canegrubs for ratoon crops and trap cropping; manipulating the flight and behavioural patterns of the adult beetles to the advantage of the grower.
- The running of the workshops and the production of the GrubPlan manual led to an increased adoption of trap cropping, especially in the Burdekin, as a means of reducing the overall level of grub damage in a particular area, thus further reducing the total cost of controlling greyback canegrubs in a whole-of-farm management system. With the availability of Confidor® growers now have the opportunity to treat trap crops thus protecting them from severe grub damage. In the past these trap crop areas were treated as sacrifice areas and were generally ploughed out after severe grub infestation due to poor ratooning.
- The greyback canegrub consultative committee and the grower groups, working collectively, allowed the development and increased adoption of the principles of IPM for greyback canegrubs by canegrowers. This created a greater level of grower awareness of canegrub IPM methodology. A risk assessment planning process for minimising grub damage through the strategic use of insecticides in combination with other cultural practices was developed. Trials using current commercial cane varieties were established in the Burdekin and testing for tolerance to grub damage and ratoonability after canegrub infestation was carried out.

- During the course of this project and in conjunction with projects 2083 and 2106, field trials using combinations of available insecticides to improve the efficiency and longevity of the greyback canegrub control were established. The trials included testing BioCane™ in combination with both suSCon® Plus and Confidor® at various application rates. The results have shown some promise and will continue to be tested.
- BSS223 provided the information that was extensively used to develop the GrubPlan Manual in conjunction with project BSS225. BSS223 also provided a large proportion of the information contained in the Greyback Canegrub Management CD-ROM package.
- Training workshops (GrubPlan workshops) were run for growers and industry staff, including local sales persons, informing them of the principles of greyback canegrub IPM and whole-of-farm planning, and providing background information on the biology and ecology of the greyback canegrub. The attendance levels at the workshops far exceeded the expected outcome set in the objectives. In the Burdekin, over 90% of industry representatives completed the workshops. A total of 399 growers also attended the workshops in 2001, including 378 canegrub affected growers.
- Project BSS223 was the first project linked to management of an insect pest in the Burdekin district where the support shown by industry stakeholders, principally growers and millers, resulted in a coordinated approach to encourage growers to put into practice the principles and strategies of IPM for the control of greyback canegrub.

6.0 EXPECTED OUTCOMES

As a result of the efforts made by BSS223 and related projects, the level of grub damage in the Burdekin district has decreased. Since 1993 the Burdekin CPPB has catalogued the damage sustained to sugarcane crops throughout the Burdekin district. Observation of the data indicates that the adoption of grub management strategies was evident at the conclusion of 2001. Data indicated a drop from 51% to 38% in the number of farms receiving damage from grubs. However, it also showed that the total level of grub damage in tonnes lost and hectares damaged increased. It is believed that this is a reflection of damage occurring and not occurring where growers were slow or quick at taking up the IPM strategies for grub control.

In 2002, the level of greyback canegrub damage has seen a marked decrease. The level of damage shown in Table 1 has dropped from 6,742 hectares in 2001 to approximately 1,279 hectares in 2002. The year 2001 saw the greatest level of available control products and techniques used in the Burdekin district for some time. The increase in product use can be attributed to the consolidated push by the industry through the running of the GrubPlan workshops. The area treated with insecticide was greater than the area damaged in the previous season. The area treated in 2000 was 4,100 hectares and the level of damage recorded in 2001 was 6,742 hectares, the area treated in 2001 was 8,855 hectares, which has seen a reduction in preliminary grub damage of 1,279 hectares. This would put the conservative estimated cost to the Burdekin sugar industry in lost tonnes alone at around 1.2 million dollars for 2002 in comparison to 2001 where the cost in lost tonnes would be around 7.8 million dollars.

Table 1 - Estimates of damage caused by greyback canegrub in the Burdekin ¹.

Year	Hectares damaged	Cane loss (tonnes)
1993	1,360	22,925
1994	1,534	22,981
1995	1,420	42,707
1996	1,829	42,045
1997	4,378	123,624
1998	6,582	238,000
1999	6,061	217,771
2000	5,995	213,349
2001	6,743	257,643
2002	1,279	??

¹ (Data provided pre-1997 are only from aerial surveys; 1997-2001 data are a combination of aerial survey data and grower and CPPB estimation. ?? tonnage lost for 2002 is yet to be determined)

With the development of the Macarthur Agribusiness BMP Model, the program allows the user to make financial and grub management decisions based on the outputs derived from the model using alternative management strategies. To give an example of what the model can be used for, the following cost-benefit analysis worksheet was calculated to determine the future benefit of treating an early plant cane block in a high-risk area with suSCon® Plus in comparison to doing nothing. Figure 6 shows that treating the plant cane block with suSCon® Plus provided the grower with a future net benefit of \$14,417 in comparison to doing nothing over a crop cycle of five years.

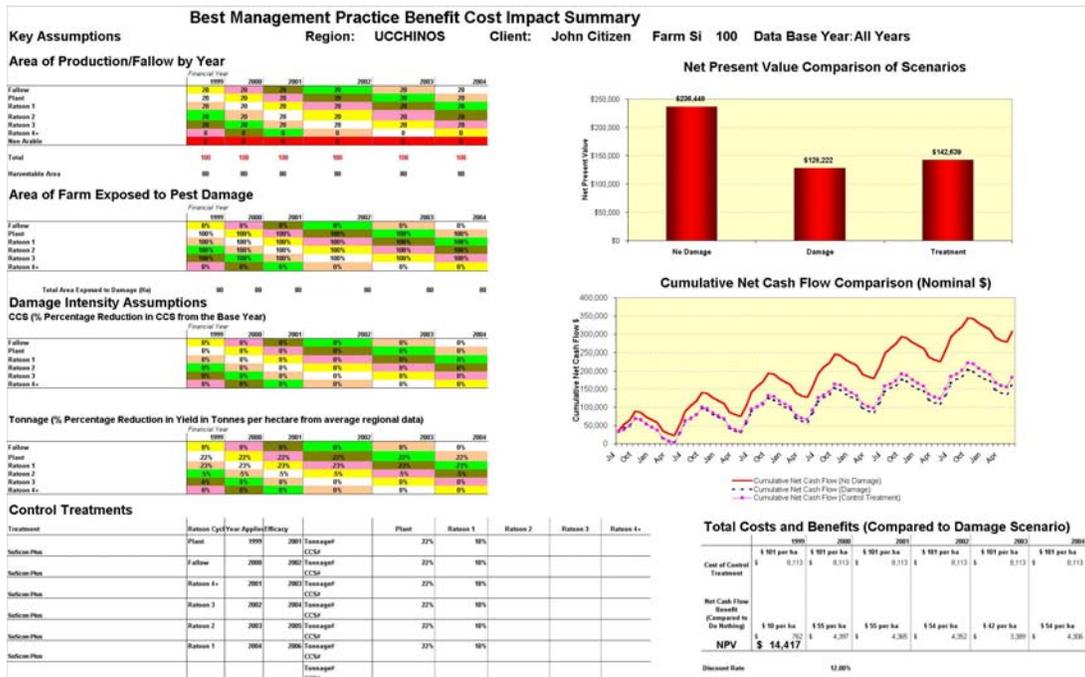


Figure 6 - Example of the Cost-Benefit Analysis worksheet that can be developed by using the Macarthur Agribusiness Best Management Practice Model.

7.0 FUTURE RESEARCH NEEDS

Although this project has concluded, canegrub research will continue. Internally funded projects 2083 and 2106 will continue to create awareness and grower adoption of the principles of IPM. Grower awareness of IPM will be created through the usual dissemination channels of one-on-one extension, group extension through sugar industry productivity groups, the development of farm demonstration trials resourced through projects 2106 and 2083, the publication of the greyback canegrub newsletter, *BSES Bulletin* articles, and local field days and bus tours.

The trials established during the course of project BSS223, looking at different combinations of available products, will continue. Funding from internal projects 2083 and 2106 will be utilised to continue trials looking into the combination of suSCon® Plus, Confidor® and BioCane™.

8.0 RECOMMENDATIONS

Greyback canegrub management strategies that have been highlighted to be successful in reducing canegrub damage will need continued refinement to make their implementation by the farming community more appealing. The implementation of these management strategies will be demonstrated to growers through the continued use of on-farm demonstration trials, one-on-one and group extension.

Research trials conducted using combinations of various insecticides established during the course of this project will continue. The results of trials thus far have shown some promise in reducing grub numbers in plant and ratoon crops for extended periods of time. The only downside of the combination trials currently being tested is the initial dollar outlay of the products in comparison to the single application of one insecticide. However, the cost over the crop cycle is somewhat reduced, due to the benefit of the products providing crop protection beyond two years.

Research has shown that the behavioural patterns of the greyback cane beetle can be manipulated to some extent through the use of trap cropping. Growers have asked the question as to whether there are additional behavioural patterns of the adults that could potentially be manipulated to benefit the grower in controlling the beetles and potential grub population. Thus providing growers with a better understanding of the behavioural patterns of the greyback canegrub and the future management options for the pest.

