



FIELD GUIDE

DISEASES OF AUSTRALIAN SUGARCANE

Robert Magarey

Sugar Research Australia Limited

Brisbane Office 50 Meiers Road, Indooroopilly QLD 4068 Australia

Postal Address PO Box 86 Indooroopilly QLD 4068 Australia

T 07 3331 3333

E sra@sugarresearch.com.au

sugarresearch.com.au

ISBN: 978-0-949678-43-0
633.6193094

Copyright © 2022 by Sugar Research Australia Limited. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the written permission of Sugar Research Australia Limited. **Warning:** Our tests, inspections and recommendations should not be relied on without further, independent inquiries. They may not be accurate, complete or applicable for your particular needs for many reasons, including (for example) Sugar Research Australia Limited being unaware of other matters relevant to individual crops, the analysis of unrepresentative samples or the influence of environmental, managerial or other factors on production. **Disclaimer:** Except as required by law and only to the extent so required, none of Sugar Research Australia Limited, its directors, officers or agents makes any representation or warranty, express or implied, as to, or shall in any way be liable (including liability in negligence) directly or indirectly for any loss, damages, costs, expenses or reliance arising out of or in connection with, the accuracy, currency, completeness or balance of (or otherwise), or any errors in or omissions from, any test results, recommendations, statements or other information provided to you.

FIELD GUIDE
DISEASES
OF AUSTRALIAN
SUGARCANE

Robert Magarey
Sugar Research Australia Limited 2022

Contents

Page No.

Introduction	05
Key	06
Photo index	07
Layout	16
Icons	17
AUSTRALIAN LEAF DISEASES	19
Quick comparison	19
Brown rust	21
Brown stripe	22
Eye spot	23
Orange rust	24
Red leaf spot	25
Ring spot	26
Yellow spot	27
EXOTIC LEAF DISEASES	28
Quick comparison	28
Brown spot	30
Leaf scorch	31
Target blotch	32
Veneer blotch	33
White speck	34
Zonate leaf spot	35

Contents

Page No.

PLANTING-MATERIAL DISEASES	36
Fusarium sett rot	36
Pineapple sett rot	37
AUSTRALIAN WHOLE-PLANT DISEASES	38
Quick comparison	38
Bacterial mottle	40
Chlorotic streak (CSD)	41
Fiji leaf gall	42
Leaf scald	43
Mosaic	44
Pokkah boeng	45
Ratoon stunting (RSD)	46
Red rot	47
Red stripe/Top rot	48
Sclerophthora	49
Smut	50
Striate mosaic	51
EXOTIC WHOLE-PLANT DISEASES	52
Downy mildew	52
Grassy shoot	53
Green grassy shoot	54
Gumming	55

Contents

Page No.

Sugarcane streak mosaic (SCSMV)	56
Ramu stunt	57
White leaf	58
SOIL-BORNE DISEASES	59
Basal stem rot (BSR)	59
Nematodes	60
Pachymetra root rot	61
Pythium root rot	62
Diagnosis	63
When diseases occur	67
Leaf diseases	68
Severity assessment	73
Planting-material diseases	75
Whole-plant diseases	77
Queensland minor diseases	83
Soil-borne diseases	84
Quarantine – State	88
General	90
Glossary	95
Index	98
Acknowledgments	106
Further information	107
Biosecurity zone map	108
Metric conversion table	110

Introduction

This guide has been designed for practical 'in-field' use.

Text is kept to a minimum and symbols are used to convey information.

General information is at the end of the guide.

To use the guide, follow the procedure below:

Understand the layout

- The disease layout is illustrated on page 16

Symptoms

- Determine the main symptom you have seen on page 6
- Matching page numbers will lead you to the disease

Confirmation

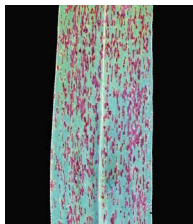
- Specific comparison pages on where, when and how common the diseases are will help confirm your diagnosis

Key

Main symptom	Page number
Crop is brown	21, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33, 34, 35
Crop or stalks are dead	37, 43, 48, 51, 5
Reduced crop growth <ul style="list-style-type: none"> • Whole crop • Patch 	46, 47, 50, 52, 53, 54, 55, 57, 58, 60, 61 40, 41, 42, 43, 49, 51, 52, 53, 54, 55, 57, 58, 59, 61
Uneven plant growth	40, 41, 42, 43, 49, 51, 52, 53, 55, 57, 58, 60, 61
Twisted, deformed shoot	42, 45
Bent stalks	45
Dead spindle leaf	45, 48
Leaf spots	21, 22, 23, 24, 25, 26, 27, 30, 32, 33, 34, 35
Leaf stripes	40, 41, 43, 48, 52, 55, 59
Leaf galls	42
Poor germination	36, 37
Poor root growth	59, 60, 61, 62
Side-shooting	43, 49

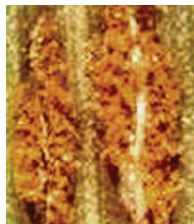
Similar symptoms may be caused by more than one disease or by other factors such as pests, nutrition, herbicides and physical damage.

Photo index



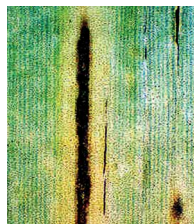
Brown rust

p 21



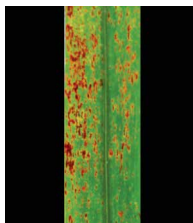
Brown stripe

p 22



Eye spot

p 23



Orange rust

p 24

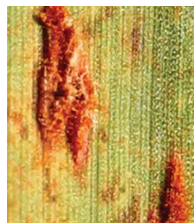
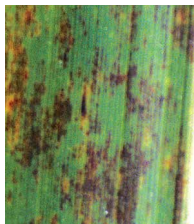


Photo index



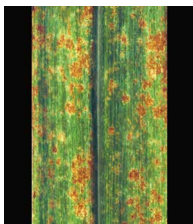
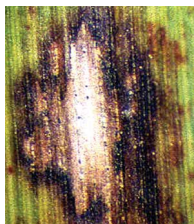
Red leaf spot

p 25



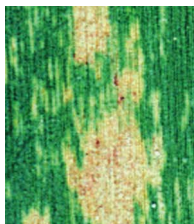
Ring spot

p 26



Yellow spot

p 27



Brown spot

p 30

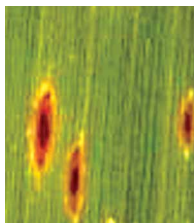


Photo index



Leaf scorch

p 31



Target blotch

p 32



Veneer blotch

p 33



White speck

p 34

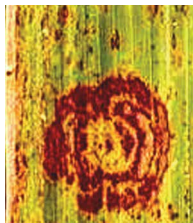


Photo index



Zonate leaf spot

p 35



Fusarium sett rot

p 36



Pineapple sett rot

p 37



Bacterial mottle

p 40



Photo index



Chlorotic streak

p 41



Fiji leaf gall

p 42



Leaf scald

p 43



Mosaic

p 44



Photo index



Pokkah boeng

p 45



Ratoon stunting

p 46



Red rot

p 47



**Red stripe/
Top rot**

p 48



Photo index



Sclerophthora

p 49



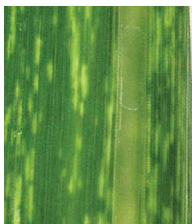
Smut

p 50



Striate mosaic

p 51



Downy mildew

p 52

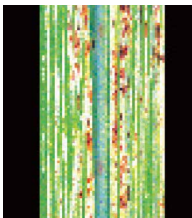


Photo index



Grassy shoot

p 53



Green grassy shoot

p 54



Gumming

p 55



Sugarcane streak mosaic (SCSMV)

p 56



Ramu stunt

p 57

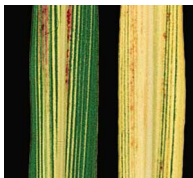


Photo index



White leaf

p 58



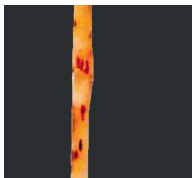
Basal stem rot

p 59



Nematodes

p 60



**Pachymetra
root rot**

p 61

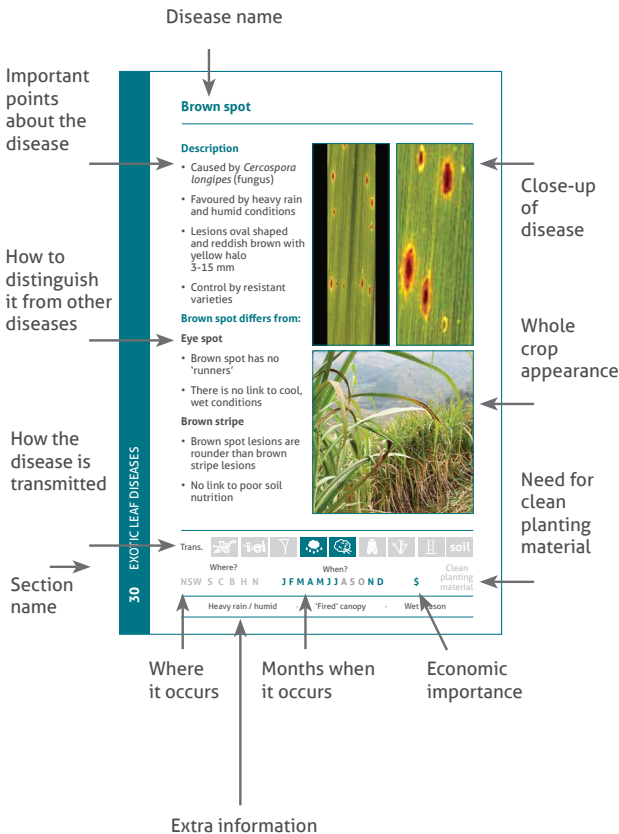


Pythium root rot

p 62



Layout



Icons

Five types of icons are used:

- How the disease is transmitted
- Where it occurs
- When it occurs
- Economic importance
- Need for clean planting material

Transmission icon



Harvesters



Planters



Cane knives & mechanical equipment used to cut cane



Wind-blown rain



Wind



Insects



Planting material



Drainage water

soil

Soil-borne



A coloured icon suggests disease transmission



A grey icon suggests no transmission

Icons

Distribution icon

Where the disease occurs (coloured font).

NSW	New South Wales	B	Burdekin region
S	Southern region	H	Herbert region
C	Central region	N	Northern region

Where?

Occurs here → **NSW S C** B H N ← not here

Occurrence icon

Months when the disease occurs (coloured font).

Occurs in these months → **J F M A M J J A S O N D** ← not usually seen in these

When?

