



THE WET TROPICS RATOON STUNTING DISEASE EXTENSION PACKAGE FOR GROWERS & CONTRACTORS





COVER IMAGE: RSD infected cane on the left and healthy uninfected cane on the right. SRA completed a demonstration block for RSD infected versus not infected cane.

This document has been compiled as a joint effort from all Wet Tropics Cane Productivity Services and industry organisations; Mossman Ag Services, Tablelands Canegrowers, MSF Sugar, Innisfail Babinda Cane Productivity Services and Tully Cane Productivity Services in conjunction with SRA.



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Disclaimer

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Introduction

Ratoon stunting disease (RSD) was discovered by BSES pathologists in 1944. It is now recognised worldwide as probably the most economically important disease of sugarcane. Cane Productivity Services (CPS) throughout Australia complete plant source inspections (PSI) every pre-planting season, which includes sampling for RSD.

Background

Throughout the Wet Tropics, RSD has become a significant issue contributing to productivity and profitability losses to individual growers and the local industry.

With improvements to the diagnostic tests for RSD, we can now see the number of cases of infection has increased. This increase in infection has been found within plant source material, with the status of infection within commercial crops currently unknown.

Our aim is to reduce the number of RSD diseased crops in the Wet Tropics. Each CPS in the Wet Tropics has their own targets and timelines for improvement relating to RSD infection and management.

This booklet provides growers and the local industry with a better understanding of RSD: what it is, how it is spread, and what this means for an individual farm and the industry.

This booklet provides the basis and the tools required to develop an RSD management plan in consultation with your extension officer.

What does RSD mean for your farm?

The identification of RSD is not easy. RSD can be the cause of hidden losses to productivity and profitability to your farm and business.

If RSD is found on your farm, it is difficult to eradicate the disease and this certainly will not happen overnight. There are a number of key steps to follow as outlined below to ensure that you keep RSD off your farm and, also, that you implement a strategy to remove RSD, in conjunction with your extension officer and contractors.

The best attitude to have is to keep the disease off your farm, as it is a lot easier to keep it off-farm than to remove the disease once your farm becomes diseased. This can be achieved by simply having a clean seed and hygiene strategy/system in place for your farm and equipment.





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Ratoon stunting disease

RSD is found in all mill districts in Australia. The incidence of the disease is associated with the degree to which control measures are followed. Generally, RSD is present in fewer than 5% of fields in Australia, although in some districts RSD incidence is much higher. When the disease does occur, it can cause yield losses of 5-60%. Losses are greatest when the cane is moisture stressed

and, even with good irrigation, losses can range from 10 to 30%. This often means a significant financial loss to the business.

What causes RSD

The disease is caused by a bacterium, which infects the xylem (water transport) vessels of the sugarcane plant. (See Diagram 1).

(DIAGRAM 1: WHAT CAUSES RSD)

HEALTHY UNINFECTED SUGAR CANE	BILLET OF CANE PLANTING MATERIAL	VASCULAR BUNDLES ARE FREE FROM DISEASE	CANE IN UNINFECTED PADDOCK RSD FREE
UNHEALTHY INFECTED SUGAR CANE	BILLET OF CANE PLANTING MATERIAL	RSD INFECTION PRESENT VASCULAR BUNDLES BLOCKED	CANE IN INFECTED PADDOCK RSD PRESENT

Symptoms of RSD

RSD can occur in plant cane, not just ratoons as the name would suggest. The effect of RSD is greater in ratoons compared to a plant crop.

Diseased fields can have an 'up-and-down' appearance due to differing levels of stunting in adjacent stools but this may not only be caused by RSD. Sometimes cane will display red-orange dots or 'commas' in the nodal tissue or a faint pink discolouration of the growing point of young plants. These symptoms are not always present in infected cane nor are they a reliable indicator of infection and should not be used as a diagnostic. No symptoms DOES NOT mean no infection.

Diagnosis of RSD

The bacteria that cause RSD are most readily found in sugarcane sap extracted by blowing compressed air through a billet. Sampling for RSD diagnosis involves collecting at least 16-20 stalks through a field. Selecting

poor stools in a field can increase the chances of detecting the disease if it is present. When a grower requests a plant source inspection (PSI), this is the recommended method for collecting samples. The EB-ELISA method is used to diagnose RSD. The SRA RSD laboratory tests approximately 30,000 samples each year using EB-ELISA for the Australian sugarcane industry.



