

**BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA**

FINAL REPORT

SRDC PROJECT BS144S

DEVELOPMENT OF A TRASH RAKE

by

R J Davis and F L Chapman

SD99003

**Principal Investigator: R J Davis
Research Officer
BSES
PO Box 651
BUNDABERG QLD 4670
Phone: (07) 4159 3228**

This project was funded by the Sugar Research and Development Corporation during 1995-96 and 1996-97 financial years.

**BSES Publication
SRDC Final Report SD99003**

March 1999

CONTENTS

	Page
SUMMARY	
1.0 INTRODUCTION	1
2.0 OBJECTIVES	2
3.0 METHODOLOGY	2
3.1 Materials	2
3.1.1 Trash rakes	2
3.2 Trial design and establishment	3
3.2.1 Trial sites	4
3.2.2 Measurements	5
4.0 RESULTS AND DISCUSSION	5
4.1 Rake performance	5
4.1.1 SEMCO®	5
4.1.2 Bonel® rake	6
4.2 Crop development	6
4.3 Harvest yields	9
4.4 Alternative rake design	12
4.4.1 Prototype development	13
4.4.2 Field testing	14
5.0 DIFFICULTIES ENCOUNTERED DURING PROJECT	15
6.0 RECOMMENDATIONS FOR FURTHER RESEARCH	15
7.0 APPLICATION OF RESULTS TO THE INDUSTRY	15
8.0 PUBLICATIONS ARISING	16
9.0 REFERENCES	16
10.0 ACKNOWLEDGMENTS	16
APPENDIX – DETAILED DRAWINGS	

SUMMARY

This two-year project evaluated the performance of selected commercial trash rakes under various field conditions, assessed the interaction between trash raking and ratooning vigour of sugarcane varieties and determined its effect on cane yield.

The Australian sugar industry is under increasing environmental pressure to cease pre- and post-harvest burning. The use of the green cane trash blanket system in canegrowing areas north of Townsville is widespread and, in some areas such as Ingham, complete adoption has occurred. In these areas adoption has been rapid, and this has brought with it many advantages that have led to improved productivity and profitability.

In southern Queensland, northern New South Wales and the Burdekin canegrowing regions, there is strong grower resistance to green cane harvesting and trash blanketing due to a variety of climatic and agronomic reasons. Many growers perceive the system has lower productivity and an unacceptable risk of delayed ratoons, or even failures in cool and wet conditions.

Adopting farming systems that help achieve maximum productivity has become increasingly important in today's competitive environment. In Bundaberg, many growers are moving to green cane trash blanketing to conserve moisture due to inadequate rainfall and reduced availability of irrigation water. However, one of the factors limiting adoption has been the perceived risk of poor ratooning after wet or cold weather. This has led to some growers seeking a more appropriate system between trash blanketing and conventional cultivation.

Previous research work has indicated that removal of trash from the cane row is beneficial in raising soil temperatures and enhancing both emergence rate and the number of shoots. Many growers are now evaluating the option of harvesting green then raking trash off the stool.

Trials were conducted at Bundaberg and in northern New South Wales to compare three trash management regimes incorporating full trash blanket with trash raked off the cane row and trash removed (burnt). An evaluation of two commercially available trash rakes was also undertaken in conjunction with the trash management treatments.

The commercially available single row SEMCO® rake and the three-row Bonel® rake were evaluated to determine their effectiveness at removing trash from the cane row.

The SEMCO® rake was simple to operate but can be difficult to set up and adjust. Operation speed is limited to 5 km/h due to the design and configuration of the finger wheels. At lower ground speeds the rake performs well, leaving a swath width of between 30 to 40 cm with little trash remaining on the row. The rake performs best in cane topped with a shredder topper, as the resulting trash residue is short enough to resist wrapping. The principal disadvantage with this unit is that it is a single row unit, and hence workrate is low.

