Sugar Research Australia

SOUTHERN REGION

RATOON STUNTING DISEASE EXTENSION PACKAGE FOR GROWERS AND CONTRACTORS

COVER/INSIDE FRONT COVER: Young Bundaberg cane.

CONTENTS

INTRODUCTION

Ratoon stunting disease (RSD) was discovered by BSES pathologists in 1944. It is now recognised worldwide as one of the most economically important sugarcane diseases. Cane Productivity Services (CPS) throughout Australia undertake plant source inspections (PSI) every year with one of the most important inspections parameters being an assay for RSD.

BACKGROUND

RSD is a significant factor leading to productivity and profitability losses for individual growers and the local industry in most Australian production areas.

With improvements to the diagnostic tests for RSD, and spread of the disease, the incidence of RSD has increased in recent years. Most detections have been in plant sources; the incidence within commercial crops is largely unknown due to the logistical difficulties in sampling commercial cane.

The aim of this extension package is to reduce the number of RSD-diseased crops in the Southern Region. Staff in each mill area have their own targets and timelines with respect to the management of RSD and for minimising its effects on the local industry.

This booklet provides growers and the local industry with a better understanding of RSD: what it is, how it spreads, and what this means for individual farms and the industry. A deeper understanding of the disease plus the tools required to develop an RSD management plan are also provided.

WHAT DOES RSD MEAN FOR YOUR FARM?

Identifying RSD is not easy as there are no external disease symptoms – nothing on the leaves, stalks or other plant parts. For this reason, RSD can be causing hidden losses to productivity and profitability on your farm.

RSD is difficult to eradicate once it has been detected. There are a number of key steps to either prevent the disease entering, or to eradicate the disease from your crops. If it is found on your farm, follow the strategy outlined in this booklet and consult with your extension officer and contractors.

Prevention is better than cure: it's easier to keep RSD off-farm than to eradicate the disease once it is affecting your crops. Prevention can be achieved by routinely accessing disease-free seed cane and employing a strict hygiene strategy for your equipment.

RATOON STUNTING DISEASE

RSD is found in all cane-growing regions in Australia. The incidence in each region is a reflection of the diligence with which control measures have been implemented in the area. Regional incidence varies from <5 per cent diseased crops to around 50 per cent in the worst affected regions. Yield losses between 5-60 per cent are associated with infection so it is most important to minimise disease incidence to maintain both productivity and profitability. Losses are greatest when the cane is moisture stressed; even with adequate irrigation, losses can range from 10 to 30 per cent - leading to significant financial losses.

WHAT CAUSES RSD?

The disease is caused by a tiny bacterium, which infects the xylem (water pipes) vessels of the sugarcane plant.

SYMPTOMS OF RSD

As mentioned on the previous page, there are no definitive external symptoms of RSD in cane. Diseased fields tend to have an 'up-and-down' appearance, due to varying degrees of stunting in adjacent stools - but this may be caused by something other than RSD. Sometimes cane will display red-orange dots or 'commas' in the nodal tissue when a stalk is sliced open or a faint pink discoloration near the growing point in young plants. These symptoms are not always present in infected cane nor are they a reliable indicator of infection so they should not be relied upon as a diagnostic tool. ***No symptoms DOES NOT mean no infection.***

RSD can occur in plant cane, not just ratoons as the name would suggest, though larger yield losses may occur in ratoon cane.

DIAGNOSIS OF RSD

The bacteria that cause RSD are readily detected in sugarcane sap that has been extracted from cane stalks. This is usually achieved by blowing compressed air through a billet. Approximately 16-20 stalks are normally sampled in a field for sap extraction. It should be noted that there are around 80,000 stalks/ha in a crop – so a negative test with sap from just 16-20 stalks won't guarantee there is no disease present in that crop. Selecting poor stools in a field can increase the chances of detecting the disease. The most up-to-date DNA tests are used to detect the presence of RSD in the sap samples; SRA operates a RSD assay laboratory and this lab handles most of the samples collected across the industry.