9.0 LIST OF PUBLICATIONS

GrubPlan Grower Manual

Greyback Canegrub Integrated Pest Management Manual

Greyback Canegrub Management – An interactive training and resource package

Fact Sheets: suSCon® Blue and Plus
Confidor®
BioCane™
Trap Cropping
GrubPlan – Whole farm management of canegrubs
Comparative costing of insecticides versus replanting

10.0 ACKNOWLEDGMENTS

I would like to thank the following BSES staff who assisted with this project – David Logan, Catherine Kettle, Keith Chandler, Annette Vandermaat and William Harris.

APPENDIX 1

GrubPlan Manual
(see separate publication)

APPENDIX 2

Greyback Canegrub Integrated Pest Management Manual (see separate publication)

APPENDIX 3 Grower Workshop

APPENDIX 4 Advisory Staff Workshop

APPENDIX 5: 1999 Greyback canegrub management survey results

Greyback canegrubs continue to be responsible for the highest monetary losses associated with pests in the sugar industry. Conservative estimates put the damage losses for the 1998 crop at more than \$10 million for the areas from Mackay through to Mossman. New outbreaks of greyback canegrub damage have been seen in Mackay, Tableland and Ingham. Areas such as the Burdekin are still recording high levels of damage caused by greyback canegrub.

The question then arises as to what causes these increases in canegrub populations and are there any management tools that growers can use that will reduce the level of damage caused by greyback canegrub?

Historically the control of greyback canegrub in northern Queensland has involved the use of organochlorine insecticides such as BHC and heptachlor. Due to the health concerns associated with the use of these insecticides they were last used for control of canegrubs in 1988. These products were then replaced by the controlled-release insecticide formulation suSCon® Blue (active constituent 140 mg/kg chlorpyrifos).

In recent times, problems associated with suSCon Blue in controlling greyback canegrub have been reported in areas such as the Burdekin and Innisfail. The current performance problems with suSCon Blue, the cost and time needed for development of new insecticides, and the environmental pressures being put on insecticides have made the industry realise that a real threat was emerging. It became obvious that sole reliance on insecticides for the reduction of grub numbers could result in a scenario far worse than is currently being seen in the sugar industry.

It became apparent that what was needed was a range of strategies that growers could use that would reduce the dependency on using only one control to reduce grub damage and at the same time offer both short- and long-term sustainability to the grower.

The use of integrated pest management (IPM) to reduce greyback canegrub damage involves the use of a range of strategies encompassing all aspects of farm management. These strategies include crop rotation, cultivation practices, irrigation practices, harvesting and planting practices (establishment of trap crops), varietal selection, nutrient usage and strategic use of insecticides.

As part of the SRDC project BSS223 (Management of greyback canegrub in sugarcane: from research to practice), a survey of grower practices in relation to management of greyback canegrubs was conducted during March 1999. It is anticipated that growers in the Burdekin region will use the results of the survey as part of a benchmark for monitoring management practices for greyback canegrub.

In the following report, a summary of the results from the survey is given, followed by an outline of the results from the questionnaire form (all tables contain actual numbers of growers while the bracketed numbers represent the percentages of growers).

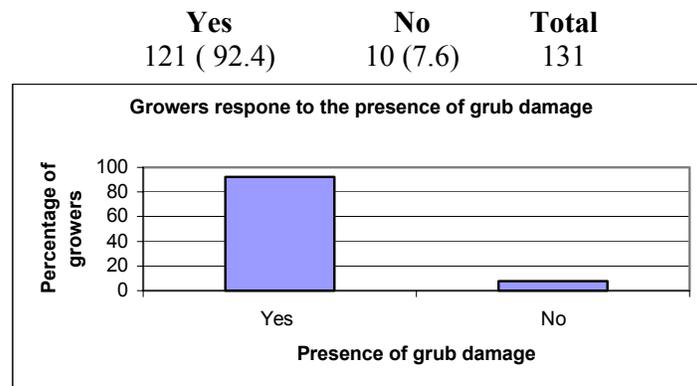
Summary of results

In March 1999, Burdekin growers known to have had greyback canegrub damage in the previous year were posted a questionnaire concerning issues relating to the amount and management of greyback canegrub damage.

In total, 678 growers were sent questionnaires to return to BSES via prepaid mail. BSES received back 131 questionnaires, or a return percentage of 19.5%.

Question 1. Do you suffer from grub damage?

Of those growers who returned questionnaires 7.6% denied having grub damage on their farms. While it is a concern that some growers will not admit that they have grub damage, this figure is a vast improvement on the results of previous surveys conducted by local CPPBs where estimates as high as 25% of growers not admitting the presence of grub damage have been recorded. It is thought that many growers believe that the presence of grub damage is a reflection of poor farming practice.



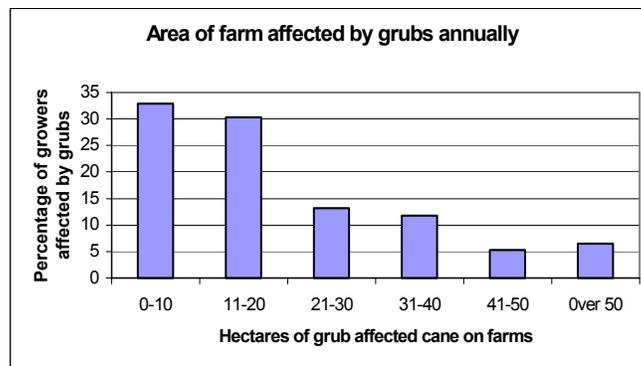
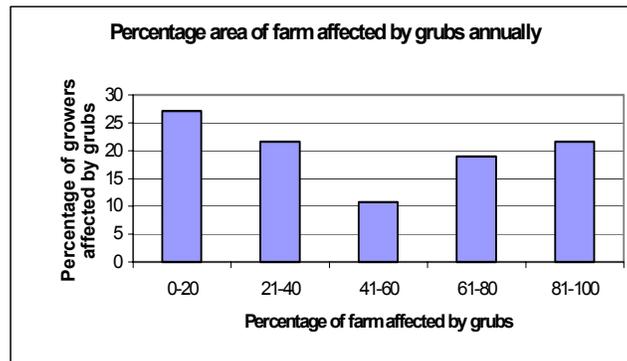
Question 2. What area would be affected by grubs on your farm annually?

On reading through the questionnaires it becomes obvious that growers are becoming frustrated with the amount of grub damage that is occurring on their farms; however, it is apparent that most growers are not fully aware of the amount of grub damage that occurs on their farms. Previous surveys of grub damage in 1998 indicated that on average approximately 23 hectares of damage were found on each grub-damaged farm. This equated to a loss of approximately 10 hectares of sugarcane per grub-damaged farm annually. Additional information from the survey showed that grub damage on most farms ranged from 0 to 20 hectares. Assuming that the average size of a delta farm is 70 hectares this equates to 29% of a farm being affected by grubs on an annual basis.

% Damaged	No. of growers
0-20	10 (27)
21-40	8 (21.6)
41-60	4 (10.8)
61-80	7 (18.9)
81-100	8 (21.6)
Total	37

Hectares damaged	No. of growers
0-10	25 (32.9)
11-20	23 (30.3)
21-30	10 (13.2)
31-40	9 (11.8)
41-50	4 (5.3)
Over 50	5 (6.5)
Total	76

18 no answers



To obtain a true estimate of damage caused by grubs on farm, growers must document blocks and areas of blocks affected by grubs and compare these figures with those when the blocks have had no grub damage. This should give an accurate summation of the loss of cane yield due to grubs, given that most farming practices and maximum yields from delta soil types have not improved in the last 10 years (internal BSES report).

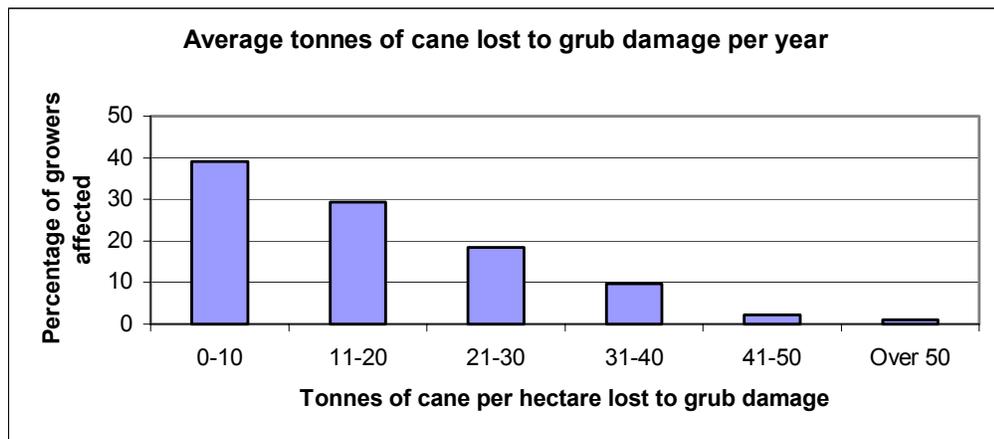
Question 3. What reduction in tonnes per hectare would grubs currently cause to your farm?

There has been criticism from growers that the local CPPB estimate for the reduction in tonnes per hectare due to grubs is too low. This survey is the first to gauge what growers believe is the loss in tonnes per hectare from grub damage.

Most growers' estimates of cane loss attributed to canegrubs ranged from 0-20 tonnes per hectare. Burdekin CPPB estimates have in the past been set at 30 tonnes cane per hectare and are now as high as 55 tonnes per hectare for moderate to severe infestations.