The three-row Bonel® rake proved to be the most successful of the two rakes. This rake is easy to set up for operation and is simple to adjust. Rake components are compatible with standard hay delivery rakes ensuring easy replacement of parts and repairs.

Ground speed is limited to approximately 8 km/h due to the sweeping action throwing trash onto the adjacent rows. A higher ground speed is obtainable over the SEMCO® rake due to the vertical orientation of the finger wheels. A swath width of approximately 30-40 cm is achievable with little trash residue remaining on the cane row. The rake performed best where the cane was topped with the use of a shredder topper. The rake unit is large and heavy, and is the primary disadvantage. A number of design changes have been made as a result of these trials.

Sequential shoot counts were recorded to compare the levels of ratooning vigour of varieties between raked and non-raked treatments.

Results indicate that shoot counts are significantly higher in both the trash removed and trash raked treatments, and less in the full trash blanket treatment in the early stages of shoot development. After at least 120 days there were no significant differences in stalk counts in the three treatments in trials at Harwood in 1995 and Bundaberg in 1996. At Harwood in 1996, stalk development stabilised after a longer period of 210 days. Stalk numbers stabilised to around 11 to 14 shoots per metre. No significant differences between trash raked treatments were found in all trials.

These results illustrate that while the trash blanket initially restricted shoot development, there was late development of secondary shoots. This effect, coupled with the mortality of some of the secondary shoots in the trash removed and the trash raked resulted in similar stalk numbers at harvest.

Trends in cane yields for the three trash management treatments were not consistent in all trials. At Harwood in 1995, cane yields were highest in the trash raked followed by trash blanket then the trash removed treatment. At Bundaberg in 1996, trash blanket yielded highest followed by trash raked then trash removed. Trash removed treatment out-yielded trash raked then trash blanket treatments at Harwood 1996.

The trials demonstrated the effect of trash raking on shoot development and cane yield. Trash raking successfully moderated the yield depression associated with green cane trash blanketing under wet conditions.

1.0 INTRODUCTION

Pre-harvest burning of sugarcane has a long traditional association with the Australian sugar industry. Over the past 15 years, there has been a significant expansion of green cane harvesting in Queensland, with adoption levels approaching 50% in 1995. In north Queensland 90% of the crop was cut green, while only 40% of the crop in south Queensland was harvested green in 1995. In 1995, New South Wales was harvesting only 2% of the crop green.

The green cane harvesting and trash blanket system has been adopted widely due to a number of advantages over the burnt cane system. These advantages are well documented and include greater harvesting flexibility in wet weather, avoiding burnt cane deterioration, reduced soil erosion, improved soil moisture conservation and improved weed control due to the protection of the trash blanket.

Lower adoption in southern Queensland canegrowing areas is related to concerns about lower productivity under cooler and wetter conditions. In New South Wales and the Burdekin areas, harvester capability for the efficient harvest of large two-year and one-year crops respectively is the common concern.

In today's competitive environment adopting farming systems that will achieve maximum productivity has become increasingly important. These industry issues must be addressed in the context of increasing pressure from the community for the industry to universally adopt green cane harvesting and trash blanketing as part of reducing environmental impact and to improve quality of life.

During the 1980s many south Queensland growers experimented with green cane harvesting and the trash blanket system adapting it from northern conditions. This modified system proved highly successful in mid- to late-season harvests on well drained soils. There has been less success following early season harvests when conditions are usually cold and occasionally wet after harvest, or in poorly drained blocks where weak ratoons or ratoon failures have occurred. The impact of best management practice on productivity of the green cane trash blanket system under these difficult conditions has to date not been fully quantified.

Many southern growers who originally adopted green harvesting and trash blanketing have returned to conventional farming methods due to the risk of poor ratooning after wet weather.

This barrier has to be addressed since the added benefits of improved water conservation, soil erosion control, and improved weed control, combined with savings in labour and fuel costs are too great to ignore with the green cane trash blanket system.

This project aims to evaluate the benefits of one such technique in green cane trash management under these difficult conditions. This technique incorporates a green cane harvest, then raking trash from the cane row into the interrow.