Image 1: *Juicing billets to sample for RSD.*

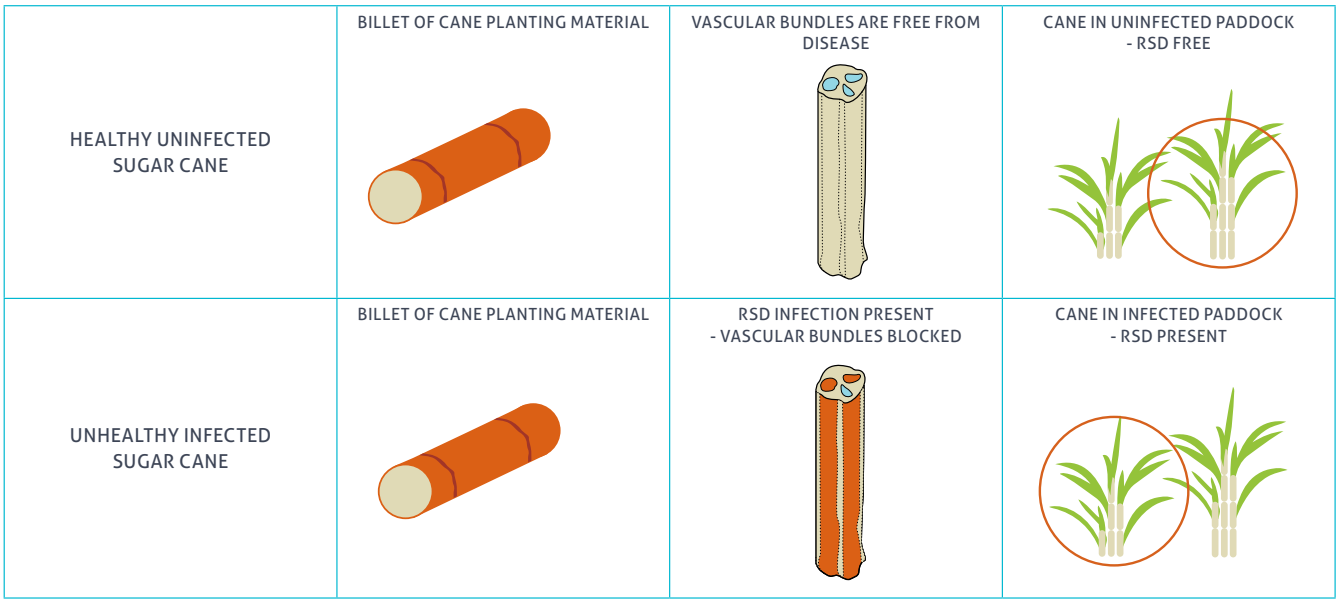


Diagram 1: *A simplified example of uninfected cane compared with RSD-infected cane and how it occurs systemically in a cane plant.*

MANAGEMENT OF RSD

Several management measures are the key for either preventing RSD from reaching your farm or for eliminating the disease. The most important strategy is to have a well-planned disease-free seed cane plan.

CLEAN SEED PLAN

Disease-free seed cane can be obtained from local approved seed plots, which are often established and run by local Cane Productivity Services. Obtaining disease-free seed is not sufficient in itself. It is very important to plant RSD-free seed cane into fallow ground where there are no 'volunteers' arising from a previous crop. The presence of a few diseased volunteers is all that it takes to introduce RSD into the next crop. RSD is highly infectious and spreads rapidly via cutting implements (e.g. cane knives, planters, harvesters). For this reason, machinery and implement hygiene is also vital for RSD management.

You should talk to your extension officer about this before the planting season.

FALLOW MANAGEMENT

The fallow period is an opportunity to minimise weeds and their seed banks, realigning blocks and drains and breaking the sugarcane monoculture with a fallow crop. Fallow periods - in particular, volunteer-free fallows - help to break pest and disease cycles. For RSD, it is vital to ensure that the fallow is free of RSD-diseased volunteer cane - to ensure that there is no RSD present in the block before planting.

