The Physiology of Flowering in the Australian Paper Daisies *Helipterum roseum* and *Helichrysum bracteatum*

By

Kerry Veianne Sharman

Department of Plant Physiology

Waite Agricultural Research Institute

University of Adelaide

South Australia

awarded 7.2.90

Thesis submitted for the Degree of

Doctor of Philosophy

November, 1989

TABLE OF CONTENTS

APPENDIX 1. Sharman K.V. and Sedgley M. (1988). Floral initiation and development in *Helipterum roseum* (Hook.) Benth. and *Helichrysum bracteatum* (Vent.) Andrews (Asteraceae). Australian Journal of Botany 36: 575-587.

APPENDIX 2. Sharman K.V., Sedgley M. and Aspinall D. (1989). Effects of photoperiod, temperature and plant age on floral initiation and inflorescence quality in the Australian native daisies *Helipterum roseum* and *Helichrysum bracteatum* in relation to cut flower production. Journal of Horticultural Science 64: 351-359.

APPENDIX 3. Sharman K.V., Sedgley M. and Aspinall D. (1989). Production of the Australian native daisies (*Helipterum roseum* and *Helichrysum bracteatum*) for the cut flower market. Australian Journal of Experimental Agriculture 29: 445-453.

APPENDIX 4. Sharman K.V., Sedgley M. and Aspinall D. (1989). Australian daisies break new ground. Australian Horticulture 87: 44-49.

APPENDIX 5. Sharman K.V. and Sedgley M. (1988). Floral initiation and development in *Helipterum roseum* (Hook.) Benth. and *Helichrysum bracteatum* (Vent.) Andrews, (Asteraceae). (Poster) In 'The Australian Society of Plant Physiologists, Twenty Eigth General Meeting, (Program and Abstracts)', Adelaide, South Australia, May 16-20, p. 102.

APPENDIX 6. Sharman K.V. (1988). Cut flower production of Australian daisies, *Helichrysum bracteatum* and *Helipterum roseum*. Seminar presented at the 'Protea and Wildflower Seminar', Adelaide, South Australia, September 16-17.

APPENDIX 7. Sedgley M., Sharman K.V. and Fuss A.M. (1989). An overview of research into banksias, native daisies, eucalypts and acacias at the Waite Research Institute. (Seminar) In 'The Production and Marketing of Australian Flora (Proceedings)', The University of Western Australia and The Western Australian Department of Agriculture, Perth, Western Australia, July 13-14.

The Physiology of Flowering in the Australian Paper Daisies *Helipterum roseum* and *Helichrysum bracteatum*

SUMMARY

Floral initiation and development in *Helipterum roseum* and *Helichrysum bracteatum* (Asteraceae) were investigated by scanning electron microscopy. The sequence of events in these two species was similar and occurred rapidly. Seven stages in apical development were identified, which were distinctive in both appearance and size. Stage 1 was a small vegetative meristem with between two and four leaf primordia. Stage 2 (also vegetative) was characterised by a doubling in both height and diameter. A doming of the apical meristem signified the commencement of stage 3 and at the appearance of the first involucral bracts (stage 4) the apex had further tripled in height and doubled in diameter. This was followed by the appearance of floret primordia (stage 5). By the time the inflorescence buds were visible to the naked eye (stage 6) several rows of florets were present, and at anthesis (stage 7) the capitulum was covered with florets.

The effects of photoperiod, temperature and plant age on floral initiation and inflorescence production in both species were investigated using controlled environment growth cabinets, glasshouse and field environments. Both species were quantitative long day plants, with floral initiation occurring sooner in long photoperiod and night-break conditions. Photoperiod affected time to floral initiation rather than floral development. Floral initiation in *Helipterum roseum* was

inhibited at 25 °C (photoperiod 12 h, light intensity 250 W m^{-2}).

Peaks in bloom production occurred during the spring and summer under Adelaide conditions, regardless of planting time in both glasshouse and outdoor environments. There was a tendency for inflorescence diameter of successive inflorescences of both species and corresponding stem length of successive blooms of *Helipterum roseum* to decline with time from anthesis of the apical inflorescence. Optimum production of top quality blooms of *Helipterum roseum* extended from October to January following planting between autumn and spring. Peak production of *Helichrysum bracteatum* between December and March could be expected following planting during autumn to spring. It is proposed that both species be considered for the fresh cut flower market in addition to the traditional drying and wiring, with *Helipterum roseum* marketed as single stems and *Helichrysum bracteatum* as sprays.

The effect of temperature on morphological development and cell-cycling in shoot apical meristems of *Helipterum roseum* during the floral transition was investigated. Apical development proceeded to anthesis (stage 7) at 20 °C, but rarely progressed beyond stage 2 at 25 °C. Morphological development was arrested at stage 3 when plants were transferred from 20 to 25 °C at stage 3, and delayed for a short period when transferred at stage 4. It was concluded that the apical meristem was committed to the production of an inflorescence at stage 4 and that developmental pathways were still optional at stage 3. The length of the cell-cycle and its component phases were determined by the percent-labelled-mitoses method using autoradiography and Nomarski interference microscopy, after labelling with tritiated

thymidine. The duration of the cell-cycle was constant in cells labelled during the pulse at stages 2, 3 and 4 at 20 °C (64, 41 and 47.5 h respectively) but varied in cells of meristems inhibited at stage 2 at 25 °C. It was concluded that the inhibition of floral initiation in *Helipterum roseum* at 25 °C was due, at least in part, to the variation in the duration of the cell-cycle within the cell population.