Raking trash from the cane row after harvesting green is not a new concept. Some northern areas have 'stool splitter' type fertiliser applicators which allow trash to be removed from the stool and fertiliser and pre-emergent herbicide are applied in one pass.

2.0 OBJECTIVES

- To evaluate the performance of selected commercial rakes under various field conditions.
- To assess the ratooning vigour of varieties after raking trash from the stool area.
- To develop an improved trash rake to remove trash from the stool.
- To disseminate information derived from this project to the industry via publications and extension programs and enable demonstrations of trash raking.

3.0 METHODOLOGY

3.1 Materials

3.1.1 Trash rakes

Two commercially available rakes were selected and evaluated under various field conditions. The first rake selected was a product of Schultz Engineering and Manufacturing Company Pty Ltd (SEMCO®). The SEMCO® illustrated in Figure 1 is a single-row rake featuring two cup shaped finger wheels inclined to both the vertical and horizontal planes.



Figure 1 – Single row SEMCO® rake

The second rake selected was a product of Bonel® Manufacturing Limited (now P & H Rural Limited). The Bonel® rake illustrated in Figure 2 is a three-row rake incorporating standard hay rake finger wheels. The wheels are mounted vertical and inclined at 45° to the direction of travel.



Figure 2 – Three-row Bonel® finger wheel trash rake

3.2 Trial design and establishment

We evaluated the effectiveness of the two commercial rakes at removing trash from the cane row and their impact on ratooning vigour. Replicated trials were established in two southern canegrowing regions. Trials were established in northern New South Wales in the Harwood Mill area and at Bundaberg in the Fairymead Mill area in 1995 and 1996.

After the sites were harvested green, three trash management treatments were established. Treatments included undisturbed green cane trash blanket, green cane trash blanket with trash raked from the cane row and zero trash. The zero trash treatment simulated a burnt cane harvest and conventional cultivation with the trash removed from the plots.

Figure 3 illustrates a trial layout showing the three trash management strategies treatments.



Figure 3 - Three trash management treatments

3.2.1 Trial sites

The initial trial at Woodford Island on the Clarence River was designed to simulate the best case scenario, *viz* a strong ratooning variety, late in the season, well drained alluvial soil and mounded rows. The trial area was under plant TS65-28 sugarcane that was harvested green in early November 1995. The three treatments were evaluated in a strip design of nine rows wide by 300 m in length.

Two early season trials were then set up on Fairymead Farms at Bundaberg and at Woodford Island in the Clarence River in April and August 1996 respectively. At Bundaberg, the trial comprised of plant Q151 sugarcane, a variety with average ratooning vigour. This variety is predominately harvested in early rounds due to high early ccs until harvested for planting material. The block was laser levelled prior to planting with the rows well filled in after planting.

The trial area at Woodford Island was planted with Q124, a sugarcane variety with slow ratooning speed. The heavy clay soil block had been land planed before planting and the cane planted into mounded rows.

For both 1996 sites, the three trash management treatments were evaluated in a randomised block design with four replications with the plot size comprising six rows wide by 30 m in length.

3.2.2 Measurements

The performance of each of the rakes was quantified subjectively using a visual appraisal of the raking action during operation and the condition and presentation of trash off the row.

The strength of ratooning was evaluated by progressively measuring the number of shoots in each of the three trash management treatments through to harvest. Yields and CCS were recorded at harvest to quantify the treatments.

4.0 RESULTS AND DISCUSSION

4.1 Rake performance

Rake performance is dependent on a number of factors. These include condition of trash after harvesting, time after harvest and speed of operation.

4.1.1 SEMCO®

The single-row rake is simple and safe to operate if normal safety precautions are followed. The rake is difficult to set up and adjust for operation. This is due to its design and presentation of the finger wheels that are inclined in both the vertical and horizontal planes to the cane row.