Ensure your fallow is free of volunteers to give your new crop the best chance of remaining healthy.

It takes just one RSD-infected volunteer in a block to initiate infection - the juice from that infected volunteer can be spread by any of the implements or machines that enter that block.

For this reason, planting material should not be sourced from, or planted into, replant or poorly managed fallow blocks.

To control volunteer cane in your bare fallow, use the non- selective herbicides mentioned in Table 1.

To control volunteer cane in your broadleaf fallow crop, use the grass knockdown herbicides mentioned in Table 2.

TREATMENT	RATE/HA	COMMENTS
glyphosate 360 – single salt	4000-9000 mL	Apply to actively growing ratoons, 60-120 cm tall. Use lower rate or suppression where cultivation is to follow. Use ammonium sulphate or Liaise if hard water is used. Add wetter as recommended on the product label.
glyphosate 360 – dual salt (Weedmaster DUO)	6000-9000 mL	
glyphosate 450 (Gladiator)	4800-7200 mL	
glyphosate 470 – dual salt (Weedmaster DST)	4600-6900 mL	
glyphosate 540 – dual/single salts (Weedmaster ARGO/Glyphosate 540 K)	4000-6000 mL	
glyphosate 570 (Roundup UltraMAX)	3800-5700 mL	
glyphosate 600 – triple salt (Crucial)	3600-5400 mL	

Table 1: *Herbicide recommendations for ratoon spray-out. Contact your local reseller for current prices per hectare.*

CROP	TARGET	TREATMENT	RATE/HA	COMMENTS
Soybeans, peanuts	Volunteer cane and grasses	fluazifop-P (Fusilade Forte)	820-1650 mL (soybeans) 1240-1650 mL (peanuts)	Apply the higher rate to perennial grasses above the 6-leaf stage. Apply in a minimum of 100L/ha water. Minimum withholding period: 17 weeks (soybeans), 6 weeks (peanuts).
Soybeans, mungbeans, peanuts	Volunteer cane and grasses	butroxydim (Factor)	120-180g	Always apply with Supercharge at 1L/100L spray solution for ground application. Do not graze or cut for stockfeed until 14 days after application.
		haloxyfop (Verdict 520)	100-150 mL	Always add an adjuvant. Add Uptake Spraying Oil at 500 mL/100 L of spraying solution. Alternatively, add non-ionic wetting agent at 200 mL/100 L and use the higher rate of Verdict 520. Do not add Uptake Spraying Oil if tank mixing with Blazer or Basagran.
		quizalofop (Quizalofop 200EC)	250-500 mL	Always add a surfactant or wetting agent when applying to weeds that have started to tiller.
		clethodim (Clethodim 240EC)	250-500 mL	Always apply with D-C-Trate at 2000 mL/100 L or Hasten or Supercharge at 1 L/100 L or Uptake at 500 mL/100 L spray volume.

Table 2: *Herbicide recommendations for legume fallow management. Contact your local reseller for current prices per hectare.*

Group A herbicides (e.g. Fusilade Forte® Verdict™ 520, Clethodim 240EC, Quizalofop 200EC) are classified as having a high risk of resistance. Monitoring is essential to identify survivors after spraying with Group A herbicides. Survivors must be killed before seed set. Survivors may be more likely at the lower usage rates. Spray water quality is important and bicarbonate levels should be below 170-180 ppm. Ammonium sulphate may help improve performance if water quality is suspect.

This list is not exhaustive.

PLANTING MATERIAL

Once a grower has identified the varieties they wish to plant, there are several factors to consider before planting:

What is the original source of that material?
When selecting planting material, a grower should consider if the material has come from an approved seed plot (ASP), if it has been hot water treated (HWT) or if the material was planted using tissue culture (TC).

What is the crop class of the material?
Ideally, when selecting planting material, the material should be Pl – 1R.