IMAGE 1: A CPS Extension Officer juicing billets to sample for RSD using the ELISA method.

Management of RSD

There are several measures that can be used when facing management of RSD on a farm or within a harvest group or implement syndicate. The most important key step to managing RSD in any situation is to have a well-planned clean seed plan.

Clean seed plan

As a part of a growers' clean seed plan; fallow management strategies, source of planting material and machinery and implement hygiene are vital components to consider. You and your extension officer should talk about this before the planting season.

Fallow management

The fallow period is an opportunity to reduce emerged 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. With regard to

RSD, it is vital to ensure that the fallow is free of volunteer cane to ensure that the disease is eliminated from the block. Volunteer cane can carry RSD from a diseased old crop to the new one.

Volunteer cane is cane that has ratooned after being sprayed out or tilled. Ensuring your fallow is free of volunteers will give your plants the best chance for a healthy and disease-free establishment.

Planting clean material into a block with volunteers, whether it is after a fallow or replant, will reduce the benefits of clean seed as the risk of RSD infection is increased. It takes one RSD infected volunteer in a block to initiate infection as 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.

Herbicide Recommendations for both ratoon spray out and legume fallow management.

SITUATION	HERBICIDE	RATES	WATER RATE L/HA	\$\$/HA (GST INCL)
RATOON SPRAY OUT				
Cane control in Fallow Cane should be fully emerged and actively growing (+ annual and perennial weeds)	Glyphosate 540 Products Must ADD wetter = LI-700 or Activator	4 – 6L/ha	300-400	\$25-\$36
LEGUME FALLOW MANAGEMENT				
Control cane volunteers & grasses Controls grasses in legume crops Use with Uptake spraying oil	Verdict™ 520 or Exert™ 520	150 – 800ml/ha	50 – 100	\$8 - \$44
Broad spectrum control in Fallows (annual & perennial grass, vines, & broadleaf weeds)	Basta® or Biffo®	1 – 5L/ha Or 500mls/100L for spot spraying	300 – 500	\$22 - \$105

(TABLE 1)

Planting material

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

- **What is the original source of that material?** When selecting plant material a grower would ideally consider if the material has come from an approved clean seed

plot (ACSP), if it has been hot water treated (HWT), if the material was planted using tissue culture (TC) or if the material was PSI in the previous year.

- **What is the crop class of the material?** Ideally when selecting planting material, the material should be PL – 1R. In situations where this is not the case, 2R is the very last resort that should be considered.