The ground speed of this rake is limited to approximately 5 km/h due to the sweeping action throwing trash onto the adjacent rows. A swath width of approximately 30-40 cm is achievable with little trash residue remaining on the cane row.

The rake performed best where the cane was topped with the use of a shredder topper. In this shredded state the short trash prevents wrapping around the finger wheels and very little residue remained on the cane row. The rake did not perform well in unshredded trash where the length of tops was sufficient to cause wrapping and impede the throwing action of the finger wheels. The use of coulters immediately in front of the rakes to slice through tops and trash is necessary for successful operation in this situation.

Time after harvest is also an important consideration for the optimum performance of the rake. Three to five days after harvest the trash blanket dries sufficiently to become loose, friable and brittle. At this stage, the sweeping action of the rake is able to work at its optimum in clearing trash from the row.

The principal disadvantage with this unit is that it is only a single row unit and thus work rate is limited.

4.1.2 Bonel® rake

The three-row Bonel® rake has proved to be the most successful of the two rakes. This rake is easy to set up for transport or operation and is simple to adjust. The compatibility of finger wheels with standard hay delivery rakes makes for easy replacement parts and repairs.

The ground speed of this rake is also limited to approximately 8 km/h due to the sweeping action throwing trash onto the adjacent rows. A higher ground speed is obtainable due to the vertical orientation of the finger wheels. A swath width of approximately 30-40 cm is achievable with little trash residue remaining on the cane row.

The vertical sweeping action of the rake results in the trash being aerated and fluffed up when deposited. The movement of small amounts of the trash back onto the row occurred when operating on windy days. After a few days the trash had settled so this was perceived to be a minor problem.

The rake performed best where the cane was topped with the use of a shredder topper. In this shredded state the trash was short enough to prevent wrapping around the wheels and with little residue remaining on the cane row. The rake's performance was reduced where a conventional topper was used with the length of cut top impeding the brushing of trash off the row. However, the large diameter of the finger wheels ensured that wrapping was not an issue. The use of coulters immediately in front of the rakes to slice through tops and trash would enhance the operation of this rake in unshredded trash situations.

Time after harvest is also an important consideration for the optimum performance of the rake. Three to five days after harvest the trash blanket dries sufficiently to become loose, friable and brittle. It is at this stage that the sweeping action of the rake is able to work at its optimum in clearing trash from the row.

The rake unit is large and heavy and is the primary disadvantage. The rake was provided to growers as a loan implement to aid adoption of this technology. Under these circumstances a number of design faults with the structural integrity and robustness of the rake were highlighted. Communications were held with Bonel® Manufacturing and subsequently design changes in future production models have been incorporated to overcome these problems.

4.2 Crop development

Ratoon shoot emergence for the 1995 Harwood trial harvest was recorded up to stabilisation of the shoot density data. At harvest the final establishment of stalks in each treatment was also recorded. The ratoon shoot emergence and final establishment results are summarised in Table 1.

Table 1
Ratoon shoot emergence and final establishment of TS28-65 with different trash management regimes versus days after harvest in Harwood 1995

Days after harvest	Stalks/m ²						Final Establishment (x1000/ha)
	15	30	45	60	90	120	
Treatment *							
Burnt	12 ^a	16 ^a	16 ^a	17 ^a	17 ^a	14 ^a	93 ^a
Raked 1	11 ^a	15 ^a	16 ^a	15 ^a	15 ^a	14 ^a	93 ^a
Raked 2	10 ^a	15 ^a	15 ^a	16 ^a	16 ^a	14 ^a	93 ^a
Trash blanket	7 ^b	10 ^b	11 ^b	12 ^b	15 ^b	14 ^a	93 ^a

* Burnt = Trash removed: Burnt cane cultivation
 Raked 1 = Trash raked off stool: SEMCO®
 Raked 2 = Trash raked off stool: Bonel®
 Trash blanket = Full trash blanket

Means followed by the same letter were not significantly different by least significance difference test (P<0.05).