Economic value icon

This has three levels, based on:

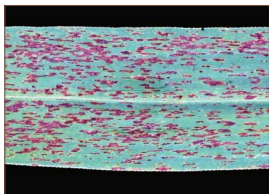
- The historical economic effect in Australia
- The potential effect (exotic disease)

\$\$\$	\$\$	\$
Very significant	Significant	Insignificant

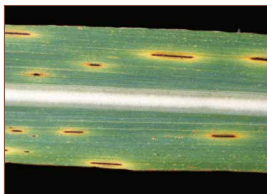
Planting material icon

Coloured font means it is essential to use disease-free planting material.

Clean Planting Material → Disease-free planting material is essential for control



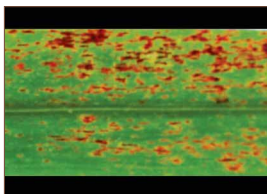
Brown rust



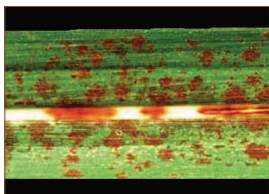
Brown stripe



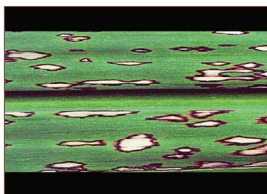
Eye spot



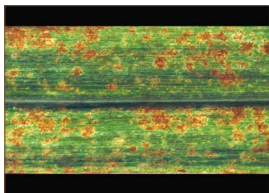
Orange rust



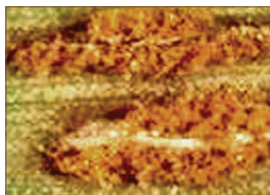
Red leaf spot



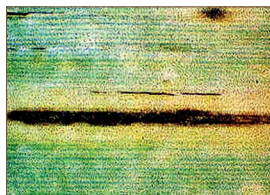
Ring spot



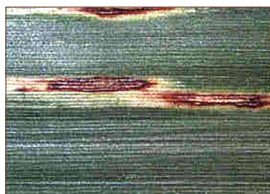
Yellow spot



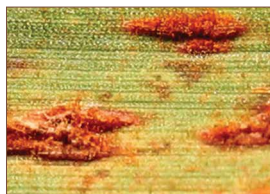
Brown rust



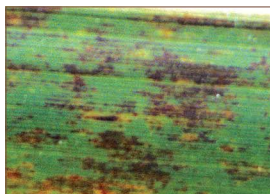
Brown stripe



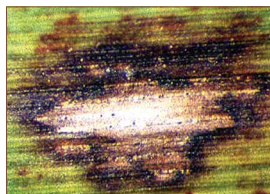
Eye spot



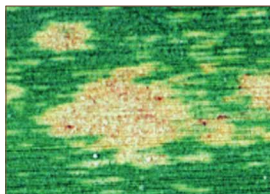
Orange rust



Red leaf spot



Ring spot



Yellow spot

Brown rust

Description

- Caused by *Puccinia melanocephala* (fungus)
- Favoured by cool nights (dew), warm sunny days
- Lesions elongated 5-10 mm x 1-2 mm
- Control by resistant varieties

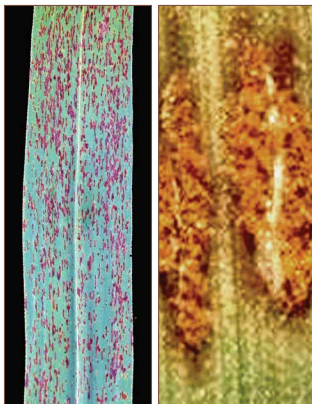
Brown rust differs from:

Yellow spot

- Brown rust occurs in dry season, not wet
- Has elongated lesions (not round)
- Brown spores on underside of leaf

Orange rust

- Brown rust has brown, not orange spores
- Occurs in dry season, not wet
- Lesions longer than orange rust



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Cool nights and sunny days

• Brown canopy

• Dry season

Brown stripe

Description

- Caused by *Bipolaris stenospila* (fungus)
- Favoured by poor nutrition
- Lesions elongated 5-7.5 mm x 2-4 mm
- Control by resistant varieties and better soil nutrition (P, K)

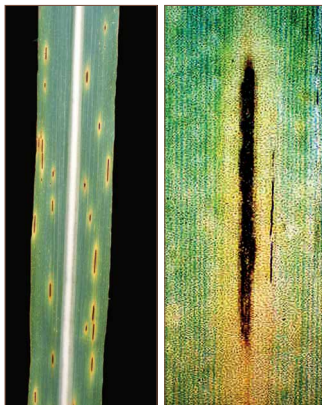
Brown stripe differs from:

Eye spot

- Brown stripe is linked to soil nutrition
- Has no 'runner' associated with the stripe

Ring spot

- Brown stripe has a dark coloured centre to the lesion
- Has a halo around the edge of the lesion
- Lesions are elongated not round



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Nutrient-deficient soils

Brown canopy

Mature cane

Eye spot

Description

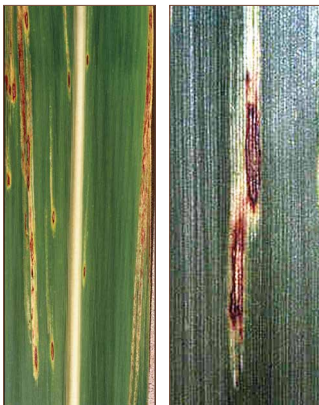
- Caused by *Bipolaris sacchari* (fungus)
- Favoured by cool, wet weather
- Lesions elongated 0.5-4 mm x 0.5-2 mm
- Dark centre with lighter halo
- Control by resistant varieties

Eye spot differs from: Brown stripe

- Eye spot has a runner associated with the lesion
- Lesions more round than elongated

Ring spot

- Eye spot lesions are smaller
- Has a runner associated with the lesion
- Eye spot has a coloured centre to the lesion
- Not as common as ring spot



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$

Clean
planting
material

Cool, wet weather

Brown canopy

Winter

Orange rust

Description

- Caused by *Puccinia kuehnii* (fungus)
- Favoured by warm, humid weather (summer or early autumn)
- Lesions elongated 3-8 mm x 1-2 mm
- Control by resistant varieties

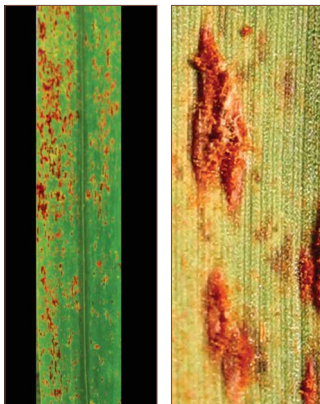
Orange rust differs from:

Yellow spot

- Orange rust has elongated lesions (not round)
- Orange spores on underside of leaf

Brown rust

- Orange rust spores are orange, not brown
- Occurs in wet season, not dry
- Lesions shorter than brown rust



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Warm, humid weather

• Brown canopy

• Wet season

Red leaf spot

Description

- Caused by *Dimeriella sacchari* (fungus)
- Favoured by warm, humid weather
- Lesions round, up to 12 mm
- Control by resistant varieties (not normally an issue)

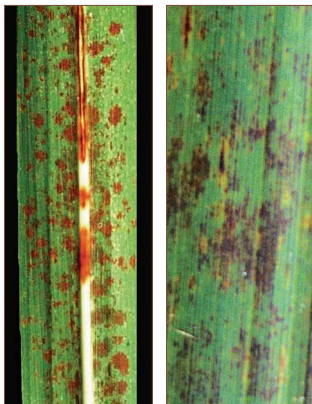
Red leaf spot differs from:

Yellow spot

- Red leaf spot lesions seen only on upper side of leaf blade
- Lesions more red than yellow

Ring spot

- Red leaf spot lesions seen in upper section of canopy
- Lesions seen on upper leaf surface only
- Lesions lack dead tissue as seen with ring spot



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Warm, humid weather

Red-brown canopy

Wet season

Ring spot

Description

- Caused by *Leptosphaeria sacchari* (fungus)
- Favoured by warm, humid weather
- Lesions oval elongated 1-5 mm x 4-18 mm
- Straw-coloured centre to lesions

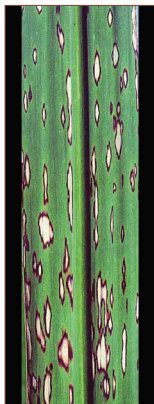
Ring spot differs from:

Eye spot

- Ring spot has no 'runner'
- Has larger lesions
- Occurs lower in crop canopy

Yellow spot

- Ring spot occurs lower in canopy
- Has dead tissue in the central part of lesion
- Has minimal effect on crop yield
- No specific controls required



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Warm, moist conditions

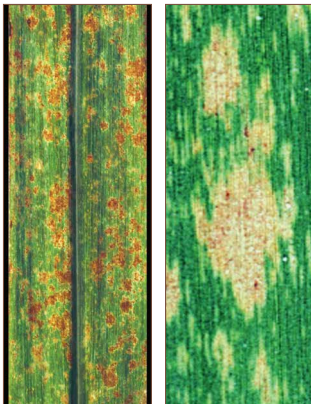
• Dead lower leaves

• End of wet season

Yellow spot

Description

- Caused by *Mycovellosiella koepkei* (fungus)
- Favoured by warm, humid weather
- Lesions irregular (roundish) up to 10 mm in diameter
- Lesions initially yellow but turn brick red
- Control by resistant varieties



Yellow spot differs from:

Red leaf spot

- Yellow spot lesions seen on both sides of the leaf
- Lesions yellow or brick red, not red



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

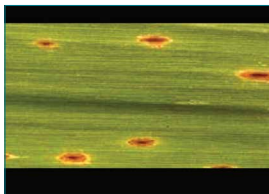
\$\$\$

Clean
planting
material

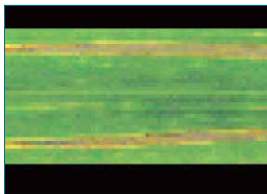
Wet, humid weather

Brown canopy

Wet season



Brown spot



Leaf scorch



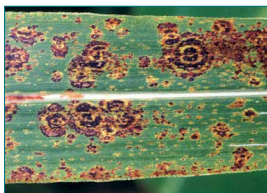
Target blotch



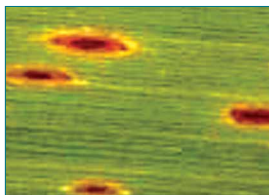
Veneer blotch



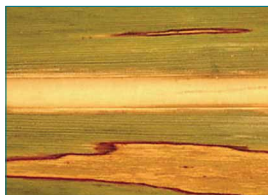
White speck



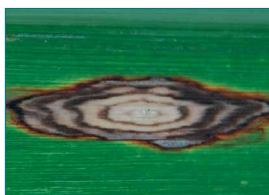
Zonate leaf spot



Brown spot



Leaf scorch



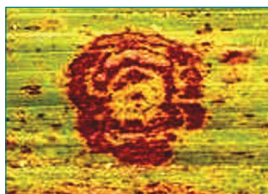
Target blotch



Veneer blotch



White speck



Zonate leaf spot

Brown spot

Description

- Caused by *Cercospora longipes* (fungus)
- Favoured by heavy rain and humid conditions
- Lesions oval shaped and reddish brown with yellow halo 3-15 mm
- Control by resistant varieties