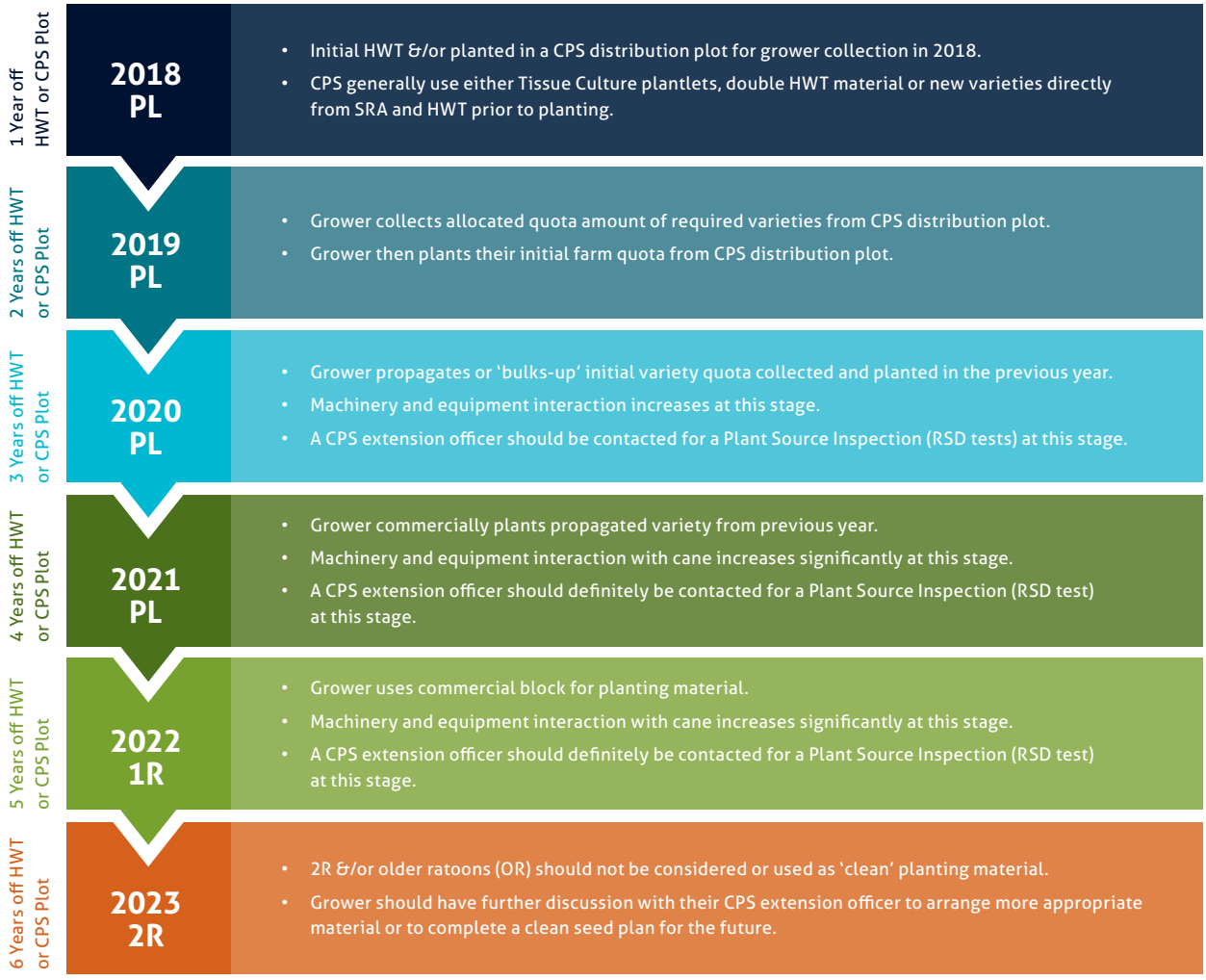


Diagram 2: *An example of a timeline for a Plant Material Source – tracking how long that the planting material has been away from either Hot Water Treatment, Tissue Culture or a Cane Productivity Services (CPS) Approved Clean Seed Plot. The timeline shows that just because it's plant cane, doesn't mean it is 'clean cane'.*

When a grower is selecting planting material, crop class and the time period from hot water treatment should always be considered.

