PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY BIENNIAL CONFERENCE

Official publication of The Australian Rangeland Society

Copyright and Photocopying

Form of Reference

The reference for this article should be in this general form;
Author family name, initials (year). Title. *In*: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).
For example:
Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite (*Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15th Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

Disclaimer

The Australian Rangeland Society

THE IMPORTANCE OF EREMOPHILA SPECIES (POVERTY BUSH) FOR RANGELAND AND MINESITE REHABILITATION.

G.S. Richmond

School of Environmental Biology, Curtin University of Technology, Bentley, GPO Box U1987, Perth, W.A.

ABSTRACT

Little is known of *Eremophila* seed production, viability or germination characteristics. The number of fully developed seed within the fruit varies (i.e. between 12.5-64.1%), and there are varying levels of aborted and dead seed. Fruits may be devoid of seed due to parthenocarpy. Another cause of loss of good viable seed within fruit is insect attack. Seed viability, though high for the first few years after seed set, appears to decline markedly after 3 years. The paper reports seed germination experiments conducted under controlled conditions using a day/night cycle of 25°/11°C for 11/13 hrs. *Eremophila maculata* seeds, when excised from the fruit, germinated rapidly with the first radicals emerging after 5 days. Peak germination occurred after 12 days, with a germination rate of 98%. However, with the seed within the fruit, the germination rate was much lower, at 18%. The main factor inhibiting germination of *Eremophila* is the woody endocarp which surrounds the seeds. Once the fruit apex is worn down the seed may germinate when water and oxygen are available. A secondary dormancy mechanism, in the form of inhibitory chemicals within the fruit wall, restricting the germination of *Eremophila* seeds is implicated.

INTRODUCTION

The project aims to investigate factors affecting the seed germination and ecology of *Eremophila* species (Family *Myoporaceae*) in Western Australia (W.A). Dr R.J. Chinnock (pers.comm.) who is revising *Eremophila* recognises 208 species with 175 occurring in W.A.. Of these 75 are new species, still to be described. The genus is widespread throughout Australia, especially prominent in the semi-arid and arid regions. Many species are salt and drought tolerant (e.g. *E. miniata* and *E. scoparia*) and have potential for use in range and minesite revegetation programs. Interest has also been shown in the ecology of some *Eremophila* species e.g. *E. mitchellii* and *E. sturtii* in the Cobar region in NSW, and *E. gilesii* in parts of Queensland, where these shrubs dominate the rangeland as invasive woody weeds.

Current practice for establishing *Eremophila* species largely relies on nursery growers using cuttings (Fox *et al*. 1987). Previous research on Eremophila seed germination has indicated that members of this genus are difficult to propagate from seed. Research has also suggested the presence of inhibitory chemicals within the fruit/seed, though there is no experimental evidence to support this presumption (Boden 1972; Chinnock 1982; Warnes 1983). One of the first attempts to germinate *Eremophila* species focussed on mimicking fruit coat scarification with sulphuric acid (Beard 1968). No difference in germination occurred between scarified and controlled fruit treatments. Beard concluded that there is no fruit coat dormancy in *Eremophila*, although failure to germinate in some species may be due to seed non-viability.

The first detailed study of germination focussed on the weedy species *E. gilesii* in Queensland (Burrows 1974). Germination from fruits peaked at 45% after 7 days at an optimum temperature of 250C. Burrows observed for *E. gilesii* that the effect of fruit weathering indicates germination improves exponentially 3 years after fruit maturation. Furthermore, he noted that the low initial germination can be attributed to an impervious, woody endocarp and that there is no evidence of toxic inhibitors preventing seed germination. However this germination rate recorded may represent only about 10% of potential germination, since *E. gilesii* fruits may contain up to 12 seeds per fruit (Chinnock 1982). Harrington (1977) found germination of *Eremophilas* to be low for *E. sturtii*, *E. longifolia* and *E. bowmanii*.