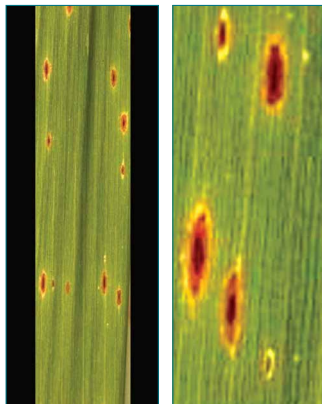
Brown spot differs from:

Eye spot

- Brown spot has no 'runners'
- There is no link to cool, wet conditions

Brown stripe

- Brown spot lesions are rounder than brown stripe lesions
- No link to poor soil nutrition



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Heavy rain / humid

• 'Fired' canopy

• Wet season

Leaf scorch

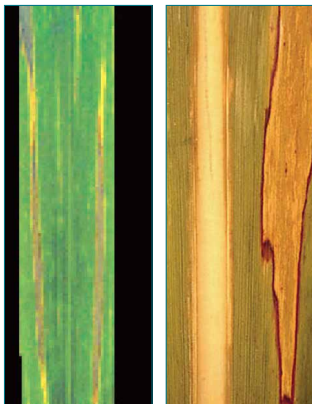
Description

- Caused by *Stagonospora sacchari* (fungus)
- Favoured by rain and warm conditions
- Lesions spindle-shaped with dead tissue in centre, 50-200 mm x 5-10 mm
- Control by resistant varieties

Leaf scorch differs from:

Other diseases

- Leaf scorch has characteristic spindle-shaped lesions
- Ramu scorch looks very similar, but caused by an insect
- Pathogen spores are found within the lesion with leaf scorch, but not Ramu scorch



Trans.



Clean
planting
material

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Warm, rainy weather

• 'Fired' canopy

• Wet season/early dry

Target blotch

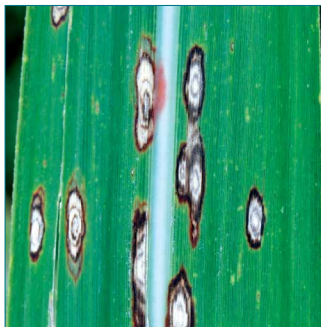
Description

- Caused by *Helminthosporium* sp. (fungus)
- Occurs principally on mature cane in winter
- Lesions straw-coloured to brown, necrotic areas with concentric rings (some similarity to ring spot)

Target blotch differs from:

Ring spot

- Target blotch lesions are similar, except target blotch has concentric margins to the lesions



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Wet conditions

·

Dead lower leaves

·

Winter

Veneer blotch

Description

- Caused by *Deightonella papuana* (fungus)
- Lesions straw-coloured with a pattern like wood veneer
- Lesions up to 10-15 mm wide x 600 mm long

Veneer blotch differs from:

Ring spot

- Veneer blotch differs by having much larger, more elongated 'winged' lesions

Target blotch

- Veneer blotch lesions are much larger and more elongated
- Veneer blotch has 'winged' lesions



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Humid weather

Winged lesions

Wet season

White speck

Description

- Caused by *Elsinoe sacchari* (fungus)
- Little is known of favourable conditions
- Lesions are whitish-grey, sometimes with a red margin, 1-4 mm x 0.4-1 mm

White speck differs from:

Other leaf diseases

- White speck lesions are small and whitish-grey, and not readily confused with other leaf diseases



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Little known information

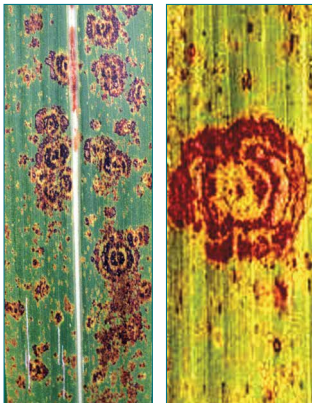
White speckled leaves

Older cane

Zonate leaf spot

Description

- Caused by *Gloeocercospora sorghi* (fungus)
- Favoured by hot, humid weather
- Lesions are a series of concentric rings of alternating dark and light brown tissue, up to 60 mm in diameter



Zonate leaf spot differs from:

Yellow spot

- Zonate leaf spot has less affected tissue within the lesion and more reddening
- Lesions have a concentric pattern with zonate leaf spot



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Hot, humid weather

• Red leaf lesions

• Wet season

Fusarium sett rot

Description

- Caused by *Fusarium sacchari* (fungus)
- Favoured by damaged planting material or cold/wet soil conditions
- No chemicals registered for control
- Activity of chemicals unknown

Fusarium sett rot differs from:

Pineapple sett rot

- Fusarium sett rot lacks the blackening of the central internal sett tissues and the fruity pineapple smell of freshly split setts
- Fusarium sett rot has a more purple colouration



Trans.



soil

Where?

When?

NSW S C B H N

J F M A M J J A S O N D

\$

Clean
planting
material

Cold, dry or wet soils

Purple sett tissue

Young plant cane

Pineapple sett rot

Description

- Caused by *Ceratocystis paradoxa* (fungus)
- Favoured by damaged planting material or cold, dry or wet soil conditions
- Reddening of internal sett tissues, black in the centre (spores)
- Fungicide control

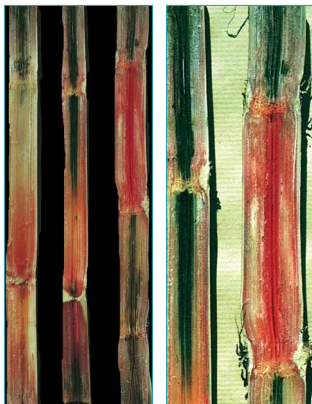
Pineapple sett rot differs from:

Fusarium sett rot

- Pineapple has a central blackening of internal sett tissues (spores)
- PSR also has a pineapple smell in freshly split affected setts

Other sett rots

- Lack the red/black symptoms



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

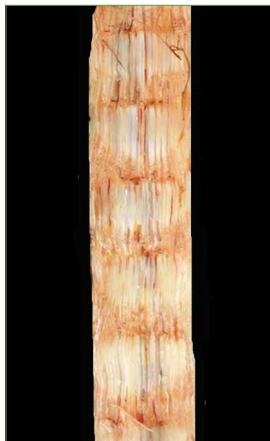
\$\$\$

Clean
planting
material

Cold, dry or wet soils

Red/black sett tissue

Young plant cane



Leaf scald



Ratoon stunting (RSD)



Chlorotic streak



RSD – young symptoms



Leaf scald



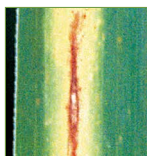
Chlorotic streak



Chimera (genetic)



**Leaf
scald**



**Chlorotic
streak**



Chimera

Bacterial mottle

Description

- Caused by *Pectobacterium chrysanthemi* (bacterium)
- Favoured by flooding during growing season
- Symptoms: creamy-white regular stripes (1-2 mm wide) or a general chlorotic mottle
- Stunting, excessive tillering
- Control by resistant varieties



Bacterial mottle differs from:

Sclerophthora

- Sclerophthora has a wavy leaf margin
- Sclerophthora causes leaf shredding/drying out of leaf tips, giving the canopy a ragged appearance



Trans.



Where?

When?

NSW S C B H N

J F M A M J J A S O N D

\$

Clean
planting
material

Flooding

Chlorotic stripes/excessive tillering

All year

Chlorotic streak (CSD)

Description

- Caused by *Phytocercomonas venanatanas* (protozoan)
- Favoured by wet soil conditions/flooding
- Symptoms are irregular chlorotic streaks and internal stalk reddening
- Control is by improved drainage/disease-free planting material/resistant varieties



Chlorotic streak differs from:

Leaf scald

- With CSD, leaf stripes are irregular, no 'pencil line' and less reddening of internal stalk tissues
- Leaf scald causes a general chlorosis in the acute stage, chlorotic streak does not



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Flooding/planting material

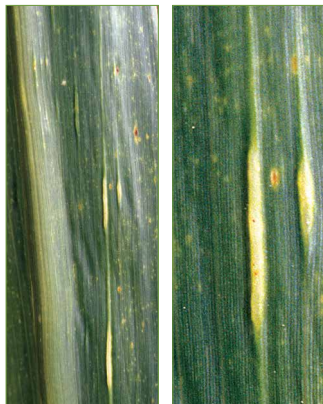
• Leaf stripes

• All year

Fiji leaf gall

Description

- Caused by *Fiji disease virus*
- Transmitted by planthoppers (*Perkinsiella saccharicida*)
- Characteristic symptom is a gall on the back of the leaf
- Causes stunting, dead spindle, distorted tops and short, erect, dark green leaves
- Control by resistant varieties and clean planting material



Fiji leaf gall differs from:

Pokkah boeng

- In many ways Fiji is similar to pokkah boeng, but the latter has no associated leaf galls
- Affected crops grow away from pokkah boeng but not Fiji



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

High vector numbers

• Leaf galls/stunting

• All year

Leaf scald

Description

- Caused by *Xanthomonas albilineans* (bacterium)
- Favoured by water stress
- Leaf stripes, pencil line, tissue chlorosis and stalk death are common symptoms
- Control by resistant varieties and clean planting material



Leaf scald differs from:

Chlorotic streak

- Leaf scald has more regular leaf stripes, and stalk death is not unusual
- Transmitted by machinery
- Favoured by dry conditions, not flooding



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Stress favours expression

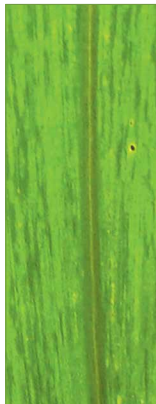
• Stalk death/leaf stripes

• All year

Sugarcane mosaic (SCMV)

Description

- Caused by sugarcane mosaic virus (a Potyvirus) and spread by aphids
- Seen most easily in young cane/young leaves
- Symptoms are a mosaic leaf pattern and stripes on the young stalk
- Control by resistant varieties



Mosaic differs from:

Striate mosaic

- Striate mosaic has very fine striations on the leaf
- Striate mosaic occurs only in the Burdekin, while mosaic is normally seen in south Queensland



Trans.



Where?

When?