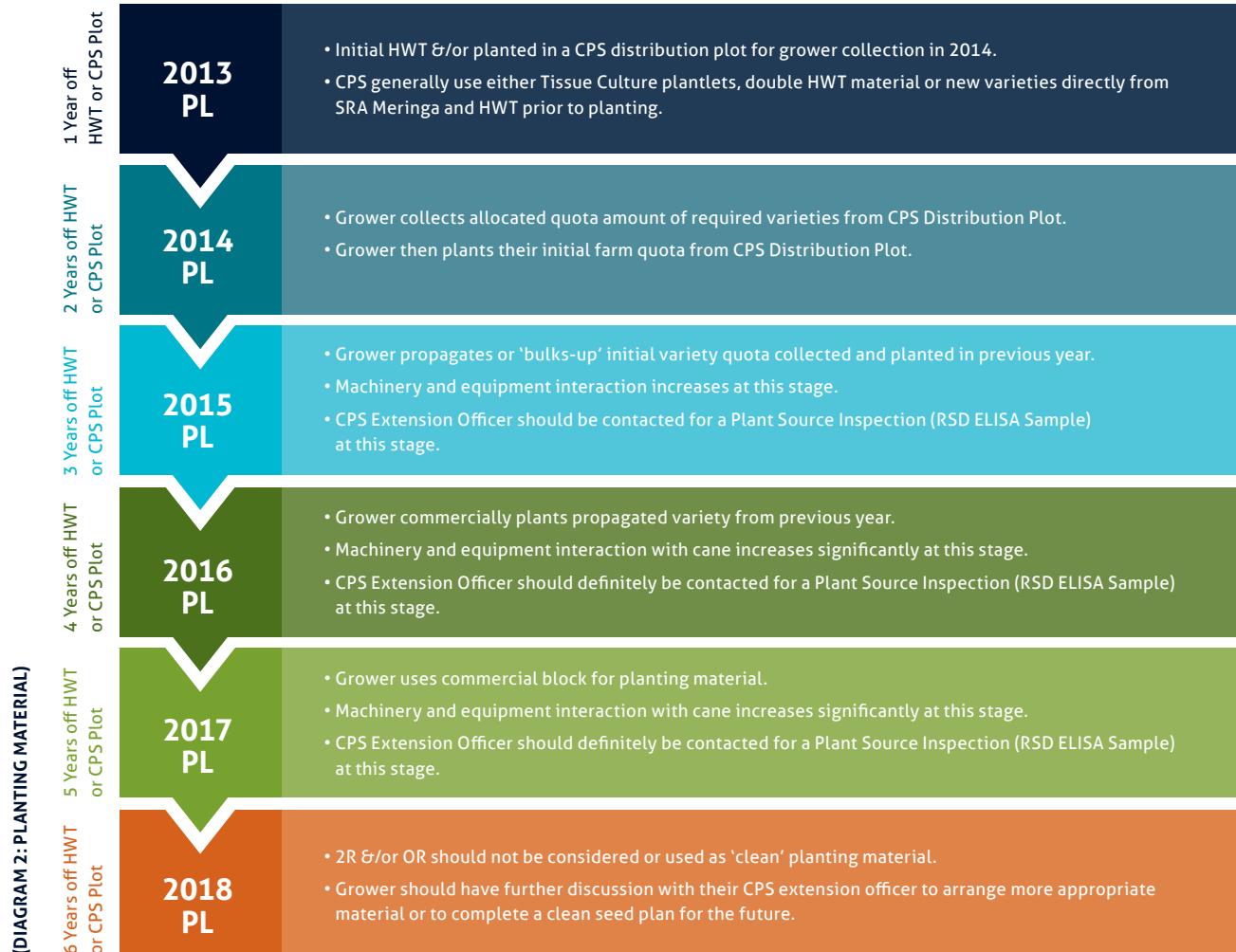


Diagram 2: An example for a Plant Material Source - tracking back how long that material has been away from either Hot Water Treatment, Tissue Culture or CPS Approved Clean Seed Plot. The timeline shows that just because it's plant cane, does not mean it is "clean cane".

When a grower is selecting material for planting, 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, does not necessarily mean that it is clean. The time since 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 material is away from hot water treatment, the risk of infection is increased due to more interactions with potential contaminant sources (i.e. cane volunteers, machinery).

- **What is the condition of the material?** A grower should always organise a 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 in the plant. A PSI for RSD in particular should become a vital step in farm practice plans to ensure individual growers are optimising their potential for 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 readily spreads RSD. Some of the more common implements that can spread RSD are cane knives, planters, harvesters and coulters or discs.

Refer to Appendix 3 for 'Machinery Hygiene Checklist'

Resistant varieties

Some varieties have partial resistance to RSD (eg Q208(b) and disease spread is restricted in these varieties. Many highly productive varieties, such as Q155, KQ228(b) and Q242(b) are highly susceptible and may lose substantial

yield if infected. 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 a simple as planting a resistant variety as there is no guarantee of avoiding infection.

Cost analysis

RSD can almost be a silent killer when it comes to a profit loss to a farm.

(TABLE 2)

ASSUMPTIONS	RSD	RSD FREE
Variety	Q200(b)	Q200(b)
Sugar price (\$)	\$450	\$450
Relative CCS	12.5	12.5
Yield (t/ha)	80	88
Estimated yield loss due to RSD (%)	10%	0%
Cane price (\$/t)	35.68	35.68
Gross \$/ha	\$2854.00	\$3139.40
Cost of production (\$/ha)	\$700	\$700
Net return (\$/ha)	\$2154.00	\$2439.00
Potential profit lost due to RSD infection	- \$285.00	

Table 2: An example for a Plant Material Source - tracking back how long that material has been away from either Hot Water Treatment, Tissue Culture or CPS Approved Clean Seed Plot. The timeline shows that just because it's plant cane, does not mean it is "clean cane".