Tonnes lost	No. of growers
0-10	36 (39.1)
11-20	27 (29.3)
21-30	17 (18.5)
31-40	9 (9.8)
41-50	2 (2.2)
Over 50	1 (1.1)
Total	92

39 no answers



Question 4. Do you currently use any insecticides for the control of canegrubs?

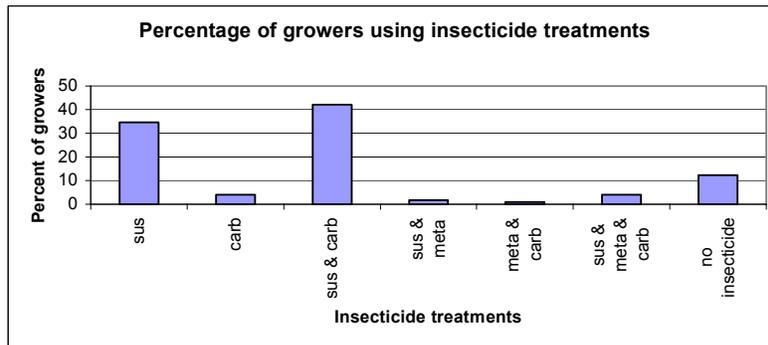
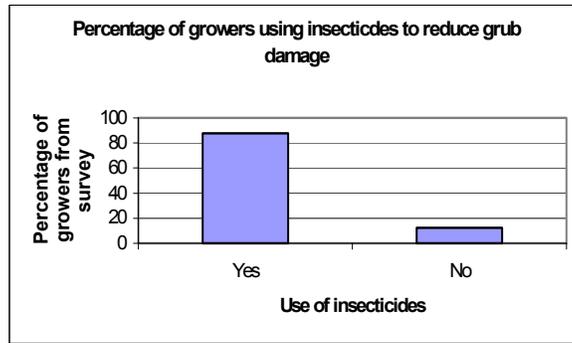
This question was used to gauge the number of growers using insecticides to reduce grub damage. It was thought that many growers had the belief that replanting was more cost effective than using an insecticide.

Analysis of the treatments used to reduce grub damage indicated that 87.6% of growers use an insecticide to reduce grub damage. Of the insecticides used suSCon® Blue (sus) equated to 82.6% of use followed by Carbaryl (carb) 51.2 % and then *Metarhizium* (meta) with 6.7%.

Yes	No	Total
106 (87.6)	15 (14.2)	121

10 no answers

Treatment	No. of growers
sus	42 (34.7)
carb	5 (4.1)
sus & carb	51 (42.1)
sus & meta	2 (1.7)
meta & carb	1 (0.9)
sus & meta & carb	5 (4.1)
None	15 (12.4)
Total	121

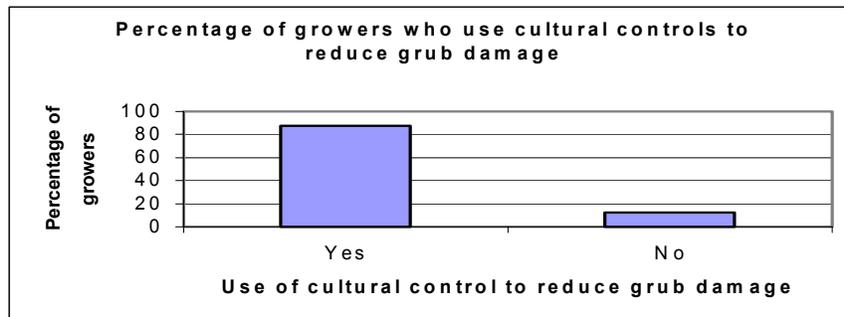


Questions 5 to 11 asked growers whether they have used or would in the future make use of cultural controls and altered farming practices to reduce grub damage.

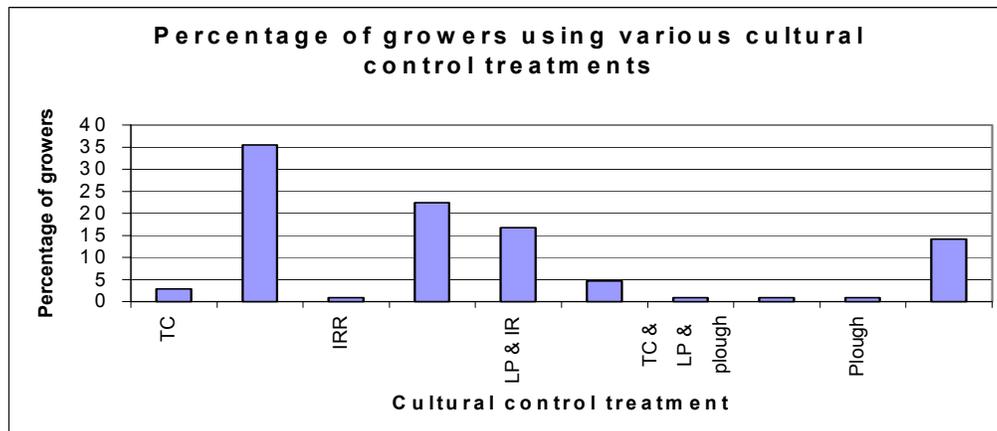
Question 5. Do you or have you used any cultural controls to reduce grub damage?

TC = Trap crop, LP = Late plant, IRR = Irrigation, Plough = Ploughing, Lights = Light trapping

Yes	No	Total	
105 (87.5)	15 (12.5)	120	11 no answers



Treatment	No. of growers
TC	3 (2.9)
LP	38 (35.5)
IRR	1 (0.9)
TC & LP	24 (22.4)
TC & IRR	0
LP & IRR	18 (16.8)
TC & LP & IRR	5 (4.7)
TC & LP & Plough	1 (0.9)
LP & Lights	1 (0.9)
Plough	1 (0.9)
None	15 (14.1)
Total	107



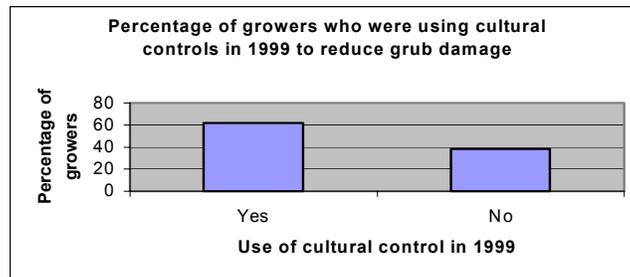
Growers indicated that management strategies involving the use of cultural controls had been used as a tool to reduce grub damage. The use of strategies such as late planting either by itself or in conjunction with other cultural control practices totalled 80% in previous years. Of the major cultural controls used to reduce grub damage, late planting, trap cropping and irrigation management were the main strategies used, totalling 85% use by growers.

Question 6. Are you currently using any cultural control practices on your farm?

This question was used to determine the numbers of growers currently using cultural controls to reduce grub damage. It was believed that many growers were not using any cultural controls after having difficulties with some of the practices initially.

The use of cultural controls for the 1999 season indicated that 61.7% of growers were using cultural controls to reduce grub damage. This indicates that a number of growers were not using cultural control in the 1999 season although they had used them in previous years.

Yes	No	Total	
71 (61.7)	44 (38.3)	115	16 no answers



The question then arises as to why there has been a swing away from the use of cultural controls? A possible explanation for these results may include:

- the reuse of suSCon Blue to the exclusion of other control practices following improvements in suSCon performance within the last two years. In growers minds, suSCon Blue now offers growers control of canegrubs in plant cane and first ratoon with little planning needed and ease of operation as compared to IPM strategies;
- the dissatisfaction of growers with the results obtained through the use of cultural controls. It is not perceived by growers as a tool to reduce grub numbers but only as a means of reducing grub damage.

An interesting point from the survey was that although many growers are late planting, there is still a large amount of insecticide being applied to the late plant. Given the current expenses associated with the application of suSCon Blue and acidifiers (\$400-\$500 per hectare), many growers are spending large sums of money for the control of canegrubs. In addition, many of the late plant areas that are currently treated with suSCon Blue are not being targeted by canegrubs.

BSES trials indicate that growers would find it more cost effective if they were to get back into an early plant crop strategy, thus concentrating grub numbers to early plant cane and then treating the early plant with suSCon Blue and acidifiers.

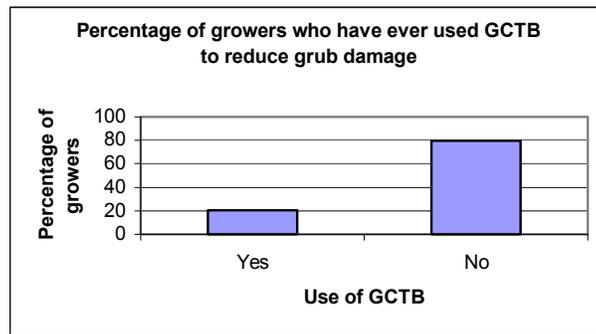
Reports from past BSES/SRDC projects (eg project BS120S Key factors in the control of greyback canegrub populations, Robertson *et al.*, 1998) have given evidence supporting the use of green cane trash blanketing (GCTB) as a management tool for the reduction of grub numbers.