After 15 days stalk counts were significantly higher in the trash removed and trash raked treatments than in the full trash blanket treatment. The trash removed and trash raked treatments recorded a maximum of 17 and 16 shoots per metre respectively after 90 days. At 120 days there were no significant differences in stalk counts, as all three treatments stabilised at 14 shoots per metre. A plausible explanation for this similarity indicates there is late development of secondary shoots in the trash blanket treatments while mortality of secondary shoots in trash removed and trash raked treatments was due to crowding out of plants.

There were no significant differences between trash raked treatments. This indicates the performance of both the trash rakes in promoting shoots are identical and that ratooning is not dependent on rake type.

Shoot emergence for the 1996 trial at Bundaberg was recorded up to stabilisation of the shoot density data. At harvest the final establishment in each treatment was also recorded. The ratoon shoot emergence and final establishment results are summarised in Table 2.

Table 2
Ratoon shoot emergence and final establishment of Q151 with different trash management regimes versus days after harvest in Bundaberg 1996

Days after harvest	Stalks/m ²						Final Establishment (x1000/ha)
	15	30	60	75	90	120	
Treatment *							
Burnt	7 ^a	9 ^a	10 ^a	12 ^a	13 ^a	11 ^a	73 ^a
Raked 1	6 ^a	8 ^a	9 ^a	12 ^a	11 ^a	11 ^a	78 ^a
Raked 2	7 ^a	8 ^a	9 ^a	10 ^a	11 ^a	10 ^a	74 ^a
Trash blanket	5 ^a	7 ^a	8 ^a	9 ^a	10 ^a	9 ^a	71 ^a

* Burnt = Trash removed: Burnt cane cultivation
 Raked 1 = Trash raked off stool: SEMCO®
 Raked 2 = Trash raked off stool: Bonel®
 Trash blanket = Full trash blanket

Means followed by the same letter were not significantly different by least significance difference test (P<0.05).

After 15 days, the trash removed and trash raked treatments had two shoots per metre more than the trash blanket treatment but this difference was not significant. This trend continued until 120 days. The trash raked treatments had slightly higher numbers of millable stalks at harvest than the trash removed followed by the trash blanket treatment with the least number of millable stalks. However, these differences were not significant.

As recorded in the earlier trial at Harwood, there were no significant differences between trash raked treatments.

Shoot emergence for the 1996 trial at Harwood were recorded up to stabilisation of the shoot density data. At harvest, the final establishment in each treatment was also recorded. The ratoon shoot emergence and final establishment results are summarised in Table 3.

Table 3
Crop emergence and final establishment of Q124 with different trash management regimes versus days after harvest in Harwood 1996

Days after harvest	Stalks/m ²						Final Establishment (x1000/ha)
	15	30	60	120	180	210	
Treatment *							
Burnt	3 ^a	3 ^a	4 ^a	9 ^a	16 ^a	12 ^a	80 ^a
Raked 1	2 ^a	3 ^a	4 ^a	8 ^a	16 ^a	12 ^a	80 ^a
Raked 2	2 ^a	3 ^a	5 ^a	9 ^a	15 ^a	12 ^a	80 ^a
Trash Blanket	0.5 ^b	1 ^b	2 ^b	7 ^b	15 ^a	11 ^a	73 ^b

* Burnt = Trash removed: Burnt cane cultivation
 Raked 1 = Trash raked off stool: SEMCO®
 Raked 2 = Trash raked off stool: Bone1®
 Trash Blanket = Full trash blanket

Means followed by the same letter were not significantly different by least significance difference test (P<0.05).

After 15 days, stalk counts were significantly higher in the trash removed and trash raked treatments than in the full trash blanket treatment. At this stage the trash removed and trash raked treatments had three and two shoots per metre, respectively with the trash blanket having less than one shoot per metre. The trash removed and trash raked treatments recorded a maximum of 16 shoots per metre after 180 days and at this stage there was no significant differences in shoot counts between treatments. After 210 days, shoot numbers had reduced and stabilised to 12 shoots per metre. This result confirms the previous results from Harwood in 1995. There were no significant differences between trash raked treatments.

