Overcoming Poor Germination in Australian Daisies

Kerry V. Bunker
Redlands Greenhouses Holdings, 191 Gordon Road, Redland Bay, Qld, 4165

INTRODUCTION

The evaluation and commercialisation of many Australian daisies has been limited by poor germination (Schaumann et al., 1987). Achenes of the Asteraceae consist of an embryo encased in a membranous coat (testa) which is surrounded by a fibrous outer coat (pericarp) which often has pappus hairs to aid dispersal. Both the testa and the pericarp have been identified as barriers to germination with exotic members of the Asteraceae. Removal of these layers, puncturing them, or soaking seeds in various solutions such as gibberellic acid are all reported to improve germination although the result is generally species specific (Atwater, 1980; Taylorson and Hendricks, 1977). Investigations were conducted to test the effects of scarification of the testa and pericarp, gibberellic acid, and light, on germination and dormancy of selected Australian daisies.

MATERIALS AND METHODS

Achenes from 27 species of Australian daisies were collected from wild populations throughout Western Australia and Queensland during the Summer of 1990 and 1991 (Table 1).

Achenes were stored at room temperature and germination trials conducted in petri dishes, within 36 weeks of collection. Germination trials were completely randomised designs of three germination treatments—intact achenes moistened with water (control), scarified achenes moistened with water, and intact achenes moistened with 500 mg $liter^{-1}$ GA_3—with two light levels (light and dark). There were five replicate petri dishes of 15 achenes for each species evaluated. Moistening solutions also contained 0.2% Thiram® fungicide (Rhone-Poulenc) and were applied at 5 ml per dish. Achenes were scarified by exposing a portion of the embryo with a dissecting needle. Petri dishes were placed on laboratory benches in ambient conditions. Mean daily minimum and maximum temperatures were 13±2C and 24±1C, respectively. Dark treatments were covered with aluminium foil while light treatments were exposed to 45±6 $\mu M\ m^{-2}\ s^{-1}$ from a combination of fluorescent and natural light, for 10 to 12 h daily.

Germinated achenes were counted at Day 15 in dark treatments and every 3 days for 30 days in light treatments. At the end of the assessment period, achenes were dissected and those which contained undeveloped or no embryos were scored as nonviable. Germination was then recorded as percent viable achenes. Time (days) to 50% maximum germination (T_{50}) of intact achenes, following imbibition with water and exposure to light, was derived from plotted curves of mean percent germination against time for each species.

RESULTS AND DISCUSSION

Species responded differently to the treatments applied and germination following one or more treatments occurred in 17 of the 27 species evaluated (Table 1). The testa and pericarp were influential in suppressing germination of *Leucochrysum stipitatum*, *Rhodanthe chlorocephala* ssp. *chlorocephala*, *R. manglesii*, and *R. stricta*, while an embryo dormancy which could be overcome by GA_3 limited germination of *Brachyscome iberidifolia, Chrysocephalum apiculatum, L. fitzgibbonii, L. molle, Myriocephalus stuartii, R. polygalifolia*, and *R. moschata* (Table 1).

Light stimulated germination of *Brachyscome iberidifolia, C. apiculatum, Hyalosperma glutinosum* ssp. *venustum, L. fitzgibbonii, L. stipitatum, R. humboldtiana, R. stricta,* and *Waitzia acuminata* (Table 2).

On the other hand, germination of *R. chlorocephala* ssp. *chlorocephala* was inhibited by light in control treatments (Table 2.).

Recommendations for seed propagation of seventeen species are given in Table 3.

CONCLUSIONS

This study has documented the germination characteristics of seventeen Asteraceae native to Australia. The pericarp and testa were influential in suppressing germination in some species, while an embryo dormancy which could be broken by GA_3 and/or light, occurred in others. It is suggested that a pre-germination treatment of GA_3 would be beneficial when germinating native daisy achenes about which little is known.

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LITERATURE CITED

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Table 1. Effect of scarification and GA_3 on mean percentage germination at thirty days from imbibition, of seventeen species of Australian daisies (Asteraceae) in light conditions.

Species[1]	Seed age[2] (wks)	T_{50}[3] (days)	Germination (%) Intact (control)	Scarified	GA_3	Signifcance of treatment effect[4]
Brachyscome iberidifolia Benth.	32	3.0	82.4a	78.7a	99.5b	**
B. latisquaemea F.Muell.	32	13.4	51.1ab	43.0a	64.4b	*
Chrysocephalum apiculatum (Labill.) Steez. (syn. *Helichrysum apiculatum*)	28	9.8	65.9b	N[5]	26.5a	*
Hyalosperma glutinosum ssp. *venustum* (Moore) Wilson (syn. *Helipterum venustum*)	28	3.4	31.7a	31.4a	37.0a	NS
Leucochrysum fitzgibbonnii (F. Muell.) Wilson (syn. *Helipterum fitzgibbonnii*)	36	5.5	18.4a	18.5a	69.6b	**
L. molle (Cunn. ex DC) Wilson (syn. *Helipterum molle*)	36	-	0	1.7a	17.4b+	*
L. stipitatum (F. Muell.) Wilson (syn. *Helipterum stipitatum*)	28	9.6	24.2a	56.3b	65.7b	**
Myriocephalus stuartii (F. Muell. & Sond.) Benth.	28	-	0	0	6.2	-
Rhodanthe chlorocephala ssp. *chlorocephala* (Turcz.) Wilson (syn. *Helipterum chlorocephalum*)	24	9.4	4.0a	17.9b	8.3[a]	*
R. chlorocephala ssp. *rosea* (Hook.) Wilson(syn. *Helipterum roseum*)	24	2.0	72.4a	68.2a	78.1a	NS
R. humboldtiana Wilson (syn. *Helipterum humbodtianum*)	24	1.5	99.9a	99.9a	99.9a	NS
R. manglesii Lindley (syn. *Helipterum manglesii*)	24	2.6	38.5a	63.9b	53.1a	*
R. moschata (Cunn.ex DC.) Wilson (syn. *Helipterum moschatum*)	36	16.5	16.0a	22.4a	75.6b	**
R. polygalifolia (Cunn.ex DC.) Wilson (syn. *Helipterum polygalifolium*)	28	-	0	0	17.3	-
R. stricta (Lindley) Wilson (syn. *Helipterum stricta*)	28	13.4	0.5a	15.9b	31.5b	**
Schoenia filifolia ssp. *subulifolia* (Turcz.) Wilson (syn. *Helichrysum subulifolium*)	32	4.0	94.9a	91.3a	93.9a	NS
Waitzia acuminata Steetz	36	4.0	86.3a	66.2a	69.0a	NS

