THE BIOLOGY AND EPIDEMIOLOGY
OF AUSTRALIAN GRAPEVINE
PHYTOPLASMAS

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# Table of Contents

Abstract .................................................. i
Declaration .................................................. iv
Acknowledgements ......................................... v
Abbreviations .............................................. vii
List of figures .............................................. ix
List of tables ............................................... xi

## CHAPTER 1: General Introduction

1.1 Background ........................................ 1
1.2 The phytoplasma genome ........................... 2
1.3 Taxonomy of phytoplasmas ......................... 4
1.4 Detection of phytoplasmas ......................... 6
1.4 Grapevine Phytoplasmas ......................... 8
1.6 Australian grapevine yellows disease and associated phytoplasmas 10
1.7 Aims .................................................. 14

## CHAPTER 2: The Seasonal Distribution of Phytoplasmas in Australian Grapevines

2.1 Introduction ......................................... 15
2.2 Methods ............................................. 16
    Source of infected plants ......................... 16
    Disease descriptors ................................ 17
    Sampling of grapevine tissues .................. 22
    Extraction of DNA from grapevine .......... 24
    Primers for amplification of phytoplasma DNA in grapevine 24
    Polymerase chain reaction (PCR) .............. 26
    Restriction fragment length polymorphism (RFLP) analysis 26
    Heteroduplex mobility assay (HMA) .......... 27
2.3 Results ............................................. 28
    Detection and identity of phytoplasmas ....... 28
    The distribution of phytoplasmas in grapevine tissues 29
    The expression of AGYd, RGD and LSLCd with time 32
    The frequency of phytoplasma detection in grapevine tissue samples 33
    in each season ......................................
    The association between phytoplasmas and disease 36
    Heteroduplex mobility assay ..................... 39
2.4 Discussion .......................................... 43
CHAPTER 3: THE INCIDENCE, DISTRIBUTION AND EXPRESSION OF AUSTRALIAN GRAPEVINE YELLOWS, RESTRICTED GROWTH AND LATE SEASON LEAF CURL DISEASES IN SELECTED AUSTRALIAN VINEYARDS

3.1 Introduction

3.2 Materials and methods
   Study sites
   Spatial analysis of disease mapping data
   Temporal analysis of disease mapping data

3.3 Results
   Vineyard surveys for disease incidence
   Expression of AGYd in Shiraz grapevines at Paringa
   Disease expression with time
   Spatial analysis of AGYd, RGd and LSLCd
   The association between AGYd and RGd or LSLCd
   Temporal analysis of AGYd, RGd and LSLCd using Log-linear models

3.4 Discussion
   The expression of AGYd
   The spatial distribution of AGYd
   The expression of RGd
   The spatial distribution of RGd
   The association between AGYd and RGd
   The expression of LSLCd
   The spatial distribution of LSLCd
   The association between AGYd and LSLCd

CHAPTER 4: THE CHARACTERISATION OF PHYTOPLASMA CHROMOSOMES ISOLATED DIRECTLY FROM AUSTRALIAN GRAPEVINES

4.1 Introduction

4.2 Methods
   Plant Material
   Preparation of phytoplasma chromosomes
   Restriction endonuclease digestion
   Pulsed field gel electrophoresis (PFGE)
   Southern transfer of DNA
   Preparation of $^{32}$p-labeled probes
   Hybridisation and autoradiography

4.3 Results
   Isolation of intact phytoplasma chromosomes
   Restriction endonuclease digestion of TBBp-G
   Comparison of the chromosomes from four isolates of TBBp and SPLL-V4p

4.4 Discussion
CHAPTER 5: A NEW GRAPEVINE YELLOWS PHYTOPLASMA FROM THE BUCKLAND VALLEY OF VICTORIA

5.1 Introduction

5.2 Methods
   Source of Phytoplasmas
   Extraction of DNA from grapevine
   Primers for amplification of phytoplasma DNA in grapevine
   Polymerase Chain Reaction (PCR)
   Restriction fragment length polymorphism (RFLP) analysis
   PCR amplification of DNA for sequencing
   Sequencing directly from PCR products
   Sequencing cloned PCR products
   Sequence analysis of the 16S rRNA gene and the 16S-23S spacer region
   Heteroduplex mobility assay (HMA)
   Vineyard surveys for GYd incidence
   Regional surveys for GYd incidence
   Analysis of GYd survey data

5.3 Results
   Detection of phytoplasmas by PCR and RFLP
   Detection of BVGYp using specific PCR primers
   Sequence analysis of the 16S rRNA gene and Spacer region
   Variability amongst isolates of the BVGY phytoplasma as determined
   by HMA
   Regional surveys for GYd and BVGYp
   Vineyard surveys for disease incidence
   GYd incidence
   The expression of GYd over time
   Temporal analysis of GYd using the Log-linear model
   Spatial analysis of GYd