Results from the trials indicate that ratooning was slower under a trash blanket at these sites. The trash raking treatments showed that raking is beneficial in promoting the emergence of shoots.

4.3 Harvest yields

Averaged cane yield, ccs and sugar yield data for the 1995 trial at Harwood were recorded and are summarised in Table 4.

Table 4
Averaged cane yield, ccs and sugar yield for Q124 with
different trash management regimes at Harwood 1995

Treatment *	Cane Yield t/ha	CCS	Sugar Yield t/ha
Burnt	101.7 ^a	12.8 ^a	13.0 ^a
Raked 1	112.7 ^b	12.8 ^a	14.4 ^b
Raked 2	111.8 ^b	12.7 ^a	14.2 ^b
Trash Blanket	108.1 ^b	12.9 ^a	13.9 ^b

- * Burnt = Trash removed: burnt cane cultivation
 Raked 1 = Trash raked off stool: SEMCO®
 Raked 2 = Trash raked off stool: Bonel®
 Trash blanket = Full trash blanket

Means followed by the same letter were not significantly different by least significance difference test (P<0.05).

Trash raked treatment resulted in the highest cane yield at the Harwood 1995 trial site, and clearly achieved statistical significance. The trash removed treatment, which simulated the burnt cane system, resulted in a significantly lower yield than both the trash raked and trash blanket treatments. Despite the higher stalk counts in the early stages of the trash removed treatment, there was no significant yield advantage from this.

The poorer performance of the trash removed can be attributed to the lack of effective rainfall during the growing season.

There were no significant difference in ccs between treatments. The lower yield in trash removed and the equivalent ccs resulted in a reduced sugar yield that was significantly different from the trash raked and trash blanket treatments.

Averaged cane yield, ccs and sugar yield data for the 1996 trial at Bundaberg were recorded and are summarised in Table 5.

Table 5
Averaged cane yield, ccs and sugar yield for Q151 with different trash management regimes at Bundaberg 1996

Treatment *	Cane Yield t/ha	CCS	Sugar Yield t/ha
Burnt	57.2 ^a	13.9 ^a	8.0 ^a
Raked 1	74.5 ^b	13.8 ^a	10.3 ^b
Raked 2	73.9 ^b	14.8 ^a	10.9 ^b
Trash blanket	79.0 ^b	14.6 ^a	11.5 ^b

- * Burnt = Trash removed: burnt cane cultivation
 Raked 1 = Trash raked off stool: SEMCO®
 Raked 2 = Trash raked off stool: Bonel®
 Trash blanket = Full trash blanket

Means followed by the same letter were not significantly different by least significance difference test (P<0.05).

Trash blanket treatment resulted in the highest cane yield at the Bundaberg trial site, however, this yield was not significantly different from that of the trash raked treatments. The trash removed treatment, which simulated the burnt cane system, resulted in a significantly lower yield than both the trash raked and trash blanket treatments.

The trend towards lower yield with the trash removed treatment is consistent with results from Harwood in 1995. This rainfed site had experienced a lack of effective rainfall during the growing season which contributed to the lower yields.

There were no significant differences in ccs between treatments. The lower yield in trash removed and the equivalent ccs resulted in a significantly reduced sugar yield from the trash raked and trash blanket treatments.

Averaged cane yield, ccs and sugar yield data for the 1996 trial at Harwood were recorded and are summarised in Table 6.

Table 6
Averaged cane yield, ccs and sugar yield for Q124
with different trash management regimes at Harwood 1996

Treatment *	Cane Yield t/ha	CCS	Sugar Yield t/ha
Burnt	120.2 ^a	11.5 ^a	13.8 ^a
Raked 1	115.2 ^{ab}	11.5 ^a	13.2 ^{ab}
Raked 2	111.1 ^{ab}	11.8 ^a	13.1 ^{ab}
Burnt	102.1 ^b	11.4 ^a	11.6 ^b

* Burnt = Trash removed: burnt cane cultivation
 Raked 1 = Trash raked off stool: SEMCO®
 Raked 2 = Trash raked off stool: Bonel®
 Trash blanket = Full trash blanket

Means followed by the same letter were not significantly different by least significance difference test (P<0.05).