[1] *Chrysocephalum podolepidium* (syn. *Helichrysum podolepidium*), *Erymophyllum*

ramosum ssp. *involucratum* (syn. *Helipterum involucratum*), *Lawrencella davenportii* (syn. *Helichrysum davenportii*), *Lawrencella rosea* (syn. *Helichrysum lindeyi*), *Minuria denticulata, Podolepis auriculata, Podolepis gracilis, Podolepis jaceoides, Waitzia aurea* and *Waitzia citrina* failed to germinate during the course of the experiment.

2 Seed age (weeks from collection) at beginning of germination trial.

3 T_{50} (time to 50% germination) of intact seeds treated with water.

4 *, **, NS; Significant at $P < 0.01$, $P < 0.05$ and non-significant, respectively. Treatment means within rows followed by different letters, are significantly different at $P < 0.05$.

5 N = not scarified.

Table 2. Effect of GA_3, scarification and light on mean percentage germination at fifteen days from imbibition of seventeen species of Australian native daisies (Asteraceae).

	Germination (%)						Significant effects[1]		
	Intact		Scarified		GA_3		light (l)	treatment (t)	t x 1
Species	light	dark	light	dark	light	dark			
Brachyscome iberidifolia	82.4b	80.7b	78.7b	58 8a	99.5c	90 3b	*	**	NS
B latisquaemea	28.0abc	26 2ab	13.6a	31 9bc	47.3cd	52.0d	NS	**	NS
Chrysocephalum apiculatum	56 9c	0.05a	N[2]	N[2]	24 7b	17.1b	**	NS	**
Hyalosperma glutinosum ssp. *venustum*	31 7b	0 05a	30.0b	0.6a	31.0b	34.4b	**	**	**
Leucochrysum fitgibbonnii	18.4b	1.7a	16.2b	1 7a	62 3d	40 9c	**	**	NS
L. molle	0	0	1 7a	6 3ab+	15 3b+	6.1a+	NS	*	*
L. stipitatum	15.4b	1 4a	25 7bc	0.05a	48 5d	41.4cd	**	**	*
Myriocephalus stuartii	0	0	0	0	4.4a+	9.4a+	-	NS	-
Rhodanthe chlorocephala ssp. *chlorocephala*	1 4a	27 3c	11.7bc	6.5ab	8.3ab	3 7a	NS	NS	**
R. chlorocephala ssp *rosea*	72.4a	62.6a	66.9a	62.8a	76.9a	97 7b	NS	**	*
R. humboldtiana	99.9b	99.9b	99.9b	99.9b	99.9b	97.1a	**	**	**
R. manglesii	37 1a	37.5a	68 4cd	77.7d	48 6ab	58.0bc	NS	**	NS
R. moschata	5 3a	18 5ab	11 2a	37.9bc	66.0d	59.1cd	NS	**	NS
R polygalifolia	0	0	0	0	4.3a+	12.0a+	-	NS	-
R stricta	0.5a+	0 05a	14.6b+	4.2ab+	12.4b+	1.4a	**	**	NS
Schoenia filfolia ssp. *subulifolia*	94.9a	89 8a	86.2a	86 7a	93.9a	91.6a	NS	NS	NS
Waitzia acuminata	34 5b	7.4a	24.8b	3.1a	69 0c	54 8c	**	**	NS

[1] *, **, NS; Significant at $P < 0.01$, $P < 0.05$ and nonsignificant respectively; +, significantly different from zero. Treatment means in the same row followed by different letters are significantly different at $P < 0.05$.
[2] N = not scarified.

Table 3. Recommendations for seed propagation of seventeen species of Australian daisies.

Species	Pre-sowing treatment	Light response	Sowing
Brachyscome iberidifolia	GA_3	positive	surface
B. latisqaemea	no	neutral	surface/shallow
Chrysocephalum apiculatum	no	positive	surface
Hyalosperma glutinosum ssp. *venustum*	no	positive	surface
Leucochrysum fitzgibbonii	GA_3	positive	surface
L. molle	GA_3	neutral	surface/shallow
L. stipitatum	scarify or GA_3	positive	surface
Myriocephalus stuartii	GA_3	neutral	surface/shallow
Rhodanthe chlorocephala ssp. *chlorocephala*	scarify	negative	covered
R. chlorocephala ssp. *rosea*	no	neutral	surface/shallow
R. humboldtiana	no	positive	surface
R. manglesii	scarify	neutral	surface/shallow
R. moschata	GA_3	neutral	surface/shallow
R. polygalifolia	GA_3	neutral	surface/shallow
R. stricta	scarify or GA_3	positive	surface
Schoenia filifolia ssp. *subulifolia*	no	neutral	surface/shallow
Waitzia acuminata	no	positive	surface