The example above is a best-case scenario using material from a plant crop each year. You should be mindful that just because the material is from a plant crop, it does not necessarily mean that it is disease-free. The time since the last hot water treatment should be considered whenever choosing your plant source. Using a timeline, like the example above, is an easy way to determine the history of your plant source material.

Refer to Appendix 1 for 'Developing a Clean Seed Management Plan'.

For every year that the plant source is away from hot water treatment, the risk of infection increases due to potential disease spread via contaminated machinery (i.e. cane volunteers, harvesters, planters, cane knives).

What is the condition of the material? A grower should always organise a Plant Source Inspection (PSI) with CPS staff. This allows for a thorough inspection for any pest damage and most importantly an inspection and analysis of any disease that may be present. A PSI for RSD, in particular, should be a vital step for every farmer to ensure they are optimising their productivity and profitability.

*Refer to Appendix 2 for 'Plant Material Inspection Checklist'.*Implements and machinery

Any implement that cuts a stalk or stool of sugarcane or comes in contact with the freshly cut end of the sett or billet will readily spread RSD. Some of the more common implements that can spread RSD are cane knives, planters, harvesters, and coulters/discs.

Refer to Appendix 3 for 'Machinery Hygiene Checklist'.

RESISTANT VARIETIES

Some varieties have partial resistance to RSD (e.g. Q208^{Φ}) and disease spread is restricted in these varieties. Many highly productive varieties, such as Q253^{Φ} and Q242^{Φ} are highly susceptible and substantial yield losses may accompany infection. SRA has never actively selected varieties for resistance to RSD because other control strategies have been successful. Varieties are rated for resistance, but this rating is only used as a guide for growers and extension staff. Nearly all sugarcane varieties are susceptible to RSD to some degree. Managing RSD infection on a farm is not as simple as planting a resistant variety as this does not guarantee disease-free crops, especially in crops of highly susceptible, highly productive varieties growing on your farm.

COST ANALYSIS

RSD can be a silent killer when it comes to farm profits.

ASSUMPTIONS	RSD	RSD FREE
Variety	$650	$650
Sugar price ($)	14.00	14.00
Relative CCS	72	80
Yield (t/ha)	10%	0%
Estimated yield loss due to RSD (%)	$49.40	$49.40
Cane price ($/t)	$3,556.66	$3,951.84
Gross $/ha	$1,200	$1,200
Cost of production ($/ha)	$9.80	$9.80
Net return ($/ha)	$2,356.66	$2,751.84
Potential profit lost due to RSD infection	**- $395.18**	

Table 3: *Represents an example of a farm cost analysis based on RATOON (not plant) cane on a diseased farm.*

Example farm

John had a PSI completed on the material he selected to use for planting that year. John's farm was an average 100-hectare farm, which cut a five year average of 80 tonnes of cane to the hectare (TCH). Unfortunately, John had one positive sample of RSD in his Q200^{Φ}. The estimated yield loss due to RSD infection in his Q200^{Φ} equates to about 10%. John's other two blocks of Q200^{Φ} were RSD free. With zero infection in his other blocks, John managed to cut a slightly higher yield of 88 TCH.

When John sat down with his extension officer to calculate the losses at the end of the season (RSD infected versus his RSD-free crops), John concluded that even though he still received a payment for that crop of approximately $2154 and $2439 in the healthy crops), John missed out on an additional $285 per hectare because of RSD. It may seem like a small figure but John worked out that his three hectares of RSD-infected cane equated to a loss of $855 for his farm that year.

As infection increases and spreads further through the farm, where farm hygiene is not being taken seriously, lost revenue will increase further as the crop cycles continue.

CONCLUSION

RSD is now recognised worldwide as one of the most economically important diseases of sugarcane. RSD has become a significant issue contributing to productivity and profitability losses to individual growers and the local industry as a whole.

