SHORT COMMUNICATIONS

ROLE OF THE SEED COAT IN DORMANCY OF *EUCALYPTUS PAUCIFLORA* AND *E. DELEGATENSIS* SEEDS*

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Gibberellic acid promotes the germination of dormant seeds of some eucalypt species including *Eucalyptus pauciflora* Sieb. and *E. delegatensis* R. T. Baker. It was suggested that gibberellic acid may stimulate germination by promoting enzymatic weakening of the seed coat (Bachelard 1967) as described for *Phacelia tanacetifolia* seeds (Chen and Thimann 1964). Previously, Grose (1963) suggested dormancy of of *E. delegatensis* seeds might be due to the seed coat limiting gaseous exchange.

The experiments described later were designed to test whether dormancy of *E. pauciflora* and *E. delegatensis* seeds is due to impermeability or to mechanical restraint by the seed coats.

Materials and Methods

Seeds of *E. pauciflora* and *E. delegatensis* were allowed to imbibe water for 24 hr after which the seed coats were pricked, or cut in various positions, or the embryo was removed from the seed coat. Additional seeds imbibed water for 2–5 days before the embryos were removed. Seeds were cut through both the outer and inner integuments with a scalpel in each of the following positions: cotyledonary end, micropylar end, both ends, one side, both sides. A hole was pricked through the coats of some seeds in the region of the cotyledons with a dissecting needle. Some seeds were left intact to serve as controls.

After treatment the seeds were placed on filter paper in Petri dishes as described by Bachelard (1967), and were kept in an incubator at 21 ± 1°C. Two dishes, each with 20 seeds, were used in each treatment and these were examined daily for germination.

Results and Discussion

The effects of the various treatments on germination of *E. pauciflora* and *E. delegatensis* seeds are given in Table 1. Pricking of the seed coat, which should facilitate gaseous exchange, did not increase seed germination. Cutting the micropylar ends of the seeds greatly stimulated normal germination whilst cutting the cotyledonary end stimulated atypical germination, i.e. germination in which the cotyledons emerged first. Cutting one side of the seed allowed some normal and some atypical germination but, in all cases where germination followed, the radicle (normal germination) or the cotyledons (atypical germination) emerged through the

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cut. Total germination was less in seeds in which one side was cut than where one or both ends were cut. Cutting both sides of *E. pauciflora* seeds also greatly stimulated germination but again emergence of the radicle or cotyledons took place only through the cuts.

Since *E. pauciflora* seeds are spherical and *E. delegatensis* seeds are oblong, it was difficult to orientate the cuts accurately relative to the longitudinal axis of the embryo, particularly with the former. This explains much of the germination variability for seeds with cut sides but germination never occurred when the seed coat could resist longitudinal elongation of the embryo. Clearly, germination of these seeds occurs more readily if physical resistance to emergence of the radicle or the cotyledons is removed.

TABLE 1

EFFECTS OF REMOVAL OF THE EMBRYO, DIFFERENTIAL INCISIONS, AND PRICKING OF THE SEED COAT ON GERMINATION OF SEEDS OF *E. PAUCIFLORA* (AFTER 8 DAYS) AND *E. DELEGATENSIS* (AFTER 12 DAYS)

Treatment	Germination (%) of *E. pauciflora*		Germination (%) of *E. delegatensis*	
	Normal	Atypical*	Normal	Atypical
Intact seeds	19·5	0	2·5	0
Embryo removed	87·5	0	35·0	0
Cut cotyledonary end	10·0	59·0	0	55·0
Cut micropylar end	75·0	0	67·5	0
Cut both ends	56·5	10·5		
Cut one side	20·5	38·5	7·5	27·5
Cut both sides	86·5	5·0		
Seed coat pricked	28·0	0	2·5	0

* Germination in which the cotyledons appear first.

Excised embryos of *E. pauciflora* germinated readily and showed no dormancy. The percentage germination of excised embryos of *E. delegatensis* was low; the reason for this will be discussed later.

Another method of determining the relative importance to seed dormancy of gaseous impermeability and mechanical restraint of the seed coat is to allow seeds to imbibe water for varying lengths of time at the germination temperature, before excising the embryos. If prevention of gaseous exchange by the seed coat is the primary cause of dormancy, excised imbibed embryos should take the same time to germinate regardless of the length of time the intact seeds were in suitable conditions for germination. If mechanical resistance by the seed coat to expansion of the embryo is the controlling factor in dormancy, some initial germination processes might take place in the intact, imbibed seed and reduce the subsequent time for germination of excised embryos.

To test this, germination of embryos excised from intact seeds imbibed for 1–5 days was compared. Embryos were also excised from the ungerminated intact and pricked seeds used in the experiment described earlier.

Germination percentages and values of Bartlett's germinative energy index for embryos in this experiment are given in Table 2, the germination period being calculated from the time the excised embryos were placed in suitable conditions for germination (Bachelard 1967).

Embryos excised 2 or more days after imbibition have greater germinative energy indices than embryos excised after imbibition for only 1 day. *E. delegatensis* seeds were fully imbibed 16 hr after exposure to water under the test conditions. It seems some initial germination processes take place in imbibed intact seeds and are essentially complete after imbibition for 2 days.

TABLE 2

PERCENTAGE GERMINATION AND GERMINATIVE ENERGY INDEX OF EMBRYOS OF *E. PAUCIFLORA* AND *E. DELEGATENSIS* EXCISED AFTER VARYING PERIODS OF IMBIBITION BY INTACT SEEDS

Time of Excision of Embryos after Imbibition (days)	*E. pauciflora*		*E. delegatensis*	
	Germination (%)	Germinative Energy Index	Germination (%)	Germinative Energy Index
1	87·5	0·526	35·0	0·400
2	82·5	0·717	15·0	0·571
3	64·1	0·697	47·5	0·553
4	90·0	0·691	50·0	0·590
5	82·5	0·629	60·0	0·592
8 (intact)	91·0	0·784	—	—
8 (pricked)	96·2	0·734	—	—
12 (intact)	—	—	85·7	0·683
12 (pricked)	—	—	62·1	0·667

The germinative energy index for *E. delegatensis* is less than for *E. pauciflora*, and the germination percentage of *E. delegatensis* embryos increases with increased imbibition time (the low germination percentage after imbibition for 2 days is an anomaly). The unprotected embryos rotted after about a week in the germination dishes so no further germination could be expected. The slight increase in germination of *E. delegatensis* embryos with increasing periods of imbibition could be due to the initial germination processes proceeding in the intact seed to give more rapid germination of more seeds once the restricting seed coat is removed.

The primary cause of dormancy in *E. pauciflora* and *E. delegatensis* seeds seems to be mechanical resistance of the seed coat. Grose (1963) showed that the inner, and not the outer, integument was the barrier to germination of *E. delegatensis* seeds. The inner integument of Renantherous eucalypt seeds is a specialized two-layered structure, suberized throughout (Gauba and Pryor 1958), and gibberellic acid probably increases seed germination by promoting enzymatic weakening of this integument.

An interesting aspect is the indication of staged processes in germination of these seeds. Embryos excised after 2 or more days of imbibition of water germinated more rapidly than after only 1 day of imbibition. However, embryos excised after

the longer periods of imbibition showed no evidence of radicle growth or distortion. This suggests that germination processes can be initiated and develop to a certain stage in imbibed intact seeds but when resistance to germination is encountered, in this case by a mechanically resistant seed coat, further stages in the germination process are prevented.

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References

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