NSW S C B H N

J F M A M J J A S O N D

\$\$

Clean
planting
material

Young cane/young leaves

• Leaf mosaic

• All year

Pokkah boeng

Description







- Caused by *Fusarium sacchari* (fungus)
- Favoured by fast cane growth
- Leaf twisting/distortion and 'knife cuts' are common
- Control not usually required

Pokkah boeng differs from:

Fiji leaf gall

- Fiji leaf gall causes galls on the back of the leaf
- Pokkah boeng is mainly seen in the peak of the growing season
- Cane will usually recover from pokkah boeng

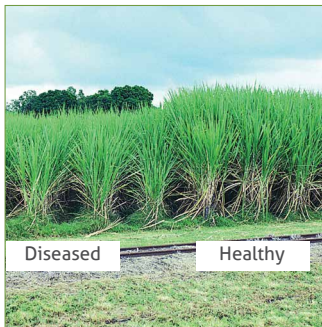


Trans.									soil									
Where?				When?				Clean planting material										
NSW	S	C	B	H	N	J	F	M	A	M	J	J	A	S	O	N	D	\$
Fast growth			Twisted/stunted leaves			Wet season												

Ratoon stunting (RSD)

Description

- Caused by *Leifsonia xyli* subsp. *xyli* (bacterium)
- Losses increased by drought
- No external symptoms besides stunting
- Diagnosis by qPCR, ELISA or phase contrast microscopy
- Up and down growth characteristic in diseased crop
- Control by machinery sanitation, clean planting material



RSD differs from:

All other diseases

- There are no external diagnostic symptoms with RSD

Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Drought

• Stunted crop

• All year

Red rot

Description

- Caused by *Glomerella tucumanensis* (fungus)
- Favoured by crop stress
- Symptoms are internal stalk reddening with transverse white patches (internal) and stalk death
- Control by resistant varieties



Red rot differs from:

Fusarium sett rot

- Red rot does not cause a purpling of tissues but a reddening, with transverse white patches
- Red rot has a starchy smell, not sour



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$

Clean planting material

Crop stress

Stalk death/red internal tissues

Mature crop

Red stripe/Top rot

Description

- Caused by *Acidovorax avenae* subsp. *avenae* (bacterium)
- Favoured by warm, moist weather
- Symptoms include red leaf stripes and/or a top rot
- Foul odour associated with the base of dead spindle
- Control by resistant varieties



Red stripe/Top rot differs from:

Leaf scald

- Red stripe has red leaf symptoms
- Top rot is also associated with the disease
- Pathogen not primarily spread by mechanical equipment



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Warm, moist weather

• Red stripes/Top rot

• Early/mid wet season

Sclerophthora

Description

- Caused by *Sclerophthora macrospora* (oomycete)
- Favoured by flooding, poorly drained soils
- Symptoms include excessive tillering, multiple budding, stunted growth, wavy leaf margins and leaf mottling
- No control usually needed



Sclerophthora differs from:

Bacterial mottle

- Sclerophthora has wavy leaf margins and less leaf striping
- The disease is caused by a oomycete – oospores can be seen in affected leaves



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Flooding, poor drainage

Excessive tillering

All year

Smut

Description

- Caused by *Sporisorium scitamineum* (fungus)
- Favoured by hot, dry conditions
- Symptoms include terminal growth ending in a 'whip', grassy growth habit
- Whips sometimes on side shoots
- Control by resistant varieties



Smut differs from:

All other diseases

- Smut produces a very characteristic black whip structure from the apical growing point with numerous spores



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Hot, dry conditions

Grassy habit and a whip

All year

Striate mosaic

Description

- Caused by a virus
- Limited to patches in affected fields
- Symptoms include fine striations in the leaf blade that are difficult to see
- Stunting and stalk death are common in susceptible varieties
- Control by resistant varieties



Striate mosaic differs from:

Mosaic

- Striate is limited to soil-associated patches, the vector is unknown and has far less-obvious leaf symptoms
- Stool death occurs
- Striate is limited to the Burdekin



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Soil-limited patches

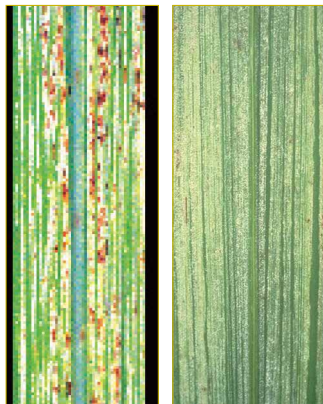
Stunting and death

All year

Downy mildew

Description

- Caused by *Peronosclerospora sacchari* (oomycete)
- Favoured by warm, humid weather
- Symptoms include leaf stripes, leaf shredding and stunting
- Spread by air-borne, fragile spores
- Control by resistant varieties



Downy mildew differs from:

Bacterial mottle

- Downy mildew has more definite leaf striping
- There is down production with downy mildew on hot, humid nights



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Warm, humid weather

Stunting/leaf stripes

All year

Grassy shoot

Description

- Caused by a phytoplasma
- Symptoms are excessive tillering with white chlorotic shoots and severe stunting
- Spread is by diseased planting material
- Control by resistant varieties

Grassy shoot differs from:

White leaf

- Grassy shoot is characterised by excessive tillering
- No insect vector has been identified with grassy shoot



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Warm weather

Grassy growth, stunting

All year

Green grassy shoot

Description

- Caused by a phytoplasma
- Symptoms are excessive tillering (without chlorotic shoots) and stunting
- Spread by diseased planting material (also suspected spread by insect vector)
- Control by resistant varieties and disease-free planting material



Green grassy shoot differs from:

White leaf

- Green grassy shoot has no white leaf symptoms

Grassy shoot

- Green grassy shoot does not exhibit leaf chlorosis



Trans.



soil

Where?

When?

Clean
planting
material

NSW S C B H N

J F M A M J J A S O N D

\$\$\$

Warm weather

Grassy growth, stunting

All year

Gumming

Description

- Caused by *Xanthomonas axonopodis* pv. *vasculorum* (bacterium)
- Favoured by high winds, high humidity, wind-blown rain
- Symptoms include leaf stripes, chlorosis and gum pockets within stalks
- Control by resistant varieties



Gumming differs from:

Leaf scald

- Leaf stripes caused by gumming are yellow to orange, with non-systemic disease development occurring in older leaves only
- Gumming causes gum pockets within stalks



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Warm, humid, windy weather

• Leaf stripes

• Wet season

Sugarcane streak mosaic (SCSMV)

Description

- Caused by *Poty* virus in a different genus to SCMV
- Seen most easily in young cane/young leaves
- Symptoms are a mosaic leaf pattern and stripes on the young stalk
- Control by resistant varieties



Sugarcane streak mosaic differs from:

Sugarcane mosaic

- Streak mosaic is caused by a different virus
- Streak mosaic does not yet occur in Australia
- There is no known insect vector for streak mosaic



Trans.



Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$

Clean
planting
material

Young cane/young leaves

• Leaf mosaic

• All year

Ramu stunt

Description

- Caused by *Ramu stunt virus* (RmSV)
- Transmitted by the planthopper *Eumetopina flavipes*
- Symptoms include severe stunting and stool death, a trashy appearance and various leaf stripes and mottling



Ramu stunt differs from:




White leaf

- Obvious white leaves are seen with white leaf

Grassy shoot

- Grassy shoot does not cause leaf patterns such as seen with Ramu stunt



Trans.										soil											
Where?			When?							Clean planting material											
NSW	S	C	B	H	N	J	F	M	A	M	J	J	A	S	O	N	D	\$\$\$			
Good growth					•	Stunting/stool death/trashy										•	All year				

White leaf

Description

- Caused by a phytoplasma
- Favoured by high populations of the vectors (leafhopper *Matsumuratettix hiroglyphicus* and *Yamatotettix flavovittatus*) in summer
- Main symptom is a chlorosis (whitening) of the leaves
- Reduced yield and stalk death also result
- Control by resistant varieties, disease-free planting material and crop termination



White leaf differs from:

Grassy shoot

- White leaf has leaf chlorosis as the main symptom
- White leaf is transmitted by a leafhopper
- Both are transmitted in planting material

Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Warm weather

White leaves/stunting

Summer

Basal stem rot (BSR)

Description

- Caused by a basidiomycete (fungus)
- Favoured by dry conditions
- Occurs in patches in young plant cane
- Symptoms include stunted growth, poor tillering and sunken brown lesions around the base of shoots
- White stripes on leaves
- Crop recovery favoured by hilling up



Basal stem rot differs from:

Striate mosaic

- BSR also occurs outside the Burdekin
- BSR affects the base of shoots
- BSR leads to a strong mushroom-like smell



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$\$

Clean
planting
material

Dry conditions

Poor patch in young cane

Plant crop

Nematodes

Description

- Caused by various species (*Pratylenchus*/*Meloidogyne*)
- Favoured by light soils
- Lesions and poor fine-root growth (*Pratylenchus*) or knots on roots (*Meloidogyne*)
- Control by crop rotation/nematicides

Lesion nematodes differ from:

Pachymetra root rot

- Lesion nematodes don't produce a soft rot of primary roots
- Lesion nematodes are not controlled through resistant varieties

Pythium root rot

- *Pythium* lesions are more oval shaped and have a more red-black appearance



Trans.



soil

Where?

When?

NSW S C B H N

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

Light soils

· Unthrifty growth/poor root growth

· All year

Pachymetra root rot

Description

- Caused by *Pachymetra chaunorhiza* (oomycete)
- Favoured by high rainfall/light soils (some districts)
- Main symptom is a rot of the thicker roots
- Control by resistant varieties
- More important in Queensland than *Pythium*



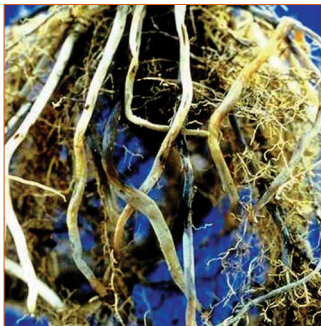
Pachymetra root rot differs from:

Lesion nematode

- *Pachymetra* causes a rot of the root system
- Controlled by resistant varieties

Pythium root rot

- *Pachymetra* is favoured by high soil temperatures
- Mainly affects the primary (thick) roots



Trans.



soil

Where?

When?

NSW S C B H N

J F M A M J J A S O N D

\$\$\$

Clean
planting
material

High rainfall/warm conditions

Root rot

All year

Pythium root rot

Description

- Caused by *Pythium arrhenomanes* (oomycete)
- Favoured by low soil temperatures
- Main symptoms are red lesions on roots and poor fine-root growth
- Not a major disease in Queensland
- No controls necessary



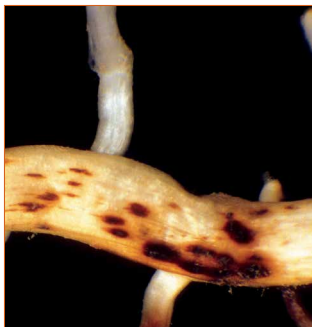
Pythium root rot differs from:

Pachymetra root rot

- *Pythium* causes red root lesions and poor fine-root growth

Lesion nematode

- *Pythium* lesions are more oval shaped and have a more red-black appearance



Trans.



soil

Where?

NSW S C B H N

When?