The identification of RSD is not easy and can be the cause of hidden losses to productivity and profitability for your farm and business. Growers should always have their planting material inspected prior to planting to ensure the material is disease-free and to minimise the risk of spreading the disease further. Strict machinery hygiene is very important since RSD is highly contagious.

The best axiom to hold to is to keep the disease off your farm; it is a lot easier to keep it off-farm than to eradicate it once your crops are diseased. This can be simply achieved by implementing a clean seed and strict hygiene strategy/system for your farm.

REFERENCES

David MJ, Gillaspie AG Jr, Harris RW, Lawson RH. 1980. *Ratoon stunting disease of sugarcane: Isolation of the causal bacterium.* Science 210, 1365-1367.

Davis MJ and Bailey RA. Ratoon stunting. In: *A guide to sugarcane diseases* (eds Rott P, Comstock JC, Croft BJ and Saumtally AS. CIRAD/ISSCT, Montpellier.

Croft B, Magarey R and Whittle P. (2000) *Disease management.* In: Manual of cane growing (eds Hogarth DM and Allsopp PG. SRA, Brisbane.

SRA Information Sheet: ISI3007

APPENDIX

APPENDIX 1 – DEVELOPING A CLEAN SEED MANAGEMENT PLAN

Step 1 – Have all resources available to refer to.

The grower should bring in the following information to the first meeting:

- Farm map
- RSD test result (Plant Source Inspection record)
- Records for clean seed purchase (plot, tissue culture or hot water treatment)
- Productivity report.