Despite these findings, results from the survey indicate that very few growers in the Burdekin have or will use GCTB as a tool for the management of canegrubs. The principal reason for this is linked to difficulties associated with irrigation, harvesting, farm development, and the perceived decrease in crop productivity when using a GCTB system. If these associated problems cannot be managed, the use of GCTB in the Burdekin will never eventuate.

Question 7. Do you or have you practised GCTB to reduce grub damage?

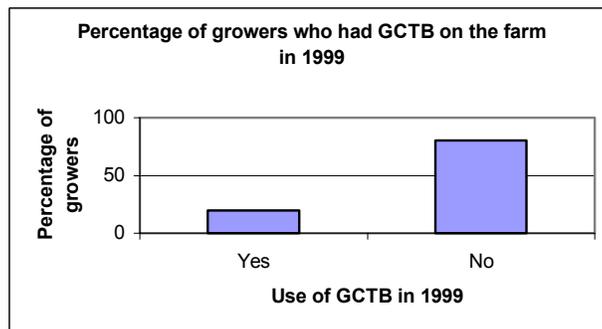
This question was asked to determine the acceptance of GCTB as a strategy for reducing grub damage.

Yes	No	Total	
23 (20.5)	89 (80.2)	112	19 no answers

**Question 8. Do you currently have any GCTB on your farm?**

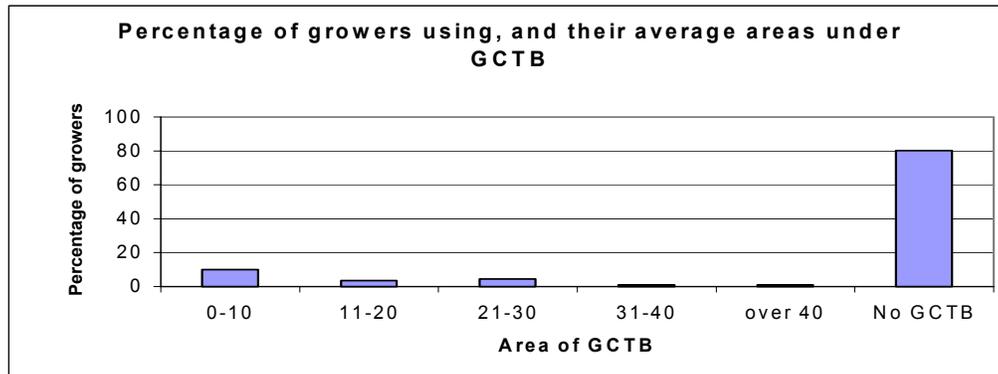
This question was used to determine number of growers in 1999 that had GCTB on their property.

Yes	No	Total	
22 (19.8)	89 (80.1)	111	20 no answers

**Question 9. What area is currently under GCTB on your farm?**

This question determined the area currently under GCTB.

Area (hectares)	No. of growers
0-10	11 (10)
11-20	4 (3.6)
21-30	5 (4.5)
31-40	1 (0.9)
Over 40	1 (0.9)
None	89 (80.1)
Total	111

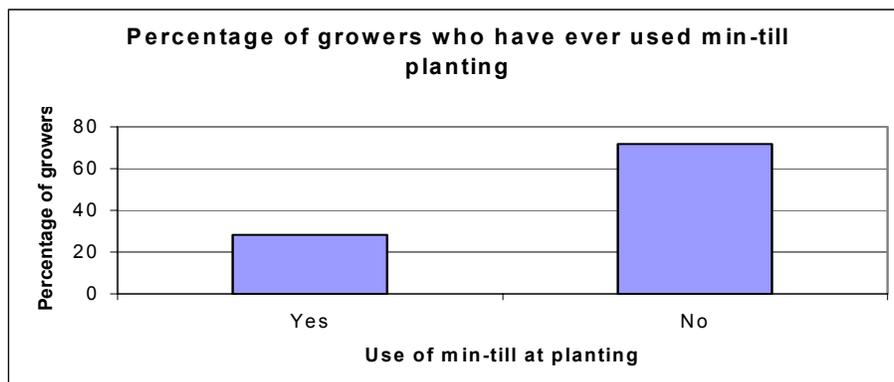


Another facet of the SRDC project BS120S was the investigation into reduced cultivation and its effect on grub numbers through the buildup of canegrub diseases. Initial trial results indicated canegrub disease levels were higher in soils where reduced cultivation, particularly in the ploughout were practised. In addition, the technique of reduced cultivation during the ploughout dramatically reduces the cost attributed to replanting sugarcane.

In view of these results, Burdekin BSES has in the last two years encouraged growers to use the technique of reduced tillage planting and the reduction of cultivation during the cropping cycle. Results from the survey indicate that adoption of this strategy has been encouraging with 28.3 % of growers using minimum till planting and 67.5 % of growers reducing cultivation during crop growth.

Question 10. Do you or have you practised minimum or reduced tillage planting?

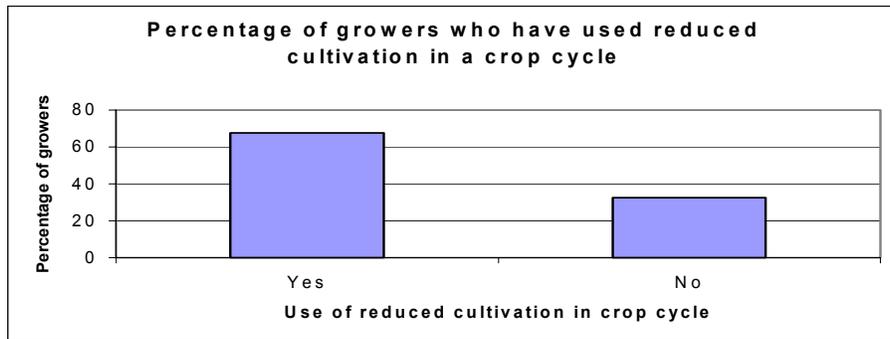
Yes	No	Total	
34 (28.3)	86 (71.7)	120	11 no answers



Question 11. Do you or have you practised reduced cultivation during a crop cycle?

In hindsight this question should have been asked in a different manner. The reason for this is that many growers are of the belief that they already practised reduced cultivation on their crops. While the amount of cultivation is less now compared to cultivation practices 20 to 30 years ago, the total amount of cultivation in sugarcane within the Burdekin is still very high.

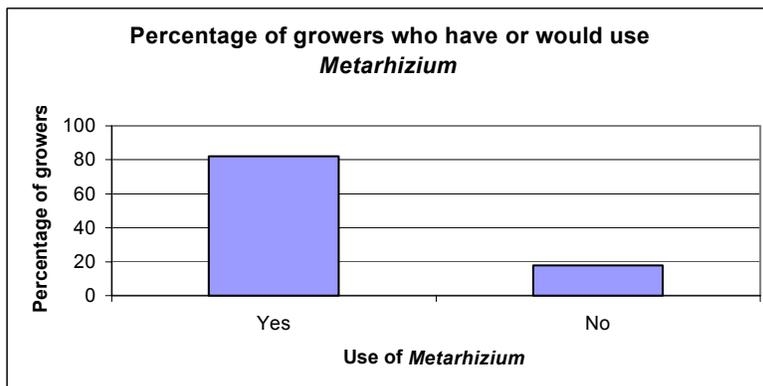
Yes	No	Total	
81 (67.5)	39 (32.5)	120	11 no answers



Over the last four to five years, BSES and the local industry have been researching and developing the biological insecticide BioCane™ (*Metarhizium anisopliae*). BioCane™ has given reductions of grub numbers in the order of 50% to 60% in both plant cane and first ratoon crops. In the last two years the product has been used under a semi-commercial size trial permit. Despite the promising results, some grower groups have been disappointed with the product. Question 12 of the survey asked growers whether they would use BioCane™ as a management tool to control canegrubs. Results from those growers surveyed indicated that 82.1% would use BioCane™ on their farms.

Question 12. Have you or would you use *Metarhizium* for the control of canegrubs?

Yes	No	Total	
96 (82.1)	21 (17.9)	117	14 no answers

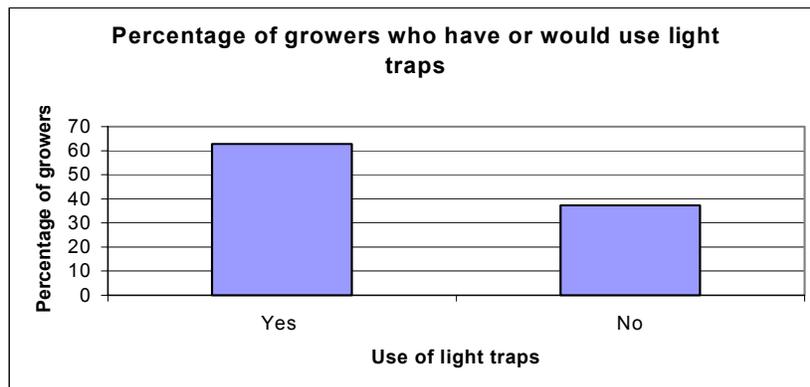


In the past four years the use of light traps for the control of greyback canegrub numbers has been slowly dropping. At the moment there are debate and conjecture regarding the efficiency with which beetle light traps can reduce grub damage. While BSES has no hard data on its effectiveness similar studies have been done overseas. Reports have all shown that the control of a soil insect pest through the reduction of adult numbers is not feasible. While this may be true, beetle lights do offer a valuable monitoring tool for study of population movements of adult beetles and the possible prediction of areas of future damage.