J F M A M J J A S O N D

\$

Clean
planting
material

Low soil temperatures

• Poor fine roots

• Winter

Diagnosis

Keep the following in mind:

1. Other causes?

- Not all symptoms are caused by disease

2. Diversity of symptoms

Examine:

- Whole crop, individual stalk, inside the stalk and a hand lens view (mites may be identified with a hand lens, for instance)

Make a summary of your observations.

3. Investigate other possibilities

This may involve:

- Slicing stalks
- Finding out the chemicals that have been applied to the crop
- Checking for unusual weather conditions that may have occurred (for instance, lightning)
- Determining the fertilisers applied

4. Look for other reasons why the symptoms may be present

- Relate appearance to the timing of other events, e.g. lightning, severe heat or cold

5. Distribution patterns

Are there any patterns that may link the symptoms with:

- Out-of-field activities, e.g. spray application in an adjoining paddock
- Soil type within the field
- Traffic paths of machinery, e.g. multiple row symptom expression patterns

Diagnosis

- Previous variety history

Attempt to link symptoms with field patterns.

6. When did the symptoms first occur?

Find out how long the symptoms have been present.

This may link the symptoms with an event, either the weather or a farming operation.

7. Is the cane 'growing out' of the symptoms?

If it is:

- The disease may be a minor one, or
- Symptoms may not be caused by a disease

8. See if the symptoms match a disease

Using the guide, consider:

- Whether symptoms fit with any known diseases
- The consistency of when and where the disease is usually found

The presence of atypical symptoms and occurrence may be enough to suggest a 'no-match'.

Seek expert advice, if needed.

How to distinguish:

1. Genetic mutations (chimeras)

- Thin, white streaks, sometimes similar to leaf scald
- Have very definite, very sharp boundaries between the white streak and the green leaf tissue
- Most diseases have a 'fuzzy', diffuse boundary

Diagnosis

2. *Nutritional symptoms*

Experience is needed to expertly diagnose nutritional disorders. Clues of nutritional causes include:

- Symptoms only expressing exclusively in either younger or older leaves
- Potential relationship with soil type and fertiliser application dose
- Symptoms linked to leaf structures (for instance, an inter-vein yellowing)

3. *Lightning*

Damage can be very spectacular and difficult to determine. Clues are:

- **Timing:** symptoms occur during the storm season
- **Patch occurrence:** symptoms are seen as a round patch with more-severe symptoms in the centre grading out to healthy cane; patches may be about 10 m in diameter
- **Purple leaf symptoms** coupled with stalk death near the centre of the patch

4. *Below-ground causation*

- Often there are no above-ground symptoms besides general unthrifty growth
- Growth limitations may occur either in patches or a whole field
- Dig up a few stools and look for shortened discoloured roots and the presence of very limited root growth

5. *Cold or heat chlorosis*

- Spectacular white bands running across the leaf blade; there may be a number of bands across a single leaf

Diagnosis

- Occurrence is linked to either:
 - > Unusually cold conditions, or rain, immediately followed by a hot, sunny period
 - > Susceptible varieties (chlorosis usually occurs in only one or two per district)

Equipment to assist diagnosis

The following equipment will assist in collecting the information you need to make a diagnosis:

Equipment	Use
Hand lens	For close-up examination of symptoms on leaves
Knife	For slicing open stalks to view internal stalk symptoms
Felt pen	For labelling bags/labels
Sealable plastic bags	For collecting specimens to send to relevant experts
Shovel	To dig up stools to examine root systems and to collect soil samples
Camera	To photograph symptoms

When diseases occur

What time of year do you see it?

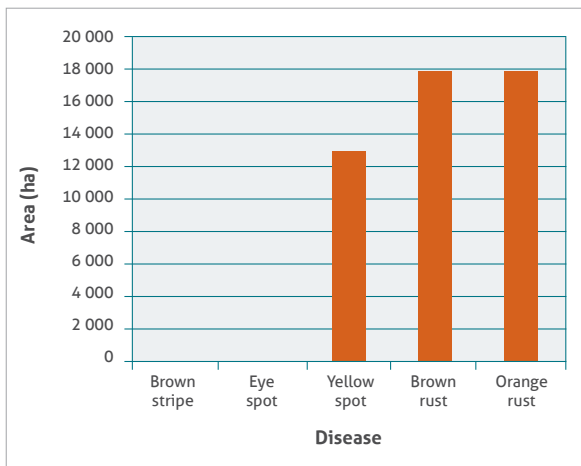
Brown rust

North	J F M A M J J A S O N D
South	J F M A M J J A S O N D
Brown stripe	J F M A M J J A S O N D
Eye spot	J F M A M J J A S O N D
Orange rust	J F M A M J J A S O N D
Red leaf spot	J F M A M J J A S O N D
Ring spot	J F M A M J J A S O N D
Yellow spot	J F M A M J J A S O N D
Bacterial mottle	J F M A M J J A S O N D
Chlorotic streak	J F M A M J J A S O N D
Fiji leaf gall	J F M A M J J A S O N D
Leaf scald	J F M A M J J A S O N D
Mosaic	J F M A M J J A S O N D
Pokkah boeng	J F M A M J J A S O N D
Ratoon stunting	J F M A M J J A S O N D
Red rot	J F M A M J J A S O N D
Red stripe/Top rot	J F M A M J J A S O N D
Sclerophthora	J F M A M J J A S O N D
Striate mosaic	J F M A M J J A S O N D

Leaf diseases

Area affected by Australian leaf diseases

Average annual incidence data (1980-2003) in Queensland



Brown stripe is associated only with poor soils.

Eye spot is associated with a small number of susceptible varieties.

Yellow spot is consistently found only in northern and Herbert districts.

Brown rust and **orange rust** are found throughout the Queensland industry.

Ring spot is commonly seen in every district but because it affects the lower canopy, only minor yield losses occur.

Leaf diseases

Distribution and importance of exotic leaf diseases

- There are a number we don't yet have in Australia
- Some are close by in PNG
- Listed below is the likely economic effect if any are introduced (however, it should be remembered that extreme susceptibility in a commercial variety may make any one of major significance to our industry)
- Each has characteristic symptoms – especially lesion shape

Disease	Country	Major/Minor
Brown spot	Widely distributed	Minor
Leaf scorch	S & SE Asia, South America, Africa	Major
Target blotch	Widely distributed	Minor
Veneer blotch	SE Asia	Minor
White speck	Widely distributed	Minor
Zonate leaf spot	PNG, USA, Solomon Islands, Samoa	Minor

Leaf diseases

Severity

Affected by:

1. Weather

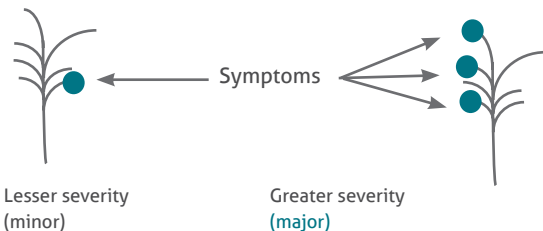
Has a huge influence on occurrence and severity of leaf diseases. Temperature and relative humidity (illustrated below) are the most important factors for spore germination.

Spore germination requirements (optimum)

	Relative humidity (%)	Temperature (°C)
Brown rust	> 99	11-27
Orange rust	> 97	17-23
Yellow spot	100	20-30

2. Where in the canopy

Greatest yield effects occur when the younger 2-4 green leaves in a shoot show obvious disease.



Severity Examples

Minor: Ring spot principally affects the senescing (old) leaves in the canopy. Although visually spectacular, yield effects are small.

Leaf diseases

Major: On the other hand, the **rusts** and **yellow spot** may affect the younger leaves and they have a very significant yield effect.

3. *Varietal resistance*

Has a very large effect; control for most diseases is via varietal resistance.

4. *Soil parameters*

Such as soil texture and nutritional content.

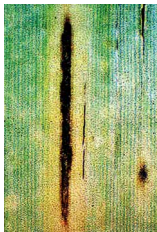
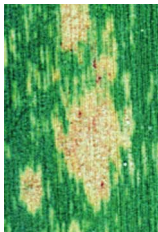
- **Poor nutrition** influences brown stripe
- **Lighter soils** favour the rusts

5. *Time of year*

Leaf diseases have greater yield effects when present in the growing crop (tonnes cane). Commercial cane sugar (CCS) drops if the disease persists into, or occurs in, the harvest season.

Lesion shapes

Lesion shape gives a substantial clue to the identity of the disease.

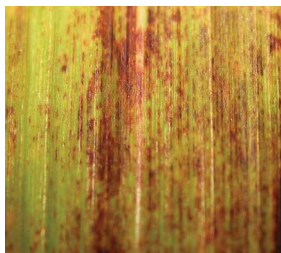


Looking carefully (close-up) at the lesion shape will greatly assist in identification.

Leaf diseases

Lesion distribution upper and lower leaf surface

Some lesions appear equally on both upper and lower leaf surfaces, some only on the upper surface.



Red leaf spot (upper)



Red leaf spot (lower)

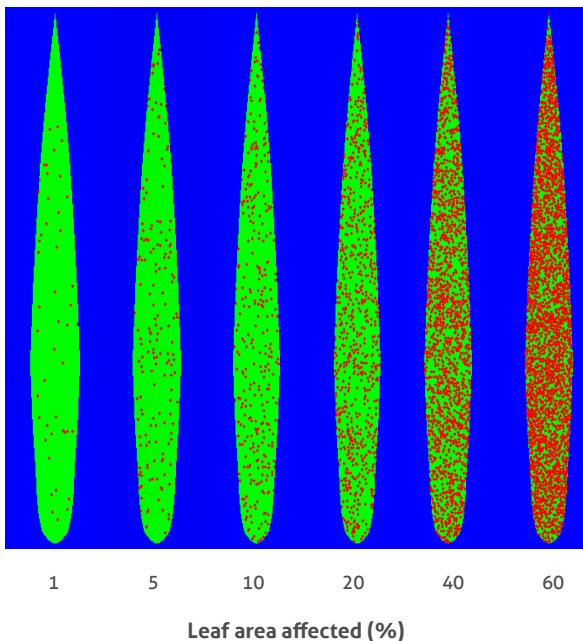


Yellow spot (upper)



Yellow spot (lower)

Severity assessment



Leaf area affected

The scale above provides a guide to the percentage leaf area affected in diseased sugarcane leaves.

A computer simulation program can be obtained from SRA, Tully, to assist in improving estimation accuracy.

Severity assessment

Estimating leaf area affected

A uniform objective measure of the leaf area affected by a disease is useful in:

- Estimating areas affected by a disease over several districts
- Estimating yield losses caused by a disease

Research has shown that even 10% leaf area affected in the 5th leaf from the spindle in a crop canopy may be enough to significantly reduce sugarcane yields (orange rust).