Interest in plant regeneration, on both pastoral properties and minesites, with *Eremophila* species has been shown by the WA Department of Agriculture and many mining companies in the Goldfields of WA. The Goldfields of WA offer a wide variety of *Eremophila* shrubs and small trees, numbering some 40 species. Of special interest for minesite revegetation programs are *E. miniata* (small tree) and *E. scoparia* (a broom-like shrub) which occur on saline "lake" country. Recent taxonomic classification of the genus *Eremophila* has resulted in *Eremophila* plant species being grouped into Sections based on similarity in plant characteristics (e.g. flower or leaf shape). The section "*Crustaceae*" MS comprises *Eremophila* species with thin fruit walls (Chinnock, unpub). This section is made up of species such as *E. paisleyi* and *E. interstans* which are prominent common understorey species in the southern Goldfields. *E. sturtii* and *E. mitchellii*, both prolific weed species in Queensland also belong to this group.

MATERIALS AND METHODS

Eremophila fruits were either collected from field sites at Mt. Weld station, Laverton (28°38'S,122°24'E) and Mt.Keith station, Wiluna (27°17'S,120°31'E), donated (see acknowledgments) or purchased from Nindathana Seed Service (Woogenilup, W.A.). Seeds were excised manually from the fruits for seed viability, seed production and germinability testing. Number of aborted, dead or damaged seeds were counted for several samples. Seed germination experiments were conducted in growth cabinets set at a day/night cycle of 25°/11°C for 11/13 hrs respectively (simulating a late winter-early spring germination period). Potential seed viability was tested using the standard tetrazolium staining technique (Moore 1973). Seed and testa were examined with the use of an Environmental Scanning Electron Microscope (ESEM). The ESEM has been fitted with a cold stage modification (Griffin *et al.* 1992) permitting the use of fresh biological material without sample degradation and cellular collapse.

RESULTS AND DISCUSSIONS

Seed viability and germination percentages are given for 10 batches of seed in **Table 1**. *E. maculata* seeds were most viable for up to 3 years old. Old seeds gave poor results. Naked seeds, when excised from the fruit germinate rapidly with the first radicals emerging after 5 days. Peak germination occurs after approximately 12 days, with a maximum germination rate of 98%. However, when the seed remains within the fruit, the germination rate is much lower, e.g. 18%. The main factor controlling the germination of *Eremophila* fruits is the woody endocarp which surrounds the seeds. Once the fruit apex is worn down the seed may germinate when available water and oxygen are available.

Table 1. Seed viability and germinability for *Eremophila* species.

SPECIES	SOURCE	STATE	AGE(months)	SAMPLE SIZE	VIABILITY %	GERMINATION %
E. goodwinii	N/A	QLD	130	100	4	3
E. longifolia	ADELAIDE	SA	7	100	N/A	30
E. longifolia	CURLWA	NSW	36	100	N/A	17
E. longifolia	ADELAIDE	SA	96	100	N/A	18
E. linearis	MARANDOO	WA	6	100	35	34
E. maculata	LEONORA	WA	6	50	74	N/A
E. maculata	LEONORA	WA	10	50	58	74
E. maculata	LEONORA	WA	18	50	74	82
E. maculata	ALICE SPGS	NT	34	50	68	92
E. maculata	MENZIES	WA	156	25	8	N/A

The percentage of fully developed seed within the fruit was highly variable i.e. 12.5 - 64.1 %. Fruit batches had varying levels of aborted and dead seed. There was also a small percentage of parthenocarpy in fruits, where no seeds were produced in any of the locules within the fruit. Insect attack also accounted for a small loss of good viable seed within the fruit. Insects such as Lepidoptera, Diptera and Hymenoptera have been retrieved from fresh fruits showing seed damage. It is surmised that these factors influence the proportion of fully developed seed within the fruit, and this may also explain, in part, the lack of success in growing certain *Eremophila* species from seed.

Microscopic examination of seed and testa has been undertaken to show cross sections of seeds. The seed has a large embryo with a thin outer endosperm. The seed is enclosed in a porous testa covering, with pores of approximately 70 μm wide.

Recent trials at Curtin University have indicated that a secondary dormancy mechanism may operate in *Eremophila*. It is possible that inhibitory chemicals within the fruit wall may restrict the germination of *Eremophila* seeds. Current research is focussing on the isolation and purification of compounds from the fruit wall.

Table 2 indicates the varied fate of seeds after seed set within fruit.

Table 2. Seed production in four *Eremophila* species.