Results from the survey for questions 13 and 14 indicated that many growers in the past had used light traps as a means of reducing grub damage. Survey results indicated that 62.8% of growers had used light traps; however, due to less than convincing results many have now chosen not to use them. In 1998, some 31.9% of growers were using light traps with most growers only having a single light trap for use in indicating when beetle flights were occurring.

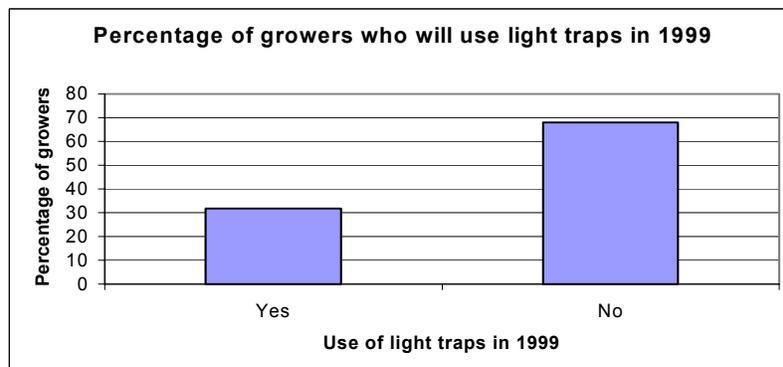
Question 13. Do you or have you used light traps for grub control?

Yes	No	Total	
76 (62.8)	45 (37.2)	121	10 no answers



Question 14. Are you currently using a light trap?

Yes	No	Total	
38 (31.9)	81 (68.1)	119	12 no answers



Question 15. What areas of research concerning canegrubs do you think is lacking or needs additional work?

This question was asked to determine if growers could identify any areas of research regarding the management of greyback canegrub that was either not currently being done or needed further emphasis to give a result.

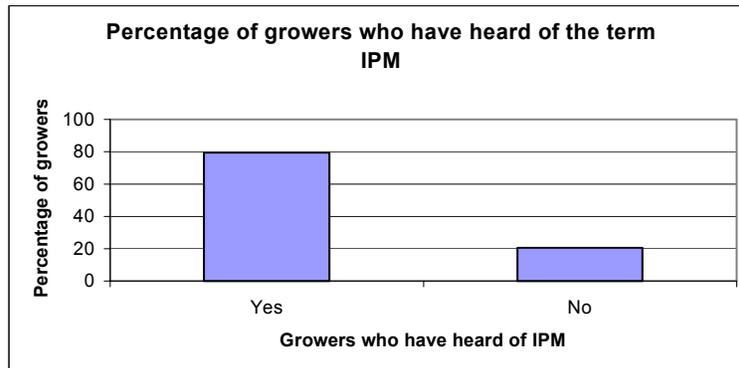
Most growers surveyed highlighted the need for further research work on the identification of new improved chemical insecticides to replace suSCon Blue. Further comments along the same line of thought included the fact that BSES is putting too much effort into “green” techniques in reducing grub numbers. General consensus also spoke of the need for research work into the use of chemical insecticides in ratoon cane crops.

Within BSES and some sugarcane industry and research funding bodies, it was believed that growers had no understanding of the term IPM and the strategies involved in the control of greyback canegrub. Because of this, research and extension services have gone to great lengths to simplify the way in which information concerning IPM for the control of greyback canegrub is distributed to growers.

Most of the growers who returned a questionnaire form had some grasp of the fundamentals of IPM for canegrubs within the Burdekin.

Question 16. Have you heard of the term integrated pest management?

Yes	No	Total	
88 (79.3)	23 (20.7)	111	20 no answers



While most growers were aware of IPM strategies for the reduction of grub damage, many found BSES ideas lacking credibility. This was either through ignorance, or a lack of want for experimentation, preferring to let the neighbour trial the strategies first. Many of the replies also intimated that to reduce grub numbers a chemical is needed now and IPM strategies can then be used once grub numbers are brought back down to manageable levels.

Question 17. In your opinion how should the grub problem in the Burdekin be reduced?

This question was asked to determine if growers could identify any areas of research regarding the management of greyback canegrub that was either not currently being done or needed further emphasis to give a result. In addition, this question was used gain valuable insight in to the current status of grower attitude towards the current grub problem, and the research and extension program designed to solve the problem.

Most growers opinions expressed the need for further research on alternative chemical insecticides for the control of grubs in both plant and ratoon cane crops.

General consensus from the answers to this question highlighted the fact that most growers in the Burdekin still want the “silver bullet”, that magical chemical control which will eradicate all the grubs from a particular block of cane. While many of the growers surveyed fully understood the concepts and control strategies of IPM, most were of the opinion that a chemical control would be better. In addition, most believed that while IPM of greyback canegrubs had a place, the only way to bring grub numbers down successfully was by using of a chemical insecticide.

Grower attitudes seemed to be one of frustration and anger over the damage being done by greyback canegrub and the supposed lack of research results in identifying a strategy to solve the current grub problem.

APPENDIX 6: 2002 Greyback canegrub management survey results

Question 2.1: Do you have or have you had a canegrub problem?

Of the 400 survey forms that were sent out to Burdekin growers, 101 (or 25%) completed surveys were returned. In relation to canegrub damage 94% of Burdekin growers have or have had a canegrub problem on their farm/s.

Question 2.2: What area on your farm per year would be affected by grubs?

The average farm area that was affected by grubs from the survey results was 41.5 hectares, or approximately 40% of the cane production area. The greater number of growers experienced grub damage on smaller areas of between 0-20 hectares, this is shown in the distribution of growers in Figure 1. Figure 2 shows the distribution of growers with certain percentages of greyback canegrub damage, with the majority of growers having less than 40% of their farms affected by canegrubs.

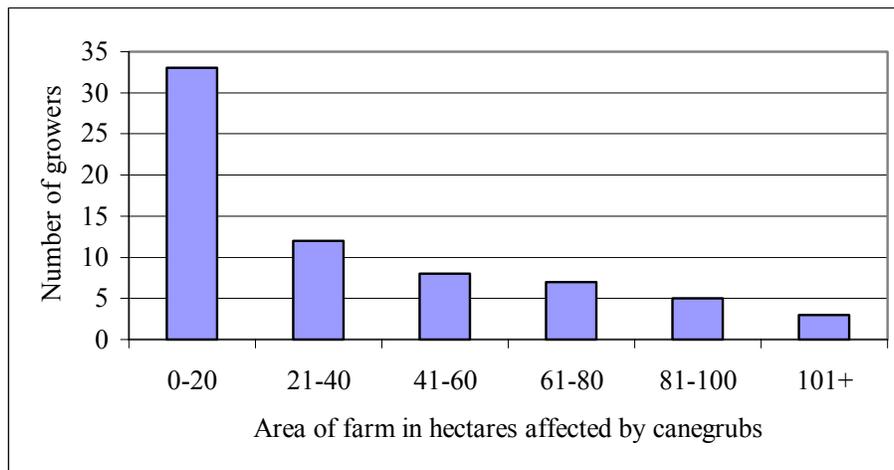


Figure 1 - The area affected by greyback canegrubs.

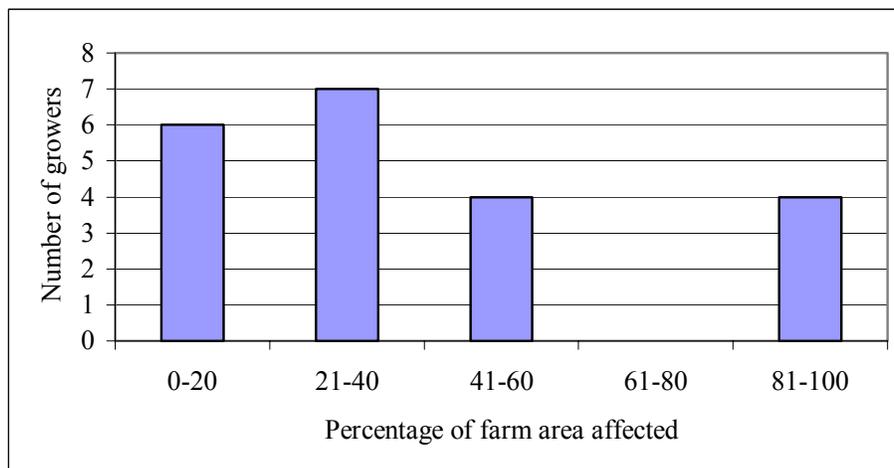


Figure 2 - Percentage of a grower's farm affected by greyback canegrubs.

Question 2.3: What proportion of your farm is affected by canegrubs?

The level of grub damage on the surveyed farms varied significantly. Figures 3 and 4 show that on average 65% of growers had received heavy damage on 17% of their farms. Seventy-five per cent of growers had moderate grub damage on 15% of their farms. Seventy-two per cent of growers received light grub damage on 20% of their farm area, and 84% of growers said that they had no canegrub damage on 48% of their farm area.

