# A METHOD FOR BREAKING SEED DORMANCY IN *BORONIA spp., ERIOSTEMON spp.* AND OTHER NATIVE AUSTRALIAN SPECIES

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It is probably necessary to outline a few basic concepts about seed germination and seed dormancy before discussing in more detail the breaking of seed dormancy.

Germination of viable non-dormant seed usually occurs when certain conditions are fulfilled. These include the imbibition of water, suitable temperature and an adequate oxygen supply.

When seeds do not respond, i.e. do not germinate when subjected to these favourable environmental conditions they are commonly called dormant.

Seed dormancy can be divided into two basic categories.

1. Physical dormancy
2. Chemical dormancy

**Physical dormancy.** These seeds have coats which are physically impermeable to water. When this seed coat is abraded, nicked, cracked or removed, the embryo imbibes water and germination occurs quickly; e.g. *Acacia* spp. and members of *Papilionaceae* (Pea family).

**Chemical dormancy.** When the normal criteria of moisture, temperature and oxygen have been fulfilled, and any physical barrier to water imbibition has been removed, and germination still does not occur there is a chemical dormancy operating.

It has been known for a long time that there are inhibitory substances present in seeds which prevent germination. These may be present in:

a. The surrounding fruit, e.g. *Fraxinus chinensis* var. *rhynchophylla* (3)
b. Seed coats
c. Endosperm
d. Embryo

These inhibitory substances prevent various physiological processes from beginning.

Growth promoting substances are also present. The role of these substances appears to be to stimulate the synthesis of enzymes which are necessary for growth of the embryo, particularly in phosphorus metabolism. Gibberellic acid ($GA_3$) appears to be the most prominent of these promoting substances.

Amen (1) states that all forms of seed dormancy (chemical) are basically concerned with the inhibitor/promotor mechanism and apparent differences in dormancy are merely in the mode of changing the balance to one more favourable for growth rather than one favourable to rest.

The interaction of the levels of these hormones with environmental stimuli such as light and temperature controls germination. (4).

Some environmental factors which may break chemical dormancy are:

a. Light; e.g. certain weed seeds.
b. Cold treatment; e.g. many temporate zone species require a cold treatment to stimulate germination. This usually leads to an increase in GA, and in many cases can be substituted for by applying GA.
c. Leaching of inhibitors.
d. Heat, e.g. fire.

The last two categories are the ones on which this present study has been based.

Many Australian species have evolved through a history of fire, and for many of these, in nature, fire is necessary before germination occurs.

Seeds of species of the Eastern Rutaceae, which include *Boronia* spp., *Eriostemon* spp., *Zierie* spp., *Phebalium* spp., etc., will not germinate by normal means. They will not germinate if their seed coats are nicked or abraded to allow water to reach the embryo so a physical dormancy can be ruled out. In nature they germinate in profusion after a fire has been through an area.

The original work with *Eriostemon australasius* (2), showed that by chipping the seed coat of the radicle end of the seed and putting the seeds in running water for about 3 weeks germination would occur. There appears to have been a water soluble inhibitor leached from the endosperm, thus changing the inhibitor/promotor balance and allowing germination to occur.

Seeds of other species from the same family have also responded to this treatment, and these include *Boronia ledifolia, B. denticulata, Zieria smithii, Crowea saligna, C. exalata* and *Geijera parvifolia*. In most cases the percentage germination has been low, around 10%. With some of the larger seed it has been possible to extract embryos and do tetrazolium chloride viability tests on them. In all cases the apparent viability has been much higher than 10%. This indicated that only some of the viable seeds have responded. This could be explained by the fact that there may be varying amounts of inhibitors present as a mechanism to ensure that not all seeds germinate at any one time.

The role of fire in their natural germination still remains a puzzle in relation to the above results.

*Persoonia pinifolia (Proteaceae)* which has a very stony layer (endocarp) surrounding the seed has been germinated using the washing technique. The fruits were cracked in a vise and then placed in running water for 3 weeks. These fruits were sown and some of the seeds germinated.

Seeds were also germinated by carefully extracting them from their fruits and placing them on filter paper soaked in a 250 ppm gibberellic acid ($GA_3$) solution.It would appear that this also fits the promotor/inhibitor hypothesis. In the first case the inhibitor was reduced by leaching and in the second the promotor level was increased by adding GA. Another species to respond to chipping and washing was *Ricinocarpos bowmannii (Euphorbiaceae)*.

Some of the species mentioned have great horticultural potential and are extremely difficult to grow from cuttings.

At the moment this technique is not a really reliable method of seed propagation, but rather as a beginning in the understanding of how the various dormancy mechanisms work. If evidence such as this can be collected on the physiological systems operating, then simple reliable systems for breaking dormancy and growing these species from seed may be devised. In the meantime the patient, dedicated grower can be assured of some success by using the chipping and washing technique.

There are literally hundreds of species of Australian plants which cannot yet be grown from seed. Some of these may respond to the technique outlined above.

A simple line of attack has been outlined in the following table to help in deciding what treatment to use.

**Table 1.** Possible treatments to use in overcoming seed dormancy.

| | |
|---|---|
| Treatment 1 | |
| Temperature 20°-30°C<br>Adequate water<br>Oxygen | *Non-dormant seeds*<br>Germination should occur<br>within 1 to 3 months. |
| When no germination has occurred using Treatment 1: | |
| Treatment 2 | |
| Scarify<br>Boiling water<br>Nicking seedcoat<br>Acid treatment | *Seeds with Physical dormancy*<br>Seeds will imbibe water, swell<br>and germinate when given<br>Treatment 1. |
| When both Treatments 1 and 2 have failed: | |
| Treatment 3 | |
| Light<br>Scarification and washing<br>Chipping and washing | *Seeds which have a chemical dormancy*<br>Following one or more of |

**Table 1. continued**

| | |
|---|---|
| Removal of seed coat and washing | these treatments seeds may germinate when subsequently given Treatment 1. |
| $GA_3$ | |
| Kinetin | |
| $KNO_3$ | |
| Ethylene | |


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# A TECHNIQUE FOR THE ACCELERATED PRODUCTION OF COMMERCIALLY ACCEPTABLE CITRUS CLONES FROM SEED


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I am often asked, "Couldn't we plant the seeds from that nice fruit we have just eaten and grow a tree in our garden just like that."

Two of the important aspects making this impracticable are time and thorniness. In the first place, seedling trees take considerably longer to produce fruit than budded trees do. Secondly almost all citrus cultivars grown from seed show a high degree of juvenile vigour which is accompanied by a high degree of thorniness.

Twenty years ago I got "hooked" on the technicalities of citrus production and particularly in citrus nursery propagation. It didn't take long to discover a vast amount of fascinating information in word and picture in "The Citrus Industry," by Reuther, Batchelor and Webber (1). One of the interesting snippets I remembered was, "the physiological change which causes the decrease of seedling thorniness, therefore, can not depend solely on the age of the tree or clone from seed: it seems to be favoured rather by repeated cell division, and perhaps by erectness or exposed position of the shoot."