SPECIES	*E. MACULATA*	*E.LONGIFOLIA*	*E.LINEARIS*	*E.GOODWINNII*
SOURCE	OWEN	CURLWA	MARANDOO	N/A
STATE	SA	NSW	WA	QLD
AGE (MONTHS)	2	30	5	129
FULLY DEVELOPED SEED (%)	12.50	41.80	30.20	64.18
ABORTED SEED (%)	26.34	15.59	38.50	0.75
DEAD SEED (%)	2.81	1.07	0.60	3.35
PARTHENOCARPIC FRUIT (%)	2.50	0.00	0.80	0.00
INSECT DAMAGE SEED (%)	11.45	1.47	0.00	0.00
EMPTY LOCULES (%)	44.40	40.07	29.90	31.75
SAMPLE SIZE	160	93	125	52
MAX. SEED POTENTIAL 1280	1280	744	1000	416
MAX SEED PER FRUIT	8	8	8	8

Key:
Fully developed - seed healthy, plump firm white seeds.
Aborted seed - seed partially develops then aborts.
Dead seed - seed fully developed then dies, characterised by black-grey colouration and moisture loss.
Parthenocarpic whole fruits - fruits where no fertilisation is presumed to have taken place.
Insect damage seed - seed which have been attacked or eaten by insects, with frass located in locules.
Empty locules - where no seed development has taken place (ie no fertilisation) although seeds may have developed in other locules within the fruit.

CONCLUSION

Eremophila germination appears to be at least partially controlled by the impermeability of the fruit wall. In addition other experiments have indicated that the fruit wall contains chemical substances involved in regulating seed germination. Seed set appears to be highly variable and affected by abortion and parthenocarpy. Seed viability declines rapidly after 3 years suggesting that for best results fruits of younger age should be utilised.

ACKNOWLEDGMENTS

The author wishes to thank the Minerals and Energy Research Institute of WA (MERIWA) for financial support throughout this project. The assistance of the Australian Rangeland Society for providing a travelling scholarship for conference attendance is gratefully acknowledged. Mr A van Riessen, Centre for Microscopy and Microanalysis, University of Western Australia gave advice on microscopy. Fruits were donated by CSIRO, Canberra; Kings Park and Botanic Gardens, Perth; J. Mossop, Karratha; P. Davidson, WADA Meekatharra; National Botanic Gardens, Canberra and the South Australian Botanic Gardens and State Herbarium, Adelaide. My appreciation also goes to Dr R.J. Chinnock for comments on the taxonomic status of the *Myoporaceae*.

REFERENCES

Beard. J.S. 1968. *Eremophila*. Australian Plants. 4:252-254.

Boden, R.W. 1972. Plant propagation. In 'The use of trees and shrubs in the dry country of Australia' (Eds. Department of National Development, Forestry and Timber Bureau). Australian Government Publishing Service, Canberra, pp. 420-432.

Burrows, W.A. 1974. A study of the phenology and germination of *E. gilesii* in semi-arid Queensland. In 'Plant morphogenesis as a basis for scientific management of rangelands' U.S.D.A. Misc. Pub. No.1271, Berkeley, California.

Chinnock, R. 1982. Taxonomy and relations in the *Myoporaceae*. PhD thesis, The Flinders University of South Australia.

Fox, J.E.D., Dixon, I.R. and Monk, D. 1987. Germination in other plant families. In 'Germination of Australian native plant seed' (Ed P. Langkamp). Inkata Press, Melbourne, pp. 83-97.

Griffin, B.J., Husca, G. and Stevens, M. 1992. Hydrated specimen stability in the ElectroScan ESEM-specimen surface temperature variations and the limitations of specimen cooling. Proceedings of the 12th Joint Conference of ASEM and ANZSCB, Perth, Western Australia, February 10-14, 1992.

Harrington, G. 1977. Seed germination. *Eremophila* Study Group Newsletter 6, Association of Societies for Growing Australian Plants.

Moore, R.P. 1972. Tetrazolium staining for assessing seed quality. In 'Seed Ecology'(Ed. W. Heydecker). Proceedings of the 19th Easter School in Agricultural Science, University of Nottingham. Butterworths, London.

Warnes, K. 1983. *Eremophila* from seed. Australian Plants. 12:23-24.