PRIMARY BUD-AXIS NECROSIS OF GRAPEVINES

by

Peter R. Dry. B.Ag.Sc. (Adel.)

Roseworthy Agricultural College
Roseworthy
South Australia

Thesis submitted for the Degree of
Master of Agricultural Science

Department of Plant Physiology
Waite Agricultural Research Institute
The University of Adelaide
South Australia

October 1986

to CHRISTINE

TABLE OF CONTENTS

SUMMARY

Primary bud-axis necrosis (PBN) is an abnormality of Vitis vinifera wherein the primary bud-axis of the compound bud aborts and becomes necrotic; the secondary bud-axes remain healthy and develop more than those in unaffected buds. Natural levels of PBN were found to be positively correlated with main shoot length and diameter, and the number and length of lateral shoots ("shoot vigour") and with butt circumference and pruning weight per vine ("vine vigour"). 'Shiraz' had the highest natural levels of all cultivars studied with up to 30 percent of nodes on vigorous vines showing PBN; in addition, nodes with lateral shoots had up to four-fold greater incidence of PBN than nodes without lateral shoots.

Anatomical studies revealed that under natural conditions necrosis commenced soon after flowering and was largely completed by mid-summer.

PBN was induced or increased by various shoot treatments (shoot thinning, topping, defoliation), or by treatment with gibberellic acid (GA_3). Besides increasing PBN the treatments increased main shoot length and/or lateral shoot number and length. The level of induced PBN was directly proportional to the severity of shoot treatments (thinning, topping, defoliation) or the concentration of exogenous GA_3. In both cases, highest levels of PBN were induced by treatments applied near flowering time with response diminishing with later treatment; shoot treatment and GA_3 application induced up to 80 and 100 percent PBN respectively on treated shoots.

The degree of susceptibility to both shoot treatment-induced and GA_3-induced PBN appeared to be primarily determined by the stage of bud development and to a lesser extent by the stage of shoot development: young, still differentiating buds were more susceptible than mature buds. Vigorous and/or seeded cultivars were most susceptible to both natural and induced PBN.

These results led to the hypothesis that induction of PBN is associated with high levels of gibberellins in the shoot and bud leading to premature elongation of the primary bud-axis; this development subsequently leads to abortion and necrosis of this axis possibly because it is subject to inhibition.

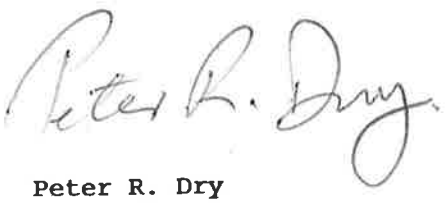
This hypothesis was tested by measuring the changes in endogenous levels of gibberellins in primary bud-axes following shoot treatment (thinning, topping, defoliation) using the barley endosperm biossay. Shoot treatment was found to increase both the concentration of gibberellin-like substances and bud tissue D.Wt. to three times that of control 21 days after treatment. Furthermore, there was a strong positive correlation between endogenous concentration of gibberellins in primary bud tissue and i) shoot vigour, ii) vine vigour and iii) subsequent development of PBN.

Shoot thinning, topping and defoliation of whole vines resulted in reduced yield per vine (topping plus defoliation of single shoots reduced yield per node) in the following growing season due to fewer and smaller bunches even though shoot number per vine and per node was generally increased. The reduction in yield was strongly correlated with increase in both PBN level and ratio of secondary to primary shoots. It is proposed that the significant decreases in grapevine productivity which may follow the use of viticultural techniques designed to increase shoot vigour on the one hand, or to reduce the number of leaves on the other, may be due in part to increased PBN.

STATEMENT

I hereby declare that the thesis here presented is my own work, that it contains no material previously published, except where due reference is made in the text, and that no part of it has been submitted for any other degree

I consent to this thesis being made available for photocopying and loan if accepted for the award of M. Ag. Sc.



Peter R. Dry

PREFACE

I am very grateful to my supervisor, Dr. Bryan Coombe, for his influence and guidance; his attention to detail and constructive criticism has been of immense benefit to me.

I am also grateful to Drs. Richard Smart, Peter May and Bryce Rankine who encouraged the commencement of this work.

Many people have helped me during the course of my study. Special thanks must go to Mrs. Lee Buller and Mrs. Pauline Phillips for their technical support; also, Dr. N. Findlay, Mr. P. Daenke (Flinders University), Dr. D. Taplin and Mr. I. Muthy, for their assistance with the preparation of sectioned material and photomicroscopy. Others who have helped in various ways include Messrs. G. Caris, D. Belton, C. Brien and Mrs. E. Berridge.

I am grateful to Roseworthy Agricultural College, The Waite Agricultural Research Institute, Flinders University, and Messrs. P. Grilli, R. Parrish, A. Wilson and W. Schmitt for the use of facilities and/or vineyards.

My thanks to Mrs. Jean Thompson for her care and patience in typing this thesis.

My family have given me tremendous support throughout this period - thank you Chris, Ben, Matthew and Nicky.

LIST OF FIGURES

LIST OF TABLES