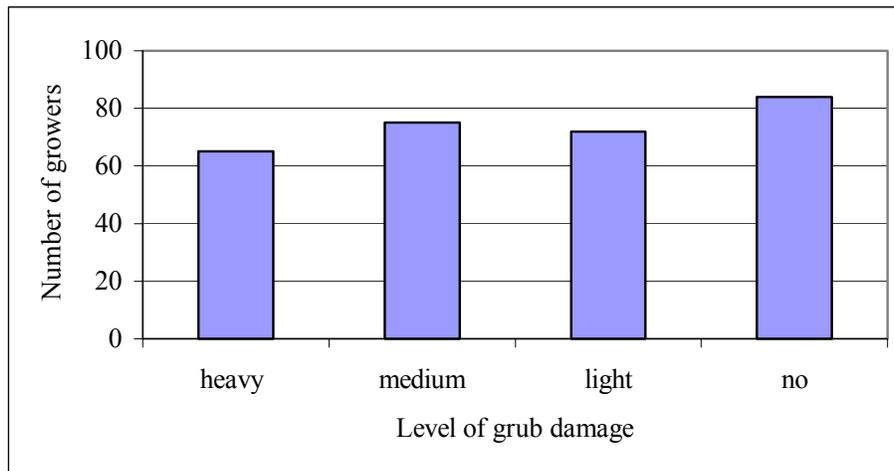


Figure 3 - Numbers of growers with various levels of greyback canegrub damage.

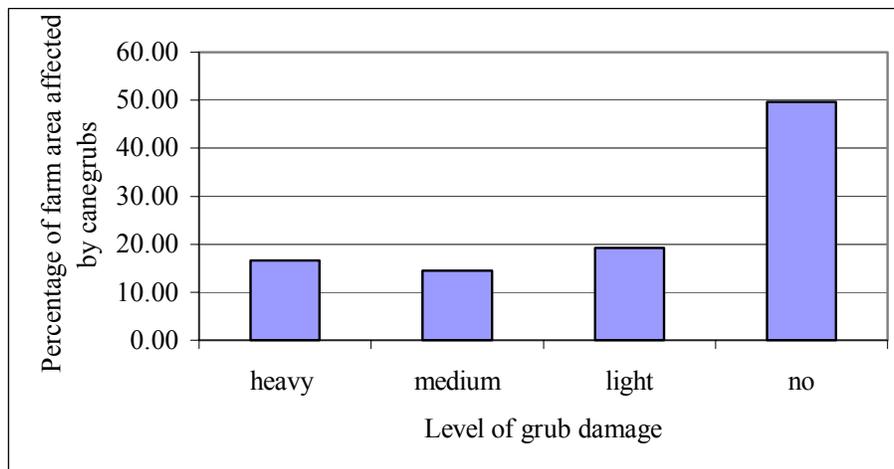


Figure 4 - Proportion of farm area on average that is affected by the various levels of grub damage

Question 2.4: How much production do you estimate that you have lost to grub damage per year?

Question 2.5: What have greyback canegrubs cost you in dollars per year?

From the survey results, growers indicated that canegrubs cause a loss of approximately 13% in production, or a production loss of approximately 23 t/hectares each year. The average cost of canegrub damage as indicated by growers was \$40,000. This figure is an

approximation of the cost and in some cases the cost of lost production was not taken into account, only chemical costs to control the grub problem.

Question 3.1: Have you attended a GrubPlan workshop?

Question 3.2: What was your major motivation for coming to the GrubPlan workshop?

The survey revealed that 77% of the growers had attended the GrubPlan workshops. The major reason for attending a workshop was to increase their level of understanding of the grub problem. Another popular reason was to see if there were any new products or techniques available to combat the current grub problem. Other reasons for attending the GrubPlan meetings were to receive the latest information on Confidor® and also to receive the certificate of attendance, which enables growers to purchase and use Confidor®. Finally, growers attended the workshops to reduce their grub problem and the financial burden that canegrubs have been causing in past years.

Question 3.3: Roughly to what level of the farm plan you developed during the GrubPlan workshop did you implement?

During the GrubPlan workshops growers developed farm plans to make improvements or alterations to their current grub management strategies and potentially reduce their grub problem. The survey showed that on average 32% of growers implemented 80% of the grub management strategies they developed during the GrubPlan workshops. Twenty-five per cent of the growers who attended the GrubPlan workshops implemented 100% of the strategies that they had developed. Of the 11% growers who have changed their farm management strategies and implemented 100% of the grub management plan, 27% expect to receive more damage than previous years. Eighteen per cent of growers expect less damage and 18% expect about the same level of damage. Due to either the time that the survey was sent out to growers or a significant reduction in visible damage, 36% of the growers who had implemented 100% of their farm grub management plans have said that it was too early to tell what the expected grub damage will be for this season.

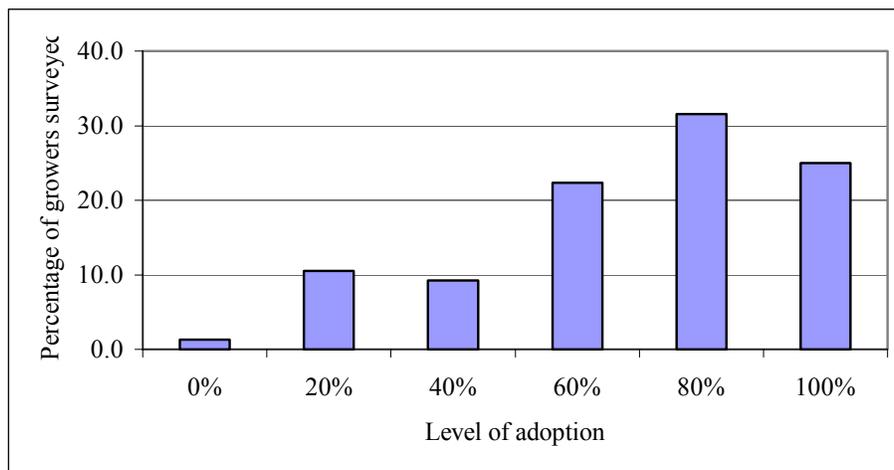


Figure 5 - The level of adoption of farm plans that were developed during the GrubPlan workshops.

Question 3.4: Have you changed your grub management strategies after attending the GrubPlan workshop?

Of the 77% of growers who attended the GrubPlan workshops, 58% have changed their current grub management strategies. Growers made changes to both their use of chemicals and cultural practices in order to reduce their canegrub problem.

Question 3.5: How much damage from canegrubs is being expressed on your farm this year in relation to last year?

This season, in regard to the level of expected grub damage, the majority of growers (32%) suggested that the level of grub damage will be less than the previous year on their farms. Thirty-one per cent of growers suggested that it was too early to judge the extent of grub damage. This could be due to two reasons, one being that the surveys were sent out too early or, secondly, growers had not noticed grub damage due to their grub control strategies having a marked effect on the level of visible canegrub damage this season. Twenty-eight per cent of the growers expect the level of grub damage to be the same as last year, and finally only 8% of growers expect to receive more grub damage this year in comparison to last year. As only 8% of growers are expecting more damage this year, this could signify that the remaining growers have faith in the current grub control strategies that they implemented last season having an impact on the grub problem.

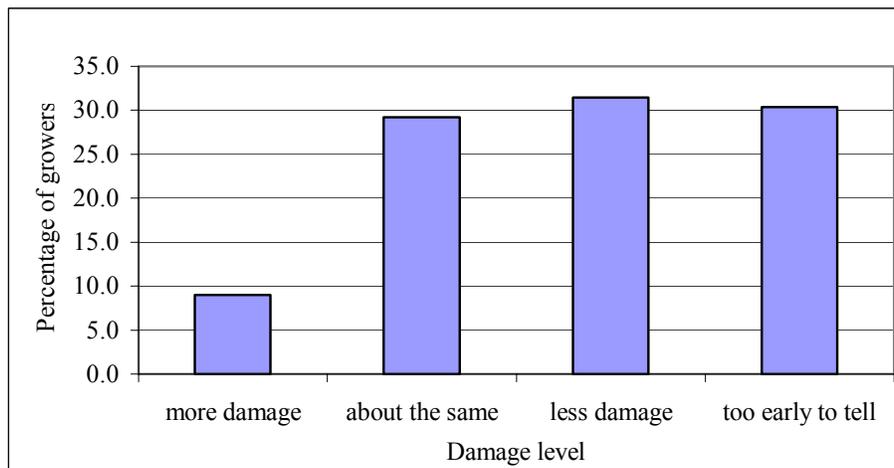


Figure 6 - The expected level of greyback canegrub damage this season.

Question 3.6: What were the two important things that you learnt from the GrubPlan workshops?

The major items of interest that were expressed by growers who returned the surveys and attended the previous GrubPlan workshop are as follows. There is a strong need for growers to work together and tackle the grub problem as a district not just as individuals. Most growers said that tackling the grub problem alone on a farm basis would not work as effectively as targeting the problem as a whole district. Growers are concerned that there are no new chemicals in the pipeline to combat canegrubs and if something occurred with

the present chemicals (eg deregistration of chlorpyrifos), growers would be unable to control the present canegrub population. A large number of growers attended the GrubPlan workshops to learn about the new product Confidor® and how to apply it correctly. Many growers were interested in developing a farm plan to improve the efficiency of their current chemicals usage, thus helping manipulate their cost of production. Growers were aware that grub damage can be more pronounced in early plant cane if untreated, growers were interested in the fact that treating their early plant crop with chemicals and utilising it as a trap crop improves the efficiency of the chemical.

