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Phase change, flowering and postharvest characteristics of *Metrosideros excelsa* (Myrtaceae)

A thesis presented in partial fulfilment of the requirements for the degree of

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in

Plant Biology

at the

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New Zealand

Robert E. Henriod
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Abstract

The development of *Metrosideros excelsa* (pohutukawa) as an ornamental crop has been limited by a lack of knowledge on the cultural requirements and underlying physiological processes associated with: (a) vegetative phase change (maturation) following micropropagation, (b) the environmental control of flowering, and (c) the postharvest characteristics of the cut-flower. These three concerns were addressed in this thesis.

First, plantlets of *M. excelsa* that had undergone rejuvenation following micropropagation, were subjected to shoot and root restriction treatments to accelerate vegetative phase change. Leaves of shoot-restricted, single-stemmed plants became progressively more adult with increasing node position, whereas root restriction reduced root growth but did not accelerate vegetative phase change. In single-stemmed plants, light saturated maximum rate of photosynthesis and leaf carbon isotope discrimination decreased within increasing node position. However, carbon isotope composition in leaves of these plants diverged away from those exhibited by leaves of adult plants, possibly reflecting physiological changes resulting from altered source/sink relations.

Second, the effects of photoperiod, temperature and irradiance on floral initiation and development were examined in *M. excelsa* by manipulating these parameters in controlled and greenhouse environments. *M. excelsa* responded as a facultative short-day plant with maximum flowering occurring following a 15 weeks cool (mean 15°C) short-day (10 h) inductive treatment. An irradiance of 567 μmol m⁻² s⁻¹ during induction provided the optimal conditions for floral primordial growth and subsequent flower development. Buds initially 2.0-3.0 mm in diameter had the highest probability of becoming floral, whilst those less than 2.0 mm in diameter were more likely to remain vegetative or to not break.

Finally, the postharvest characteristics of *M. excelsa* as a cut flower were assessed. Generally, holding solution treatments containing sucrose extended vase life, whereas those containing HQC (applied alone or as a pulse) were detrimental. Cut flowers were sensitive to exogenous ethylene and pre-treatment with inhibitors of ethylene action (STS and 1-MCP) conferred significant protection.
This thesis has contributed significantly to furthering our understanding and knowledge of cultural and physiological factors that underlie vegetative phase change, flowering and vase life characteristics in flowers of *M. excelsa*.
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<td>gibberellin</td>
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<tr>
<td>IAA</td>
<td>indole-3-acetic acid</td>
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<tr>
<td>FAA</td>
<td>90% formalin, 5% acidic acid and 5% alcohol fixative solution</td>
</tr>
<tr>
<td>GENMOD</td>
<td>generalised linear model using maximised likelihood estimations</td>
</tr>
<tr>
<td>HQC</td>
<td>8-hydroxyquinoline citrate</td>
</tr>
<tr>
<td>HQS</td>
<td>8-hydroxyquinoline sulfate</td>
</tr>
<tr>
<td>J&lt;sub&gt;max&lt;/sub&gt;</td>
<td>maximum electron transport rate</td>
</tr>
<tr>
<td>LD</td>
<td>long-day</td>
</tr>
<tr>
<td>1-MCP</td>
<td>1-methylcyclopropene</td>
</tr>
<tr>
<td>NBD</td>
<td>2,5-norbornadiene</td>
</tr>
<tr>
<td>PPF</td>
<td>photosynthetic photon flux</td>
</tr>
<tr>
<td>P&lt;sub&gt;max&lt;/sub&gt;</td>
<td>maximum photosynthetic photon flux at 99% light saturation</td>
</tr>
<tr>
<td>PPF&lt;sub&gt;sat&lt;/sub&gt;</td>
<td>light saturated maximum rate of photosynthesis</td>
</tr>
<tr>
<td>PP333</td>
<td>paclobutrazol</td>
</tr>
<tr>
<td>RH</td>
<td>relative humidity</td>
</tr>
<tr>
<td>Rubisco</td>
<td>ribulose-1,5-bisphosphate carboxylase/oxygenase</td>
</tr>
<tr>
<td>SD</td>
<td>short-day</td>
</tr>
<tr>
<td>STS</td>
<td>silver thiosulfate</td>
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<tr>
<td>V&lt;sub&gt;cmax&lt;/sub&gt;</td>
<td>maximum rubisco carboxylation rate</td>
</tr>
<tr>
<td>WUE</td>
<td>water-use efficiency</td>
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Metrosideros excelsa 'Vibrance'