Trash removed treatment resulted in the highest cane yield at the early season Harwood trial site and was not significantly different from the trash blanket treatments. The trash raked treatments achieved similar yields and were not significantly different from trash removed treatment. Trash blanket treatment did not achieve significant statistical difference from the trash raked treatment.

The trend towards higher yield with trash removed treatment is not consistent with other trial results, however it is consistent with trash blanketing work from other research projects. The lower yields in trash blanket treatment can be attributed to high rainfall and hence waterlogging which occurred in that year. Under these conditions, the trash raked treatment successfully moderated the yield reduction associated with full trash retention.

There were no significant differences in ccs between treatments, a trend found in all trials. The lower yield in trash blanket and the equivalent ccs resulted in a reduced sugar yield that was significantly different from the trash removed and trash raked treatments.

4.4 Alternative rake design

Past experience with green cane harvesting and trash blanketing have yielded variable results at Bundaberg Sugar's Fairymead Farm. Blocks cut early in the season were dramatically affected by frosting and wet weather. Wet weather during the cooler part of the season has led to water logging or rotting of the stool under the trash blanket.

The trash raking trial work conducted at Fairymead Farm as part of this project yielded positive results from both the trash blanket and trash raked treatments. This work led to renewed interest in green cane trash blanketing, and in particular, trash raking. Trash raking was seen as a solution to the variability in trash blanketing while still retaining the benefits of improved moisture conservation and improved weed control.

This interest led to the development of a smaller more compact implement, which raked trash off the stool and applied a herbicide in one pass. This concept is not new, with

similar herbicide sprayers incorporated on stool splitter fertiliser applicators in use around Proserpine since the early 1990s.

4.4.1 Prototype development

The single row rake unit, shown in Figure 4 has been adapted from a Yetter® residue manager. The rake was originally designed for use on broadacre reduced tillage cereal planters. A number of significant design changes were made and these included replacing the original 300 mm diameter rakes with 500 mm diameter rakes which are more suitable for raking sugarcane trash. The rakes are mounted approximately 45° and 50° to the direction of travel and horizontal plane respectively. The rigid Yetter® setup was found to be too aggressive on the stubble and young shoots, so the new unit was developed to incorporate greater ground following ability. The unit incorporated a parallelogram linkage arrangement coupled with a rear mounted wheel for improved depth control and ground following ability.

The unit also incorporates a spray tank for the application of pre-emergent herbicide after raking trash from the stool. A coulter was mounted forward of the rakes to split the trash and enhance the performance of the rakes.



Figure 4 – Prototype implement

4.4.2 Field testing

Preliminary trials of the prototype implement were undertaken on Bundaberg Sugar's Fairymead Estate during August-September 1997. The rake removed the trash directly over the stool leaving a bare swath of approximately 300 mm width. The narrow swath width maintained a good cover of trash over the sides of the row, aiding weed control and maximising moisture conservation. The swept area was also ideally suited for the application of herbicide. These trials were conducted in shredded trash, and to date the implement has not been trialed in cane cut with a harvester fitted with a conventional topper.

Observations indicate the ratooning vigour after raking is the same as for burnt cane harvesting and a lot faster than the full trash blanket and that effective weed control can be achieved using this equipment. Figure 5 illustrates the result after raking with the unit.

The improved depth control ensures both adequate raking of the trash from the stool and good spray coverage of the raked area. The primary limitation with this unit is its capacity to rake only a single cane row per pass. A three-row unit has been designed and is currently under construction.

Detail drawings of the production three-row rake are presented in Appendix A.