Individual ability to estimate leaf area affected

Studies in the USA have shown that:

- Some people are unsuitable as leaf disease estimators
- Others may routinely over- or under-estimate disease levels, and this bias varies with disease severity

Tip for area estimation

- First estimate the % *leaf area* **diseased** (dark tissue), then check
- By estimating % *leaf area* **healthy** (green tissue)

Planting-material diseases

Disease

Pathogen

Fusarium sett rot

Fusarium sacchari

Pineapple sett rot

Ceratocystis paradoxa

1. Control

Pineapple sett rot control is principally through fungicide application at planting.

Fungicide costs

- About \$1 m annually in Queensland

2. Factors increasing severity

- Dry or wet and cold soil
- Poor-quality planting material (split/cracked/piping)
- Poor fungicide coverage of cut billet ends

3. Importance of early diagnosis

Early digging of planting material (2-4 weeks after planting):

- Provides for reliable diagnosis because sett tissues have not excessively deteriorated (few other organisms are there)
- May allow replanting of the crop if pineapple sett rot is diagnosed

Planting-material diseases

Pineapple sett rot fungicides

Commercial Products	Active Ingredient	Dose/100 L water
Sinker®	Flutriafol	100 mL
Cane sett treatment®	Propiconazole	20 mL
Cane Strike®	Flusilazole	125 mL
Bumper®	Propiconazole	20 mL
Tilt®	Propiconazole	20 mL
Sportak®	Prochloraz	20 mL
Bayleton®	Triadimefon	100 mL

Note: Check with supplier regarding dosage.

Sett coverage

It is imperative to completely cover the cut ends of setts with fungicide.

Testing coverage

- Sprays on whole-stick planters can be tested using vegetable dyes (for instance, 'marker dye' from Nufarm)
- Dips in billet planters should also provide coverage of all cut ends
- Failure to test these systems may lead to germination failure

Recommended change times for solutions

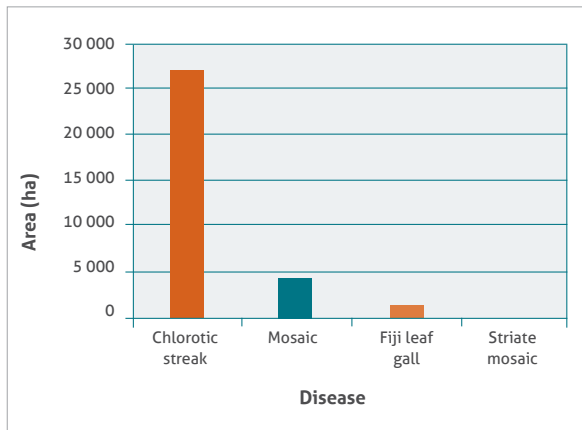
Solutions should be changed weekly in most cases.

Whole-plant diseases

Area affected by Australian whole-plant diseases

Viral diseases and CSD - a protozoan

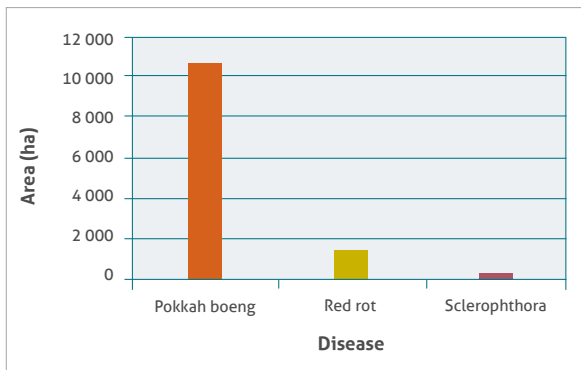
Average annual data (1980-2003) in Queensland



Whole-plant diseases

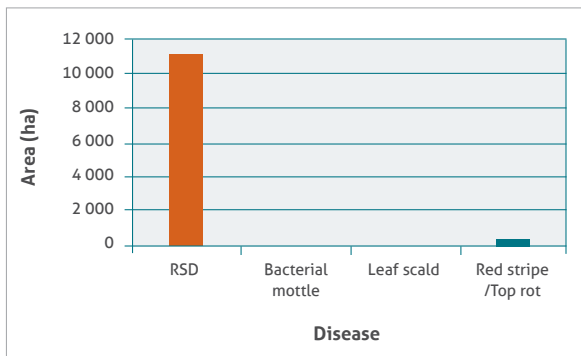
Fungal diseases

Average annual data (1980-2003) in Queensland



Bacterial diseases

Average annual data (1980-2003) in Queensland



Whole-plant diseases

Pathogen and importance

- Are those where the pathogen invades the whole plant
- Often cause greater yield loss than other diseases
- Most of our major diseases are whole-plant
- Carry over from one crop to the next

Pathogens

Disease	Pathogen	Major/Minor
Bacterial mottle	<i>Pectobacterium crysanthemii</i>	Minor
Chlorotic streak	<i>Phytocercomonas venanatanas</i>	Major
Fiji leaf gall	<i>Fiji disease virus</i>	Major
Leaf scald	<i>Xanthomonas albilineans</i>	Major
Pokkah boeng	<i>Fusarium sacchari</i>	Minor
Ratoon stunting	<i>Leifsonia xyli</i> subsp. <i>xyli</i>	Major
Red rot	<i>Glomerella tucumanensis</i>	Minor
Red stripe/Top rot	<i>Acidovorax avenae</i> subsp. <i>avenae</i>	Minor
Sclerophthora	<i>Sclerophthora macrospora</i>	Minor
Striate mosaic	<i>Sugarcane striate mosaic associated virus</i>	Minor
Mosaic	<i>Sugarcane mosaic virus</i>	Major

Whole-plant diseases

Control measures

1. *Resistant varieties*

- The most important control measure
- Resistance screening of new clones is a major SRA activity
- Appropriate levels of resistance in commercial varieties is critical to maximise profitability

2. *Disease-free planting material*

- Normally also very important, since the pathogen lives inside the cane stalk
- Approved seed plots in each mill area supply disease-free planting material

3. *Sanitation*

- Important for controlling diseases that spread in cane juice (RSD and leaf scald)

4. *Drainage*

- Diseases such as chlorotic streak are favoured by wet soils
- Improved drainage can reduce disease levels

Whole-plant diseases

Distribution and importance of exotic whole-plant diseases

- Are those not recorded in Australia
- Some would lead to a significant drop in productivity and profitability
- Some of our best varieties are susceptible to exotic diseases
- Below are major exotic diseases

Disease	Pathogen	Current distribution
Downy mildew	<i>Peronosclerospora sacchari</i>	SE Asia, Pacific Rim
Grassy shoot	Phytoplasma	S & SE Asia
Green grassy shoot	Phytoplasma	S & SE Asia
Gumming	<i>Xanthomonas axonopodis</i> pv <i>vasculorum</i>	Africa, South America, India
Ramu stunt	Ramu stunt virus	PNG
Streak mosaic	Sugarcane streak mosaic virus	S & SE Asia
White leaf	Phytoplasma	S & SE Asia

Contingency plans

Developed:

- To maximise the possibility of disease eradication, or to minimise yield losses if eradication is not possible
- For the highest risk diseases

Whole-plant diseases

The smut plan was used in 1998 when smut reached Western Australia, and in 2006 when it reached eastern Australia.

National sugar industry biosecurity plan

Plant Health Australia together with sugar industry groups have developed a national plan for responding to incursions of exotic pests and diseases. Copies of the plan can be obtained from www.planthealthaustralia.com.au.

Outline of plant pest emergency response

1. Investigation

- Detection of new pest, investigation by SRA or state agency, samples collected and identified

2. Alert

- Australia's Chief Plant Protection Officer notified
- Quarantine restrictions imposed
- Impact evaluated and decision made on response

3. Operational

- State agency manages operational responses, e.g. eradication, surveys, trace back, quarantine
- Local pest control command established

4. Stand down

- Eradication successful or decision made to move to containment and control
- Containment – quarantine to limit spread to other districts
- Control – resistant varieties, fungicides, hygiene, plough-out

Queensland minor diseases



Yellow leaf virus (SCYLV)

- Caused by a virus
- Main symptoms: a strong yellowing of the mid-rib
- Symptoms are expressed when the crop is stressed



Sugarcane bacilliform virus (SCBV)

- Caused by a virus
- Main symptoms: a flecking seen on all leaves
- Chewing canes are more susceptible to the disease



Banded sclerotial disease

- Caused by a fungus
- Main symptoms: large round lesions on affected leaves
- The disease is rarely seen and has only minor yield effects

Soil-borne diseases

Hidden

Often soil-borne diseases are unrecognised because they can't be seen without digging up root systems.

In Queensland, they cause the largest economic losses of any type of disease.

Need for a soil assay

Unless soil or root systems are assessed for disease, there is no way of telling how severe the situation is.

Assay laboratory

A soil-assay laboratory at SRA can conduct assays for:

- Pachymetra root rot
- Nematodes
- Mycorrhizae
- Soil-health indicators

Recommendations are sent with the results to guide the farm disease-control program.

Type of diseases

There are two groups of well-recognised causes for soil-borne diseases:

- Fungi
- Nematodes

Soil-borne diseases

Nematode count thresholds (per 200 g soil)

Species	Plant/1 ratoon	2 ratoon
Lesion (<i>Pratylenchus</i>)	300	900-1000
Root-knot (<i>Meloidogyne</i>)	200	400
Spiral (<i>Helicotylenchus</i>)	500	1500–2000
Stubby root (<i>Paratrichodorus</i>)	300	500
Stunt (<i>Tylenchorhynchus</i>)	500	1500–2000
Dagger (<i>Xiphinema</i>)	N/A	400

Note:

- Sub-critical populations may cause problems, particularly on sandy soils
- Soil fertility and water availability are critical factors governing yield losses
- Ideal nutrient and water supply may reduce yield losses
- Keep grasses out of fallow rotations and plant legumes to control most nematode species

Soil-borne diseases

Pachymetra root rot spore count thresholds (,000 per kg soil)

Standing crops

Susceptible varieties (ratings 7-9)

0-30	Nil-low yield loss
30-50	Medium yield loss
> 50	High yield loss

Intermediate resistance (ratings 4-6)

0-40	Nil-low yield loss
40-70	Medium yield loss
> 70	High yield loss

High resistance (ratings 1-3)

0-45	Nil yield loss
45-80	Very low yield loss
> 80	Low yield loss

Fallow ground

0-30	Low level
30-50	Moderate level
> 50	High level

Soil-borne diseases

Soil-assay laboratory: SRA Tully

1. Location

SRA, Dallachy Rd, Hewitt via Tully
PO Box 566, Tully, QLD 4854

Costs

A commercial service is available

Check current costs with SRA

2. Forms (available on sugarresearch.com.au)

Need to be filled in. Information is used to:

- Guide recommendations
- Deliver results
- Populate a database to better understand the disease

3. Transport

Nematodes

Transport conditions are critical for nematode assay samples, as temperatures of 40°C can kill nematodes. Place nematode samples in a cool esky (do not refrigerate) and transport them quickly to the assay laboratory. Ensure forms are fully completed. Do not send samples over a weekend.

Pachymetra root rot

Temperature is not critical and samples can be sent without cooling.