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Example Farm (as per Table 2)

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 TCH. Unfortunately John had one positive sample in his Q200. The estimated yield loss due to RSD infection in his Q200 equates to around 10%. John's other two blocks of Q200(b) 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 his losses at the end of the season, (RSD infected versus his RSD free blocks), John concluded that even though he still received a payment for that block of approximately \$2154, (\$2439 in the healthy blocks), 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 3 hectares of RSD infected cane equated to him missing out on an additional \$855 for his farm for that year.

As infection increases and spreads further through the block, with farm hygiene not taken seriously, lost revenue will increase further as the crop cycle continues.





Conclusion

RSD is now recognised worldwide as probably the most economically important disease of sugarcane. Throughout the Wet Tropics, 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 material is clean and minimise the risk of spreading disease further.

The best attitude to have is to keep the disease off a farm as it is a lot easier to keep it off-farm than to get rid of it once a farm becomes diseased. This can be simply achieved by implementing a clean seed and 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.

Ask the grower to bring in the following information for the first meeting.

- Farm map
- ELISA RSD results (Plant source inspection record)
- Records for clean seed purchase (plot, tissue culture or HWT)
- Productivity report

Step 2 – Grower profile

1. Fallow or PORG (for clean seed blocks)
 - a. Fallow
 - b. PORG
2. Fallow or PORG (for commercial blocks)
 - a. Fallow
 - b. PORG
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 PORG blocks managed (for clean seed blocks)
 - a. Sprayed out
 - b. Cultivated
 - c. Other
6. How are PORG 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 get a plant source inspection (PSI) done 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 3 years?
 - a. Yes
 - b. No
12. If yes to 11, how many blocks and area are infected?

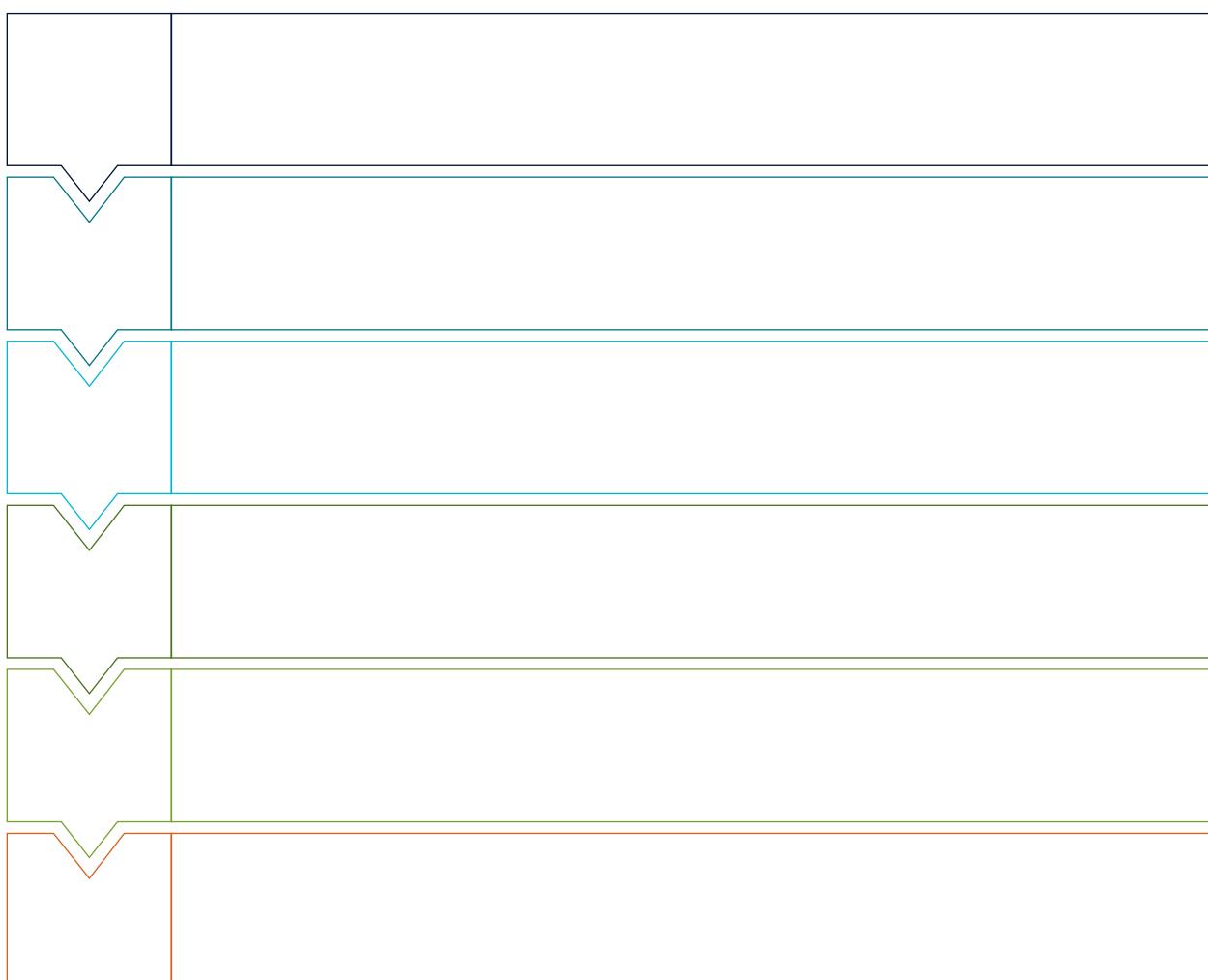
13. How is clean seed brought onto the farm