5.4 Discussion

CHAPTER 6: GENERAL DISCUSSION AND CONCLUSIONS

6.1 Seasonal detection of phytoplasmas
6.2 The association of phytoplasmas with AGYd
6.3 The yearly expression and incidence of AGYd
6.4 The association of phytoplasmas with RGd
6.5 The expression and incidence of RGd
6.6 The association of phytoplasmas with LSLCd
6.7 The expression and incidence of LSLCd
6.8 Phytoplasma variation
6.9 Characterisation of phytoplasma chromosomes isolated
   directly from grapevines
6.10 A new grapevine phytoplasma from the Buckland Valley
   of Victoria
6.11 Conclusions

REFERENCES

APPENDIX A: VINEYARD DISEASE MAPS

APPENDIX B: LOG LINEAR GRAPHS
ABSTRACT

The distribution and persistence of phytoplasmas was determined in Australian grapevines. Phytoplasmas could be detected using polymerase chain reaction (PCR) from shoots, cordons, trunks and roots throughout the year and phytoplasmas appear to persistently infect Australian grapevines from year to year. Phytoplasmas were not always detected in samples from the same sampling area from one sampling period to the next. Phytoplasma detection by PCR was improved by sampling from shoots, cordons and trunks and October was the best time to test for phytoplasmas when these three tissue types were sampled.

Only Australian grapevines yellows phytoplasma (AGYp) and tomato big bud phytoplasma (TBBp) were detected by PCR and RFLP techniques from any grapevine sample used in the distribution and persistence studies. Genetic variability was detected within isolates of AGYp and between AGYp and the papaya dieback phytoplasma (PDBp) using heteroduplex mobility assay (HMA) of the tuf gene. AGYp variants and PDBp were indistinguishable when they were compared using HMA of the tuf gene.

The diseases expressed by grapevines used in the distribution and persistence studies were recorded. Australian grapevine yellows disease (AGYd) was expressed by 17/20 grapevines at sometime during the study. Only 4/20 grapevines expressed restricted growth disease (RGd). Late season leaf curl disease (LSLCd) affected 15/20 grapevines during the study. AGYd affected all grapevines with RGd and LSLCd. The three diseases were persistently expressed in some grapevines and remission of disease was observed in others. The results of PCR detection in the same grapevines indicated that phytoplasmas were more frequently detected in AGYd grapevines that also expressed RGd and LSLCd compared to grapevines expressing AGYd alone. Asymptomatic phytoplasma infections occurred. Phytoplasmas were detected less frequently in asymptomatic plant material compared to AGYd affected material.
RGd and LSLCd may be associated with AGYd in some grapevines. However all three diseases can occur independently.

Full length chromosomal DNA of TBBp was obtained from grapevine and digested with BssHII. The digested TBBp chromosomal DNA was subjected to pulsed field gel electrophoresis (PFGE) and from this the chromosome was estimated to be 680 kb. This is the first report of isolation of an intact phytoplasma chromosome directly from naturally infected grapevine. Using PFGE and Southern hybridization, no significant difference in size was observed between full-length chromosomes of TBBp isolates from different regions and hosts. Some variation was observed after digestion of chromosomes of different TBBp isolates with BssHII indicating that some genomic diversity exists amongst isolates of TBBp. AGYp chromosomal DNA was not detected using PFGE and Southern hybridization.

A new phytoplasma was detected in grapevines with grapevine yellows disease (GYd) from the Buckland Valley of Victoria was characterised. Buckland Valley grapevine yellows phytoplasma (BVGYp) could not be amplified by PCR using primers specific for AGYp and the stolbur group of phytoplasmas indicating that it was unlikely to be a stolbur group phytoplasma. BVGYp was amplified by PCR using primers specific for the aster yellows phytoplasma group, indicating that it may be more closely related to the Aster yellows group phytoplasmas. Sequence analysis of 16SrRNA gene sequences showed that BVGYp clustered with members of the Aster yellows group of phytoplasmas and had greatest sequence similarity with Clover phyllody phytoplasma (97.1%) of the Aster yellows group.

The associated disease, GYd, was surveyed in three blocks of Chardonnay over four years in one vineyard. GYd affected many grapevines and was characterised by remission of disease, some recurrence and occurrences in previously unaffected grapevines. A regional survey of the Buckland Valley indicated that GYd and BVGYp occurred in the
same restricted grape growing area. Within this area BVGYp was detected in two vineyards that had been established using planting material from different sources. One could therefore speculate that BVGYp was present in these grapevines as a result of aerial transmission and was not present in the original planting material.