Step 2 – Grower profile

1. Fallow or plough out replant? (PORP) (for clean seed blocks)

a. Fallow

b. PORP

2. Fallow or PORP? (for commercial blocks)

a. Fallow

b. PORP

3. How are fallow blocks managed? (for clean seed blocks)

a. Sprayed out

b. Cultivated

c. Other

4. How are fallow blocks managed? (for commercial blocks)

a. Sprayed out

b. Cultivated

c. Other

5. How are PORP blocks managed? (for clean seed blocks)

a. Sprayed out

b. Cultivated

c. Other

6. How are PORP blocks managed? (for commercial blocks)

a. Sprayed out

b. Cultivated

c. Other

7. Are blocks free from volunteers prior to and after planting? (for clean seed blocks)

a. Yes

b. No

8. Are blocks free from volunteers prior to and after planting? (for commercial blocks)

a. Yes

b. No

9. Do you request a plant source inspection (PSI) prior to planting?

a. Yes

b. No

10. Has RSD ever been detected on your farm?

a. Yes

b. No

11. Has RSD been detected on your farm in the past three years?

a. Yes

b. No

12. If yes to 11, how many blocks and area are infected?

_____

_____

_____

_____

_____

13. How is clean seed brought onto the farm?

a. Not collected

b. Collected from CPS plots

c. Tissue culture

d. Hot water treated

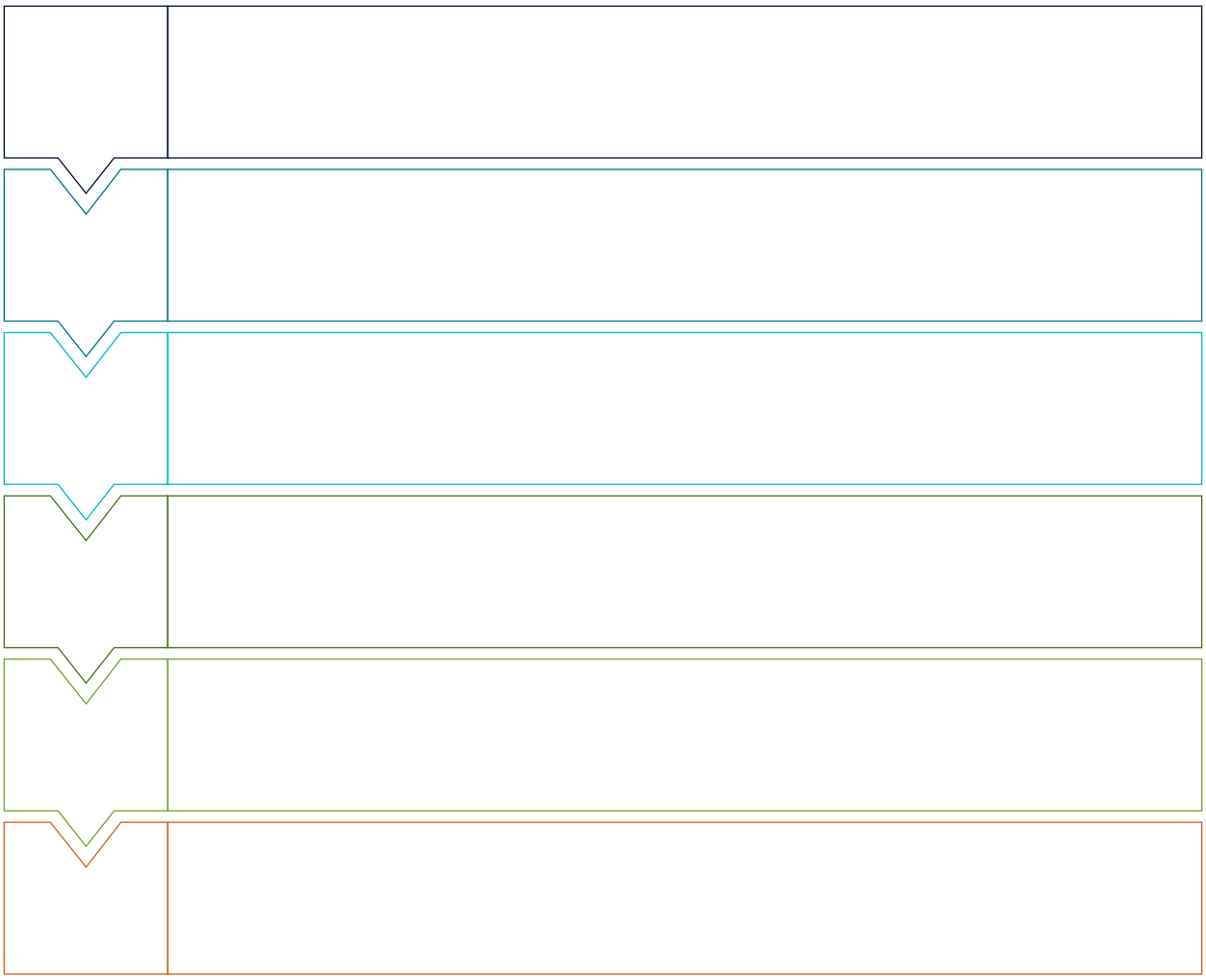
e. From another source (neighbour/planting contractor)

14. Do you know how long each plant source is away from hot water treatment or tissue culture?

a. Yes

b. No

Timeline for grower to complete (time from Hot Water Tank or Approved Clean Seed Plot)



15. How is cane planted? (for clean seed blocks)

a. Whole stalk

b. Billet

c. Tissue culture

16. How is cane planted? (for commercial blocks)

a. Whole stalk

b. Billet

17. Are all machines and implements, including stool splitters, planters and harvesters, sterilised between each crop?

a. Yes

b. No

18. Are all machines and implements including stool splitters, planters and harvesters sterilised between each crop when leaving a block with a known RSD infection?

a. Yes

b. No

19. Do you have a hygiene plan?

a. Yes

b. No

20. Do you have conversations with your harvesting and planting contractors about hygiene?

a. Yes

b. No.

Step 3 – Individual grower/farm clean seed plan

Once the questions from Step 2 have been answered, refer to grower maps for a fallow plan and RSD calculator to estimate potential $ losses/ha.

A. List the percentage of infection on farm (in hectares and dollars)

B. Select a block for a farm seed plot. This must be fallow to allow for zero contamination from volunteers.

C. Select a disease-free planting material source for the coming year.
(Collect the necessary forms from your CPS to book the selected material)

- Hot Water Treatment
- Approved Clean Seed Plot
- Tissue Culture

D. List the varieties that have RSD on your farm.

E. List what machinery and equipment need to be part of the machinery hygiene plan.

Any further comments? ....