- a. Not collected
- b. Collected from CPS plots
- c. Tissue culture
- d. HWT
- e. From another source (neighbour/planting contractor)

14. Do you know how long each plant source is away from HWT or TC?

- 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 block?

- a. Yes
- b. No

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

- Yes
- No

19. Do you have a hygiene plan?

- Yes
- No

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

- Yes
- No

Step 3 – Individual grower/farm clean seed plan

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

A. List the percentage of infection on farm. (ha and \$\$)

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

C. Select a clean material source for the coming year. (Collect the necessary forms from your CPS to book the selected method in)

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

D. List what varieties need to be cleaned up from RSD.

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

Any Further Comments....

Appendix 2 – Plant Material Inspection Checklist

Plant Material Inspection Checklist

A do-it-yourself plant material checklist before you select your source blocks

This checklist is helpful not only when selecting your Plant 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 when looking at selecting your planting material, you would want the crop to be standing to ensure quality seed.
- Are the EYES on the stalks PRESENT or MISSING?
- When assessing the eyes of your cane, feel for a firmness
- Look for any borer holes or pest damage; you do not want to use material that is damaged.
- Take a look throughout the block; are the stalks in good condition?
- Are there any STRESS CRACKS
- Is there any PEST DAMAGE (rats/red bill/borer)
- Is there any PIPING present in the stalks (cut several sticks through the block to check)

Look at your CANOPY health & habit:

Check for any SMUT WHIPS

- If whips are found, this is infected plant and you would not use it for planting material.
- 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

Check for LEAF SCALD

- Visual inspection for the specific, pencil-line symptom and the 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.
- Some sections within the lesion can die

Regardless of your personal diagnosis for any disease, ALWAYS contact your EXTENSION OFFICER to arrange a booking for further inspection, especially for RSD inspection.

Appendix 3 – Machinery Hygiene Plan and Checklist

Any equipment which may cut the cane plant can spread RSD from an infected source. Therefore Cane knives, harvesters, plant cutters, planters (whole stick and billet), and stool splitters should all be sterilised prior to entering either a clean block of cane from an infected block or from farm to farm.

Sterilisation Procedure:

1. Ensure that equipment is free of soil and debris. Wash equipment with water prior to sterilizing, if possible.
2. Use 1% STERIMAX to thoroughly sterilise equipment. Leave equipment to stand for 5 minutes for the chemical to work effectively OR use 30% water and 70% methylated spirits to thoroughly sterilise equipment. It is not recommended to use methylated spirits where there are potential fire hazards.
3. CANE KNIFE STERILISER should be disposed of after 24 hours once mixed with water. The chemical will de-activate overtime, once mixed with water.
4. Avoid using water with high organic content when mixing with CANE KNIFE STERILISER.

Equipment of concern – Key sterilisation points indicated in BLUE on diagram

HARVESTER



BILLET PLANTER



STOOL SPLITTER



WHOLE STICK PLANT CUTTER



CANE KNIFE



STOOL SPLITTER (CLOSE UP)



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