Question 3.7: Did this workshop make you reconsider ways of reducing grub damage on your farm?

Question 3.8: Would you attend the GrubPlan workshop this year for the purpose of developing a whole-of-farm plan to reduce your grub damage risk?

Of the 77% of the growers who attended the GrubPlan workshops 75% had reconsidered their farm management plans in relation to grub control. Sixty-eight per cent of the growers who returned survey forms said that they would be interested in attending the GrubPlan workshop this year. Of the growers who did not attend the GrubPlan workshops last season 33% would be interested in attending this year, 33% said that they would not attend the workshops and 33% were still undecided.

Question 4.1: Do you currently use insecticides for the control of grub damage, if so what chemicals?

Question 4.2: Do you currently use any cultural controls to help reduce grub damage, if so what?

The majority of growers (85%) who returned surveys are using chemicals to reduce the level of grub damage on farm, these include suSCon® Blue (47%), suSCon® Plus (74%), BioCane™ (35%), Confidor® (52%) and Carbaryl® (68%). A large number of the surveyed growers (66%) are using late plant to reduce the risk of plant cane crops being damaged by canegrubs. Twenty-four per cent of the growers are currently using light traps to capture and monitor beetle flights. Forty-three per cent of growers are utilising trap crops to manipulate the beetles' behaviour, and concentrate grubs to particular areas. Ploughing is still used by a large number of growers (30%) to kill large third instar and pupating grubs. Only a small percentage of growers are manipulating irrigation scheduling (2%), harvesting schedules (12%) or using reduced tillage planting and ratooning (4%). Finally, only 2% of growers are currently harvesting green cane and leaving the trash blanket.

Table 1 - The types of chemical and cultural practices growers are using to minimise canegrub damage.

Types of insecticide controls	Number of surveyed growers (85 using insecticides)	% of growers using insecticides (85 using insecticides)
suSCon® Blue	40	47
suSCon® Plus	63	74
BioCane™	30	35
Confidor®	44	52
Carbaryl®	58	68
Types of cultural practices	Number of growers using cultural controls (80 using cultural controls)	% of growers using insecticides (80 using cultural controls)
Ploughing	29	36
Trap cropping	41	51
Late planting	63	78
Light trapping	23	29

The current and future practices that growers are utilising to manage canegrubs include the use of chemicals such as suSCon® Plus, BioCane™ and Confidor®, with a reduction in the intended use of Carbaryl®. The survey results showed that the number of growers who are intending to use trap crops this season has significantly increased.

Question 4.3: Do you currently practise reduced tillage planting?

Question 4.4: Have you used reduced tillage planting in the past?

Reduced tillage in the Burdekin is only used by a small number of growers according to the survey results, with 18% of the growers using reduced tillage planting. The number of growers that have used reduced tillage in the past was higher at 23%, with 65% of growers who have used reduced tillage in the past believing it was successful.

Question 4.5: Do you know the dollar cost for the management strategies used on your farm?

Question 4.6: Do you know what return in extra dollars the management strategies have given to you?

What the survey has shown that is of concern, in the light of reducing sugar prices, is that very few growers have a good understanding of the dollar cost or benefit of using grub control techniques. Forty-two per cent of growers have an idea of what their grub control strategy is costing them in regard to chemical costs but only 14% know what the dollar benefit of the controls are returning.

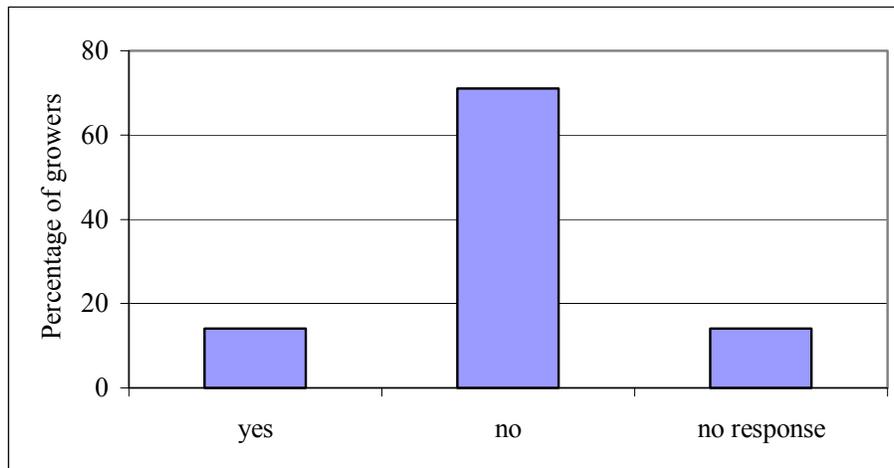


Figure 7 - The percentage of growers who know their return on investment for canegrub control.

Question 4.7: What is your current practice to reduce grub damage on your farm?

The majority of growers are currently using all available and registered insecticides to combat the grub problem, with the majority of growers using suSCon® Plus in plant cane. Confidor® usage increased in appeal after the 2001 GrubPlan workshops with 40% of growers applying it to ratoon crops. Twenty-four per cent of growers are using BioCane™ on blocks with a low risk and some growers are trialing BioCane™ in combination with suSCon® Plus. Twenty-eight per cent of growers are utilising trap crops to attract beetles away from more valuable late plant and ratoon crops. Eleven per cent of growers are scheduling harvesting times to cut less valuable older ratoons in the early rounds and more valuable plant and first ratoons in the later rounds to reduce the risk of grub damage. Currently there are a small number of growers who are using reduced tillage planting, aiming to maintain the level of existing natural pathogens of canegrubs, also reducing the operating costs associated with planting blocks, whether in a fallow or replant rotation. Finally, a small number of growers are using trash blanketing together with reduced tillage to reduce soil moisture evaporation and hopefully providing a favourable environment for natural pathogens of canegrubs.

Question 4.8: When combating grubs do you work on a farm basis or do you discuss your management strategies with your neighbours?

Question 4.9: If you currently do not work with your neighbours would you be willing to do so?

When it came to grub management decisions, 91% of growers surveyed work on a farm basis with 51% of these growers discussing their management decisions with their neighbours when tackling the canegrub problem. Only 2% of the growers who returned surveys would not be prepared to work or discuss their grub management strategies with their neighbours.

Question 5.1: Would beetle recording be of value to you?

Question 5.2: Is damage recording of value to you?

Question 5.3: Is product monitoring of value to you?

Question 5.4: If BSES was to offer a testing service for product monitoring, would you use it?

Question 5.5: If BSES was to offer as a service advice on product monitoring, product information, and farm risk management in relation to reducing grub damage assessment would you use the service. If yes, would you be willing to pay for this service?

The responses to questions about BSES providing additional services for grub control are shown in Table 2.

Table 2 - Grower responses to Question 5.1-5.5 of the grub management survey.

Question	Response	
	Yes	No
Would beetle and grub number recording be of use to you?	67%	30%
Would damage recording be of value to you?	84%	15%
Would product monitoring be of value to you?	90%	6%
If BSES provided a monitoring service would you use it?	83%	9%
If BSES was to provide advice on monitoring, product information, farm risk management in relation to canegrub management would you use it?	79%	14%
Would you be willing to pay for the above services?	30%	48%

The majority of grower responses were in favour of questions 5.1 – 5.5, and 30% are willing to pay for the service. Most of the growers believe that the additional services should be covered by the existing BSES levy.

Question 6.1: What determines which products/strategies you use to reduce grub damage?

Product results are the greatest driving force for the grower to use chemical or cultural controls for the management of canegrubs. Thirty-six per cent of growers said that the results of product plot trials and field trials go a long way when convincing them that the product is worth spending money on. The other two big issues when determining what products to use were the initial costs of the product (21%) and discussions with other people (20%), whether it is with a professional organisation or other growers. Fifteen per cent of growers rely on past experience with the use of a product or the history of grub damage when deciding on what products they will use this year for crop protection.

Question 6.2: When thinking of grub management do you think of the current year, one year ahead, or many years ahead?

In the planning process for grub control, the majority of growers that were surveyed (47%) suggested that they are planning many years ahead for grub control. Twenty-six per cent of growers are at least planning one year ahead. Due to variation from one year to the next, some growers expressed concern that planning too far ahead cannot take into consideration extraordinary events that may result in increases or decreases in grub damage.

Question 6.3: In relation to information on grub management what is more important, timely, accurate, or any information?

Growers were asked to indicate what information is more relevant to them in relation to grub control. The majority of growers (77%) require accurate information on grub management. Also of importance is timely information with 33% of growers indicating this information is of importance to them. Finally, 19% of growers said that any information is import to them in relation to canegrub management.

Question 6.4: As a grower what are your thoughts in relation to the control of grubs and the method of whole farm management control that BSES is currently advocating?

In general, the majority of growers are familiar with the ideas and concepts of whole farm planning, but it takes time to implement, and the cost of chemical controls still discourages growers from utilising some the available methods. Most of the growers believe that area-wide adoption of the principle of whole farm planning is the only way at present to achieve a reduction in the grub population. There were suggestions that an economic analysis of whole farm planning would help encourage growers to utilise the available control methods for grub management. Growers are still patiently waiting for and wanting a product that will kill all grubs and provide protection for many years.

Question 7.1: How important is access to BSES staff to you as a grower, very, moderate, slightly or not important?