Contact: SRA, Tully

M 0436 622 187 E assaylabtully@sugarresearch.com.au

4. Sampling

- See current sampling methods on sugarresearch.com.au
- Contact the assay laboratory before sampling for nematodes.

Quarantine – State

General Biosecurity Obligation

All Queenslanders have a 'general biosecurity obligation' (GBO) under Queensland's *Biosecurity Act 2014*. NSW has very similar legislation with a General Biosecurity Duty under *NSW Biosecurity Act 2015*.

This means that everyone is responsible for managing biosecurity risks that are:

- under their control and
- that they know about, or should reasonably be expected to know about.

Individuals and organisations whose activities pose a biosecurity risk must:

- take all reasonable and practical steps to prevent or minimise each biosecurity risk
- minimise the likelihood of causing a 'biosecurity event', and limit the consequences if such an event is caused
- prevent or minimise the harmful effects a risk could have, and not do anything that might make any harmful effects worse.

More information about the *Biosecurity Act 2014* and underlying *Biosecurity Regulation 2016* and *Biosecurity Manual* can be found at www.daf.qld.gov.au

Quarantine – State

Biosecurity Zones

There are six sugarcane biosecurity zones in Queensland (*Biosecurity Act 2014, Biosecurity Regulation 2016*), and two far northern biosecurity zones. These zones separate areas of high biosecurity risk from areas of low biosecurity risk.

Movement of sugarcane plants, plant parts, soil or farm equipment into or out of biosecurity zones requires a permit. Permits must be issued by Biosecurity Queensland or their authorised officers through www.daf.qld.gov.au or call **13 25 23**.

For machinery inspections, contact your local productivity service.

A map showing the biosecurity zones in Queensland is on pages 108-109.

General

Background

Sugarcane diseases affect thousands of hectares of Australian sugarcane crops each year. Varietal resistance, rather than chemicals, is the main control measure.

What is resistance and tolerance?

- **Resistant varieties** are able to resist infection and/or colonisation by the pathogen
- **Tolerant varieties** are able to yield well even though infected by the pathogen (i.e. there are some tolerant susceptible varieties)

Resistance ratings

1-9 sliding scale:

There are 3 categories:

1-3: Resistant

4-6: Intermediate

7-9: Susceptible

All commercial varieties are assessed for resistance to major diseases in specifically designed trials.

Major diseases in Australia

Viral:	Fiji leaf gall, mosaic
Bacterial:	Leaf scald, ratoon stunting
Fungal:	Orange and brown rusts, yellow spot, Pachymetra root rot, pineapple sett rot and smut

Minor diseases

Some may become major with the widespread commercial cultivation of a susceptible variety. Details are included in this guide.

General

Economic effects

Diseases are generally well controlled in Queensland. Some leaf diseases, and a couple of easily transmitted endemic diseases, still cause significant yield losses each year.

Abbreviations

SHWT = Short Hot-Water Treatment

LHWT = Long Hot-Water Treatment

CSLHWT = Cold-Soak Long Hot-Water Treatment

Hot water treatment

SHWT = 50°C for 30 minutes (controls chlorotic streak)

LHWT = 50°C for 3 hours (RSD control)

CSLHWT = 40+ hours in cold water plus 3 hours at 50°C (controls leaf scald)

RSD

RSD transmission capability: One (1) diseased stick going through a whole-stalk planter may lead to disease in the next 100 planted setts.

RSD survival time on knives: Less than 12 days.

Sanitation

Cane knife steriliser (quaternary-ammonium compounds):

- Clean all metal surfaces thoroughly before applying sterilant at recommended dose
- Allow five (5) minutes contact with the solution to ensure sterilisation
- Supplier: Agricrop Pty Ltd (agricrop.com.au)

General

Methylated spirits (for rapid sterilisation):

Mix 70 parts 'metho' with 30 parts water. This concentration is more effective than stronger solutions.

It provides instant sterilisation (on clean surfaces). The solution does not break down in the short term (period of weeks). It is very suitable for cane knives and other exposed surfaces.

Be cautious regarding the fire hazard. Consider application with a household trigger-pack (spray bottle) and labelling requirements for dangerous goods. Cleaning is still essential.

Pachymetra root rot

1. Spore life

Spores (formed in diseased roots) are the main survival structure. These last for up to five years in soil. Keeping spore levels low is important in management. Exposing the soil to the sun will have minimal impact on disease levels.

2. Distribution

Spore levels are much higher in the cane row (up to 20 times higher than in the inter-row).

3. Transmission

The disease has no swimming spore. Transmission into disease-free fields probably occurs through mud on machinery.

4. Favourable conditions for disease

Susceptible varieties, high rainfall, lighter soils (central and southern Queensland more particularly).

Soil test

Available through SRA, Tully (commercial service). Contact details same as pg 87. Recommendations are attached to the results. Turnaround time for the assay is 2 weeks.

General

Nematodes

1. *Populations*

Vary greatly through the season and with growth conditions. Growth effects need to be interpreted in the light of plant growth conditions. Can be high even on heavier textured soils.

2. *Species*

A range of species is found in canefields. *Pratylenchus zeae* (lesion nematode) occurs in almost all canefields and is the most important. *Meloidogyne* species (root-knot nematodes) are relatively common and are also important.

3. *Resistance*

Highly resistant varieties have not yet been identified.

4. *Control*

Is through cultural means (farming systems).

5. *Soil test*

Available through SRA. Samples must be kept cool (less than 35°C) in transit but do not refrigerate. Advise SRA by email (assaylabtully@sugarresearch.com.au) of samples sent. Recommendations are included with the results.

Approved seed plots

These are propagation plots in each mill area comprising the main commercial varieties that have been subject to:

- Hot-water treatment (to control systemic diseases such as RSD and leaf scald)
- Inspections for other diseases and correct identity

General

It is very important for farmers to regularly access approved seed plot material to minimise disease incidence and yield losses resulting from RSD and other systemic diseases. Plots are usually organised for each mill area by Cane Productivity Service staff.

Disease inspections

Critical in propagation plots to avoid widespread infection in a whole region.

RSD

The following is a guide to sampling for RSD in approved seed plots. Contact SRA RSD assay laboratory for the current sampling recommendations.

- Sample 50-100 stalks/variety
- Bulk xylem extracts in 6-12 5 ml tubes
- Plots of varieties less than 200 m require 10-50 samples per plot

Vascular extracts are assayed using quantitative real-time PCR, the XP284 assay. Send samples to the assay laboratory at SRA Indooroopilly.

Other diseases

Inspect for other diseases, and impure varieties, by walking each plot at least 3 times each year (young cane/advanced tillering/ 10-12 months of age). If any diseases of note are suspected or if you require further information contact SRA.

Glossary



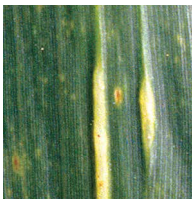
Chimera

Genetic variation with thin white streaks and very definite, sharp margins



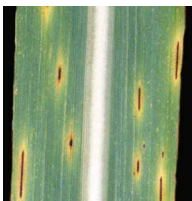
Chlorosis

Absence (partial or complete) of normal green colour



Gall

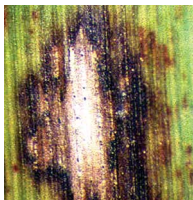
A localised proliferation of tissue producing a swelling



Halo

Ring of chlorotic tissue around a lesion

Glossary



Lesion

A localised area of diseased tissue



Necrotic tissue

Dead tissue



Pencil line

Discoloured single vascular bundle in a leaf (leaf scald)



Root-knot

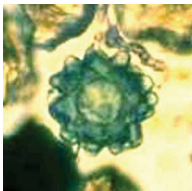
Knobby growth on roots

Glossary



Runner

Chlorotic or necrotic tissue extending away toward the leaf tip from a lesion



Spore

Fungal reproductive structure (equivalent to seed)



Systemic

Occurring throughout the plant (photo is example only)



Whip

A black whip structure arising from the apical growing point

Index

Page numbers in bold indicate the main references.

A

<i>Acidovorax avenae</i> subsp. <i>avenae</i>	48, 79
Acknowledgments	106
Aphids	44
Approved seed plots	80, 93-94

B

Bacterial mottle	10, 40 , 49, 52, 67, 78-79
Banded sclerotial disease	83
Basal stem rot (BSR)	15, 59
Bayleton	76
Biosecurity plan	82
Biosecurity zone ma.....	108-109
<i>Bipolaris sacchari</i>	23
<i>Bipolaris stenospila</i>	22
Brown rust	7, 19-20, 21 , 24, 67-68, 70, 90, 106
Brown spot	8, 28-29, 30 , 69, 106
Brown stripe	7, 19-20, 22 , 23, 30, 67-68, 71
Bumper	76

C

Cane sett treatment	76
Cane strike	76
<i>Ceratocystis paradoxa</i>	37, 75
<i>Cercospora longipes</i>	30
Chimera (genetic effect)	39, 64 , 95

Index

Chlorosis	40-41, 43, 53-55, 58, 65-66, 95
Chlorotic streak	11, 38-39, 41 , 43, 67, 77, 79-80, 91
Cold or heat chlorosis	65-66
Computer simulation program	73
Contingency plans	81-82

D

<i>Deightoniella papuana</i>	33
<i>Dimeriella sacchari</i>	25
Disease key	6
Disease-free planting material	18, 80 , 93
Disinfectant	91-92
Downy mildew	13, 52 , 81

E

<i>Elsinoe sacchari</i>	34
Equipment to assist diagnosis	66
<i>Eumetopina flavipes</i>	57
Eye spot	7, 19-20, 22, 23 , 26, 30, 67-68

F

<i>Fiji disease virus</i>	42 , 79
Fiji leaf gall	11, 42 , 45, 67, 77, 79, 90
Fungicides	75-76
Further information	107
<i>Fusarium sacchari</i>	36, 45 , 75, 79
<i>Fusarium sett rot</i>	10, 36 , 37, 47, 75

Index

G

- Gall 6, 42, 45, **95**
- General biosecurity obligation (GBO) **88**
- Genetic mutations (chimeras) 39, **64**, 95
- Gloeocercospora sorghi* **35**
- Glomerella tucumanensis* **47**, 79
- Glossary **95-97**
- Grassy shoot 14, **53**, 54, 57-58, 81, 106
- Green grassy shoot 14, **54**, 81
- Gumming 14, **55**, 81

H

- Halo 22-23, 30, **95**
- Helminthosporium* sp. **32**
- Hot water treatment **91**, 93

I

- Icons **17-18**

L

Leaf diseases Australian

- Area affected **68**, 73-74
- Quick comparison – close-up **20**
- Quick comparison – whole leaf **19**
- Time of year **67**, **71**