APPENDIX 2 – PLANTING MATERIAL INSPECTION CHECKLIST

Planting material inspection checklist

This is a do-it-yourself planting material checklist to help you select your source blocks.

This checklist is helpful not only when selecting your planting material for the coming year, but also for a general health inspection of your cane across your whole farm.

Remember if you are not sure about something, please call your local extension officer.

Look at your CROP health & habit

- Is your crop STANDING or LODGED?
  - Ideally, select standing crops to ensure quality seed.
- Are the EYES on the stalks PRESENT or MISSING?
  - When assessing the eyes of your cane, feel for firmness
- Look for any borer holes or pest damage; don't use material that is damaged.
  - Take a thorough look throughout the block - are the stalks in good condition?
  - Are there any STRESS CRACKS in the stalks?
- Is there any PEST DAMAGE? (e.g. rats/red bill/borer)
- Is there any PIPING present in the stalks? (Longitudinally slice several sticks to check).

Look at CANOPY health & habit

Check for any SMUT WHIPS:

- The sugarcane plant produces a flower that is transformed into a black whip-like structure, covered with spores of the fungus.
- Plants of susceptible varieties may be severely stunted and will take on a grass-like appearance with thin shoots.
- Each shoot may develop the characteristic 'whip' ranging from a few centimetres to a metre long.
- Whips can form on side shoots on mature stalks
  - If whips are found, don't use the cane for planting material.

Check for LEAF SCALD:

- Inspect for the specific, pencil-line symptom and other characteristic symptoms.

Check for CHLOROTIC STREAK:

- Irregular creamy-white streaks with wavy margins on the leaves.
- As the disease progresses, these streaks lengthen and widen.
  - If chlorotic streak is present, seek an alternative plant source.

Regardless of your personal disease diagnosis, ALWAYS contact your EXTENSION OFFICER to arrange a plant source inspection, and especially an RSD test.

APPENDIX 3 – MACHINERY HYGIENE PLAN AND CHECKLIST

Any equipment which cuts cane can spread RSD from an infected source. Cane knives, harvesters, plant cutters, planters (whole stick and billet), and stool splitters should therefore be sterilised prior to entering either a clean cane crop or when moving between farms.

Sterilisation procedure:

1. Ensure that the equipment is free from soil and debris. Wash equipment with water prior to sterilising.
2. Use 1 per cent STERIMAX (Cane knife steriliser) to decontaminate equipment thoroughly. Let the equipment stand for five minutes for the chemical to work effectively OR use 30 per cent water and 70 per cent methylated spirits for rapid sterilisation. Don't use methylated spirits when there is a potential fire hazard.
3. CANE KNIFE STERILISER (Sterimax) is affected by UV light - if the sterilant is well-protected from light then it will last several weeks. However, if it is either exposed to high light intensity or if it is contaminated with soil/organic matter, dispose of it regularly.
4. Avoid using water with a high organic content when diluting Sterimax.

Equipment of concern – key sterilisation points are indicated in BLUE in the photos below

HARVESTER

BILLET PLANTER

STOOL SPLITTER

WHOLE STICK PLANT CUTTER

CANE KNIFE

STOOL SPLITTER (CLOSE UP)

Sugar Research Australia Limited
ABN 16 163 670 068

For further information, contact:

Dr Robert Magarey
Pathologist
SRA Tully
E rmagarey@sugarresearch.com.au or
T 07 4088 0707

Dr Chuong Ngo
Molecular Plant Pathologist
SRA Indooroopilly
E cngo@sugarresearch.com.au or
T 07 3331 3365

Emilie Fillols
Weed Scientist
SRA Meringa
E efillols@sugarresearch.com.au
T 07 4056 4510

Lisa Devereaux
District Manager Southern
SRA Brisbane CBD
E ldevereaux@sugarresearch.com.au
T 07 3331 3333