

PHYSIOLOGICAL AND MICROBIOLOGICAL PROCESSES OF CUT FLOWER SENESCENCE IN TWO AUSTRALIAN NATIVE GENERA, ACACIA AND BORONIA

by

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DECLARATION

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Virginia G. Williamson

DEDICATION

To my parents, both of whom suffered serious illnesses during the period of my candidature. Their courage and determination is an inspiration.

FOREWORD

We are all limited by the beliefs that we carry throughout our lives, and we know not what will come next.

VGW October 1995

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ABSTRACT

Physiological and microbiological cut flower senescence processes in two Australian native genera, Acacia and Boronia, were determined. Vase life of the two Acacia spp. tested, A. subulata and A. floribunda, was not affected by exposure to ethylene (50 and 500 μL L-1 respectively for 24 h). No detectable levels of ethylene were produced by either species at different stages of floral development. Pulsing with silver thiosulphate (STS) (10.5 mol m⁻³ for 16.5 h), an inhibitor of ethylene action, did not increase vase life over that in distilled water. However, citric acid (10 mol m⁻³) significantly improved the vase life of A. amoena compared with distilled water. Cavitation events (audible acoustic emissions, AAE) were recorded for the first time in cut flowers kept in vase solutions. AAE production peaked markedly in A. amoena stems after 48 h in distilled water. This coincided with abbreviated vase life, a sharp decrease in xylem water potential (to -3.7 MPa), and decreased hydraulic conduction (29% of the initial rate). Pectinaceous deposits in xylein conduits of stems kept in distilled water were not evident until 36 h (14% of conduits filled) and by 120 h had increased to 82%. This indicates that pectin deposition is a secondary event which occurs after water column disruption. Vase solution bacteria did not produce pectolytic e 12ymes, so were not responsible for pectin release from cell walls. In citric acid, no pectinaceous deposits were evident, even after 120 h. AAE production remained low in citric acid throughout the 120 h experimental period, although the xylem water potential decreased from -0.42 to -2.62 MPa between 48 and 60 h. Hydraulic conduction was 50% of the initial rate after 48 h. It was hypothesised that citric acid degraded pit membranes, resulting in less potentially cavitatable compartments, and improved hydraulic conduction rates. This hypothesis was supported by the distance travelled by paint in xylem conduits of stems kept in either distilled water or citri: acid for 2 d. Paint particles, which should be stopped by pit membranes, were carried over 100% farther and in more conduits in stems kept in citric acid (9.8 cm) than in distilled water (4 cm). Stems in citric acid had the significantly greatest relative water content (RWC) (71.4%) after 120 h. The RWC of stems in distilled water (19.4%) was significantly less than that of stems in *Pseudomonas fluorescens* (10⁶ cfu mL⁻¹) (44.3%). AAE production was not expedited by high levels (10⁶ cfu mL⁻¹) of mixed or pure (*Ps. fluorescens*) bacterial populations. Thus, bacteria did not promote AAE production or decrease longevity.

In contrast with Acacia, the vase life of $Boronia\ heterophylla$ and $B.\ crassipes \times B.\ heterophylla$ 'Lipstick' was shortened by ethylene, as longevity was significantly increased in stems protected against ethylene action with an STS pulse. However, in two other $Boronia\ spp.$, $B.\ clavata$ and $B.\ muelleri$ 'Sunset Serenade', longevity was not significantly increased by pulsing with STS. In $B.\ heterophylla$, bacterial numbers were significantly greater in STS treatment vase solutions. Vase solution bacterial numbers had no significant influence on longevity ($\overline{R}^2 = 0.000$). These results indicate an overriding influence of ethylene in flowers which are sensitive to it, and the ambiguous role of bacteria in cut flower senescence.

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LIST OF SYMBOLS AND ABBREVIATIONS

SYMBOLS:

°C (temperature in) degrees Celsius

h hour/s

λ wavelength micrometre μm microSiemens μ S milliosmoles mOsm milliseconds ms minute/s min nm nanometre N newton

 Ψ_p xylem pressure potential

s second/s
t time
W watt

(Note that, for convenience, the symbol, L, for litre is used throughout this thesis rather than the SI unit of dm³.)

ABBREVIATIONS:

AAE audible acoustic emission/s

AD air dried

cfu colony forming units

cm centimetre

CPD critical point dried

DW dry weight
FD freeze dried

FH frozen-hydrated

FID flame ionisation detection

fw fresh weight

8-HQC 8-hydroxyquinoline citrate

MPa megapascals p.a. per annum

PAR photosynthetically ac ive radiation

PCA plate count agar ppm parts per million

RH relative humidity

RWC relative water content

SCC silver thiosulphate, citric acid and stabilised chlorine
SDIC sodium dichloroisocy murate (stabilised chlorine)

SEM scanning electron microscopy

SSE south-south-east
STS silver thiosulphate

TEM transmission electron microscopy

TSA trypticase soy agar
TSB trypticase soy broth

How often 1 regret that plants cannot talk.

Vita Sackville-West

(1892-1962)