Question 7.2: When or how often would you like to see a BSES staff person on grubs?

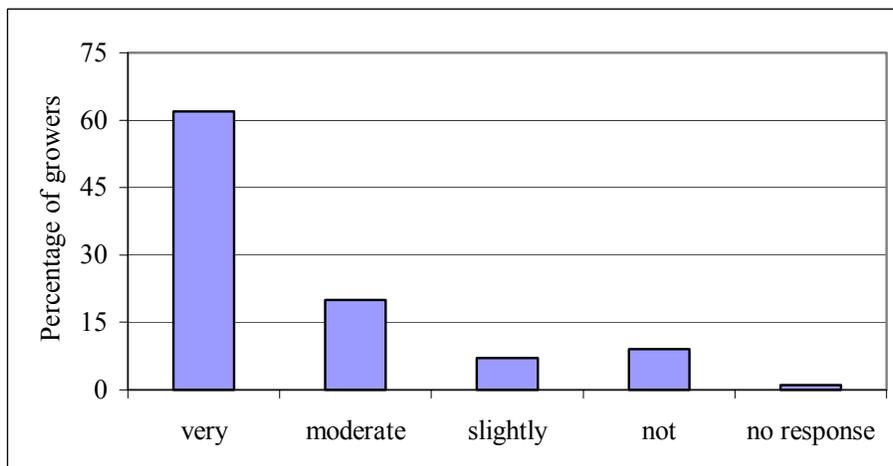


Figure 8 - The importance of access to BSES staff for growers.

Sixty-two per cent of growers indicated that access to BSES staff in relation to grubs is considered to be very important. Twenty per cent said that access to a BSES staff member is only moderately important and 9% said that access to BSES staff is not important. In relation to how often growers would like to see BSES staff, the majority (36%) of growers responded by saying that they would like to see staff on a “when needed basis”. The other main response was at least twice per year. Of interest, was the suggestion that a BSES staff member attends grower cell group meetings and shed meetings for consultation regarding to canegrub management.

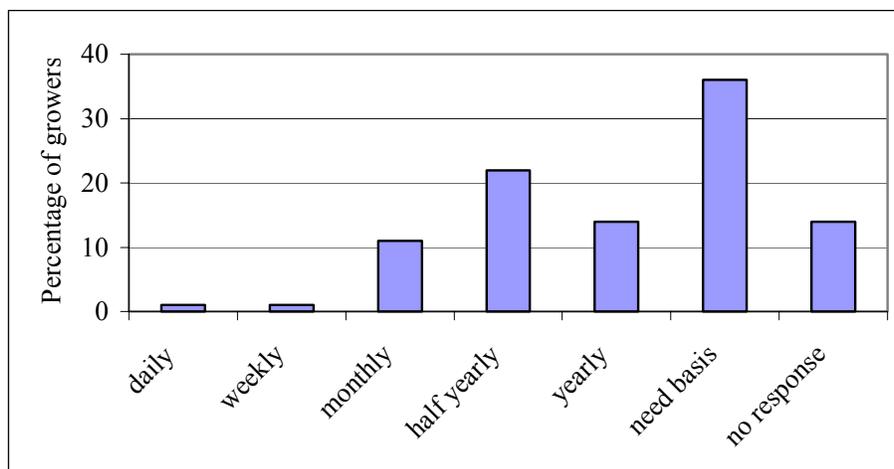


Figure 9 - How often growers would like to see a BSES staff member in relation to canegrubs.

Question 7.3: Would you be willing to pay for additional services relating to grub management and have access to BSES staff on a daily basis?

The question of access to a BSES staff member on a daily basis was put forward to growers with a cost associated for that service. Sixteen per cent of growers supported the idea of paying a fee for having access to a BSES staff member on a daily basis for information relating to grub management. Growers suggested that the most appropriate means of paying for this particular service would be through a “user pays system” or by a “levy based system”. Seventy-one per cent of growers were not concerned with having to pay to see a BSES staff member on a daily basis in relation to canegrub management.

Question 7.4: What existing service do you consider BSES offers in relation to grub management?

Growers identified the following services that they consider BSES provides in relation to canegrub management, farm and plot trials of available grub control techniques, grower workshops, grub monitoring, suSCon® monitoring, one-on-one advice, general product and research information, trial results, discussion groups, farm management options, product information, shed meetings, water and soil analysis, and field days.

Question 7.5: What areas of research concerning canegrubs do you think is lacking and in need of additional work?

The most popular response was the need for a chemical or chemicals that are cheap to purchase, and remain effective for longer periods of time in the soil. Other suggestions that growers put forward were economic analysis (cost versus benefit) of current strategies in a field situation, genetic manipulation of the cane plant to deter canegrubs from feeding upon the root system, more chemicals that could be applied to ratoon crops, systemic chemicals that can be applied aerially to provide crop protection, improve the availability of current chemicals, better understanding of the beetles' behaviour and why they prefer some crops over others, further research into biological controls and natural pathogens, devices that deter the beetle (electronic devices), a locally based entomologist, and finally a closer grower relationship with BSES.

Question 7.6: In your opinion how should the grub problem in the Burdekin be reduced?

The majority of growers suggested that a whole of district approach to the problem would be the best way to achieve a significant reduction in the level of grub damage each season. Fifty-four per cent of growers suggested that convincing all growers who frequently receive canegrub damage at any level to use some form of grub control. Other suggestions that were brought up by 10% of growers included the involvement of the government in assisting growers in purchasing grub control chemicals to treat larger areas, further research into chemicals and other methods for controlling grubs that are more economical, and targeting the beetle instead of the grub, thus reducing the number of eggs being laid during the flight period.

Question 7.7: Who do you currently obtain information from relating to reducing grub damage?

Question 7.8: As a grower, how willing are you to change your current grub control strategies?

The majority of growers who responded to the surveys use the following resources to get their information in relation to canegrubs. Eighty-one per cent of growers access BSES, 60% use the CPPBs, 58% ask other growers and 50% get canegrub information from commercial agents. Most growers do not rely on one source alone for all their information on canegrub control. This is the reason why the percentages do not add to give 100%. Figure 10 shows that 25 (or 25%) growers utilise all resources (BSES, CPPB, other growers and commercial agents) to obtain information in regard to canegrub control. When growers were asked how willing they would be to change their current practices, 44% said that they would be able to change somewhat easily, 34% said that they could change quite easily, and only 1% would never change.

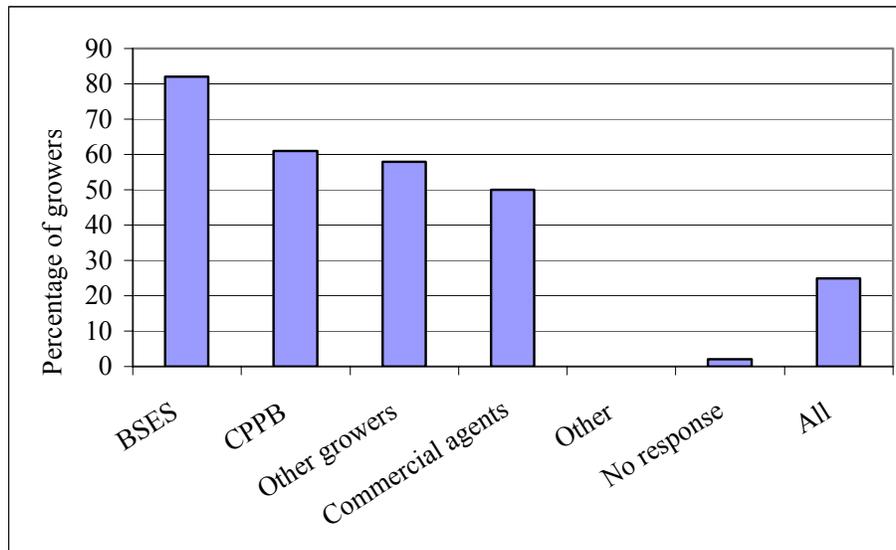


Figure 10 - Percentages of growers who utilise various organisations for information in regard to managing greyback canegrubs

Question 7.9: Do you trust the information supplied by BSES in relation to grub management, if not please explain why?

A large majority of the growers (73%) who returned surveys trust the information that BSES provides growers in relation to canegrub management. At the other end, 14% of growers do not trust the information that BSES provides on canegrub management. These respondents believe that BSES only releases results on products that show promise in the field, BSES chooses to work with a very small number of chemical companies on the control of the grub problem, BSES product trials are only run on small basis not on a farm basis, and BSES provides information to growers that is incorrect but is pushed as being true (eg green cane trash blanketing reduces canegrubs).

Question 7.10: What would be the best way to convince growers of the benefits of grub management practices?

According to 76% of growers who returned surveys, the best way to get information across to growers and improve the adoption level of canegrub management strategies is by establishing farm trials. Fifty per cent of growers suggested that grower workshops are an appropriate means of convincing these growers of the benefits of alternative grub management strategies. The other two major means of disseminating information to growers is through discussions with other growers (43%) and bus tours (38%), which give the growers the opportunity to see demonstrations of new techniques in the field situation. Of interest was the suggestion by some growers that farmers should be discussing their grub management and general farm management decisions with their accountants. In doing so growers will have a better understanding of the financial costs and benefits different decisions will have on the overall profitability of the farming business.