Figure 5 - Trash raked off row with prototype implement

5.0 DIFFICULTIES ENCOUNTERED DURING PROJECT

The staff changes at the beginning of the project posed a slight disruption to the progress of the project. The changes resulted in a delay of four months in commencing field trials.

Early in the project, it was determined that field testing of various commercial rakes under differing field conditions was very difficult and logistically impractical. It was not possible to regularly obtain different commercial rakes from dealers or farmers and have these machines at different test sites. The previous experience of Fraser Chapman in raking of trash from the Proserpine region indicated trials on only a limited number of rakes was warranted.

6.0 RECOMMENDATIONS FOR FURTHER RESEARCH

This project has provided baseline data for current best technology to sustain successful green cane trash blanketing in managed environments. While substantial gains have been made to improve the management and sustainability of green cane trash blankets in Bundaberg and northern New South Wales, this project has provided only limited scientific evaluation of the effect of residue conservation on soil water and temperature regimes. More detailed work to identify the mechanisms and processes operating under various conditions is currently being undertaken in New South Wales by the continuing project BS168S.

7.0 APPLICATION OF RESULTS TO THE INDUSTRY

The results of these trials indicate that trash raking provides greater flexibility with green cane harvesting especially in wet and cooler areas or in poorly drained areas. Raking trash off the stool promotes faster ratooning after early season harvests and is successful at moderating the yield reduction from full trash blanketing in wetter conditions. In dry conditions yield advantages from trash blanketing are likely to be due to increased moisture conservation and weed control.

The extension program has provided a framework for the adoption of the technology and techniques identified as part of this project. The three-row Bonel® rake purchased for trial work has been fully utilised as a loan implement for growers to experiment with green cane harvesting and trash blanketing. The rake has been widely used throughout northern New South Wales and has been a very successful extension tool. Approximately 15 rakes have been purchased by harvesting cooperatives in the three mill areas of northern New South Wales. In many situations, the rake was utilised to remove remaining residue from the stool after burnt cane harvest. This has relieved some of the pressure on post harvest burning to reduce residue mass.

The prototype rake was displayed at the Sugar Environmental Forum held in Mackay in March 1998. Further development, refinement and evaluation of the three-row rake is continuing with work being undertaken by Bundaberg Sugar.

8.0 PUBLICATIONS ARISING

Davis, R J (1996) The effect on ratooning of removal of trash from the cane row. Bundaberg News Mail, June 1996.

Davis, R J (1997) Development of a trash rake. BSES Bulletin 59, 23.

Davis, R J and Baillie C P (1998) Developments in trash management in Bundaberg. Australian Sugarcane 2 (2), 3-4.

Kingston, G, Davis, R J, Chapman, F L and Nielsen P J (1998) Progress with green cane systems research in cool and wet environments. Poster paper 20th Australian Society of Sugar Cane Technologists Conference, 28th April to 1st May, Ballina.

Poster papers presented at Agrotrend 1996-1998, and Bundaberg BSES (1997) Field Days.

9.0 REFERENCES

Chapman, F L (1994) Trends in farming systems - Proserpine. BSES Bulletin, 47:18-19.

Jones, C D and Hewson S A (1995) Soil conservation under trash retention systems in cane lands. Isis Land Care Group Project Report.

Ridge, D R (1998) Farming systems for green cane trash blankets in cool wet conditions. SRDC final report BS63S.

10.0 ACKNOWLEDGMENTS

The funding support from the Sugar Research and Development Corporation for this project is gratefully acknowledged, together with the assistance received from Fairymead Farms, Technical Field Department, especially Peter Maidment, Craig Baillie and Ian Dart. The assistance of growers Mr Alastair McFarlane and Mr Stuart McSwan in running the trials on their farms at Woodford Island, Harwood is also gratefully acknowledged.

In addition the assistance from BSES officers Peter McGuire, Jim Sullivan, Brian Robotham and Peter Nielsen from New South Wales Sugar Milling Co-Operative is gratefully acknowledged.

APPENDIX A

DETAIL DRAWINGS