Leaf diseases exotic

- Distribution and importance **69**

Index

• Quick comparison – close-up	29
• Quick comparison – whole leaf	28
Leaf diseases general	
• Lesion shapes	71-72
• Relative humidity	70
• Severity	70-71
• Severity assessment	73-74
• Severity assessment (tips for area estimation)	74
• Soil parameters	71
• Temperature	70
• Time of year	71
• Varietal resistance	71
Leaf scald .. 11, 38-39, 41, 43, 48, 55, 64, 67, 78-80, 90, 91, 93, 96	
Leaf scorch	9, 28-29, 31, 69
<i>Leifsonia xyli</i> subsp. <i>xyli</i>	46, 79
<i>Leptosphaeria sacchari</i>	26
Lesion	21-27, 30-35, 59-60, 62, 69, 71-72, 83, 95, 96, 97
Lightning	63, 65

M

Major diseases in Australia	90
<i>Matsumuratettix hiroglyphicus</i>	58
<i>Meloidogyne</i>	60, 85, 93
Metric conversion	110
Mosaic.....	11, 44, 51, 56, 67, 77, 79, 90, 106
Mycorrhizae	84
<i>Mycovellosiella koepkei</i>	27

Index

N

- Necrotic tissue 32, **96**, 97
Nematode population thresholds **85**
Nematodes 15, **60**, 61-62, 84-85, 87, 93
Nutritional symptoms **65**

O

- Orange rust 7, 19-21, **24**, 67-68, 70, 74, 90

P

- Pachymetra chaunorhiza* **61**
Pachymetra root rot 15, 60, **61**, 62, 84, 86-87, 90, 92
Pachymetra root rot population thresholds **86**
Pectobacterium chrysanthemi **40**, 79
Pencil line 39, 41, 43, **96**
Perkinsiella saccharicida **42**
Peronosclerospora sacchari **52**
Pineapple sett rot 10, 36, **37**, 75-76, 90
Planting-material diseases
• Fungicides **76**
• General information **75**
Pokkah boeng 12, 42, **45**, 67, 78
Poty viruses **44**
Pratylenchus **60**, 85, 93
Puccinia kuehnii **24**
Puccinia melanocephala **21**
Pythium arrhenomanes **62**
Pythium root rot 15, 60-61, **62**, 106

Index

Q

- Quarantine – state 88-89
Queensland minor diseases 83

R

- Ramu stunt 14, 57, 81
Ratoon stunting (RSD) 12, 38, 46, 67, 78-80, 90-91, 93-94
Red leaf spot 8, 19-20, 25, 27, 67, 72
Red rot 12, 47, 67, 78-79
Red stripe/Top rot 12, 48, 67, 78-79
Resistance ratings 90
Ring spot 8, 19-20, 22-23, 25, 26, 32-33, 67-68, 70
Root-knot 60, 85, 93, 96
RSD transmission 91
Runner 22-23, 26, 30, 97

S

- Sanitation treatments 91-92
Sclerophthora macrospora 49, 79
Sclerophthora stunt 13, 40, 49, 67, 78-79
Sett rot fungicides 76
Smut 13, 50, 82, 90
Soil assay laboratory 84, 87
Soil-borne diseases general 84
Spore 21, 24, 31, 37, 49, 50, 52, 70, 86, 92, 97
Sporisorium scitamineum 50
Sportak 76
Stagonospora sacchari 31

Index

Striate mosaic	13, 44, 51 , 59, 67, 77, 79, 106
<i>Sugarcane bacilliform virus</i> (SCBV)	83
Sugarcane biosecurity zones	89, 108-109
Systemic	93-94, 97

T

Target blotch	9, 28-29, 32 , 33, 69
Testing spray coverage	76
Tilt	76

U

Understanding the layout	16
--------------------------------	-----------

V

Veneer blotch	9, 28-29, 33 , 69, 106
---------------------	-------------------------------

W

Whip	50, 97
White leaf	15, 53-54, 57, 58 , 81, 106
White speck	9, 28-29, 34 , 69
Whole-plant diseases – Australian	
• Area affected	77-78
• Control measures	80
• Pathogen and importance	79
• Quick comparison – internal stalks	38
• Quick comparison – leaf streaks	39
• Time of year	67

Index

Whole-plant diseases – Exotic

- Contingency plans **81-82**
- Distribution and importance **81**

X

Xanthomonas albilineans **43, 79**

Xanthomonas axonpodos pv. *vasculorum* **55, 81**

Y

Yellow leaf virus **83, 106**

Yellow spot **8, 19-21, 24-26, 27, 35, 67-68, 70-72, 90**

Z

Zonate leaf spot **10, 28-29, 35, 69, 106**

Acknowledgments

SRA would like to thank the following people for use of photographs from their collection:

Scientist	State/Country	Disease
Jack Comstock	Florida, USA	Brown rust
Salem Saumtally	Mauritius	Brown spot
Philippe Rott	France	Zonate leaf spot Veneer blotch
Brenden Blair	Australia	Nematodes
Anusorn Kusalwong	Thailand	White leaf
Jeff Hoy	Louisiana, USA	Pythium root rot
Mike Grisham	Louisiana, USA	Mosaic
Ben Lockhart	Wisconsin, USA	Yellow leaf virus
Hideo Koike	Louisiana, USA	Zonate leaf spot Veneer blotch
CT Chen	Taiwan	White leaf
R Viswanathan	India	Grassy shoot
John Randles	Australia	Striate mosaic

We would also like to thank CIRAD and ISSCT for the supply of photographs from their collections, and the Queensland Government for their support of RD&E into endemic and exotic sugarcane diseases.

Further information

A Guide to Sugarcane Diseases (edited by P Rott, RA Bailey, JC Comstock, BJ Croft, AS Saumtally). Published by CIRAD and ISSCT, 2000. ISBN 2-87614-386-0.

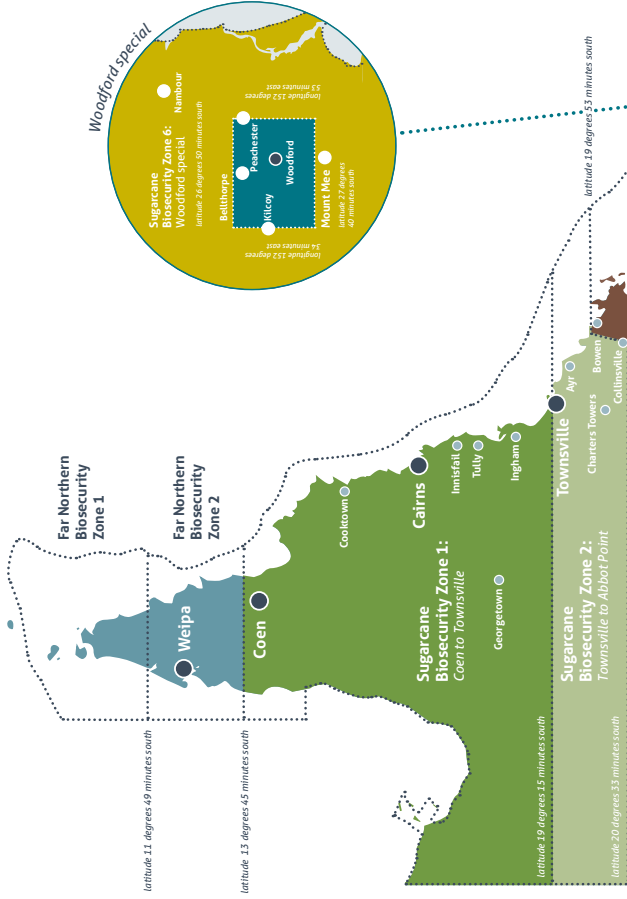
Diseases of Sugarcane: Major Diseases (edited by C Ricaud, BT Egan, AG Gillaspie Jr, CG Hughes). Published by Elsevier, Amsterdam, 1989. ISBN 0-444-42797-X.

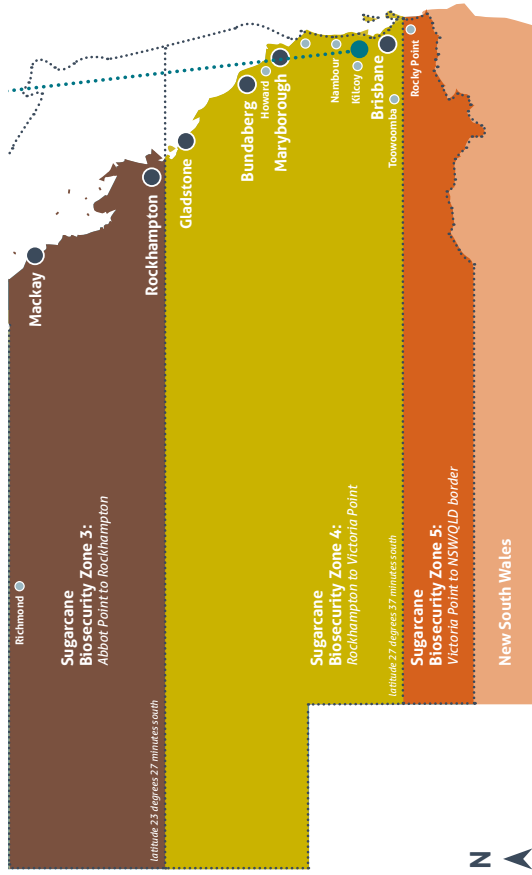
Recording Pest and Disease Data in the Australian Sugar Industry (JK Stringer, RC Magarey, PR Samson, DE Webster). Published by BSES, Brisbane, 1999. ISBN 0 949678 01 5.

Sugar Research Australia

www.sugarresearch.com.au

108 BIOSECURITY ZONE MAP





Metric conversion table


Metric	Measurement
1 inch	25.4 mm
1 foot	0.305 m
1 chain	20.117 m
1 chain/acre	49.709 m/ha
1 mile	1.609 km
1 mile/gallon	0.354 km/L
1 pound	0.454 kg
1 hundredweight	50.803 kg
1 ton	1.016 t
1 ton/acre	2.511 t/ha
1 bag/acre	123.550 kg/ha
1 acre	0.405 ha
1 fluid ounce	28.410 mL
1 gallon	4.546 L
1 gallon/acre	11.233 L/ha
1 mile/hour	1.609 km/h
1 horsepower	0.746 kw
1 pound/square inch	6.897 kPa

Poisons information

Safety Data Sheets

13 11 26

msdsonline.com



The *Diseases of Australian Sugarcane Field Guide* contains simply presented information and photos on the sugarcane diseases in Australia. All Australian diseases of importance are included, along with major exotic diseases in neighbouring countries.

The guide is designed for researchers, extension and quarantine staff, as well as farmers, harvester operators, consultants, private contractors and agribusiness personnel.



Sugar Research Australia Limited

ABN 16 163 670 068

Brisbane Office 50 Meiers Road, Indooroopilly QLD 4068 Australia

Postal Address PO Box 86 Indooroopilly QLD 4068 Australia

T 07 3331 3333

E sra@sugarresearch.com.au

sugarresearch.com.au

