GERMINATION REQUIREMENTS FOR SEEDS OF SOME AUSTRALIAN NATIVE PLANTS

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Australia boasts well over 20,000 species of plants, thousands of which have exciting horticultural potential because of their unusual and colourful flowers and/or peculiar vegetative form. Comparatively few are in cultivation and, in fact, some beautiful plants are known to only a handful of enthusiasts.

The seed of some of these species often proves difficult to germinate, either failing completely or yielding a very poor and irregular percentage. In nature, such species may germinate only under very specific weather conditions or a sequence of weather conditions that may occur very infrequently, perhaps years apart. These specialised germination requirements have developed to enable those plants to survive in our extremes of climate.

Australia has an area of nearly three million square miles, almost equal in area to the U.S.A., and lays claim to being the driest continent. Only one-third of the continent receives 20 in. or more of rain per year, one-third 10 to 20 in., and one-third less than 10 in.

Rainfall has a tremendous influence on the development of vegetation, but in Australia it is only half the story. The whole of Australia has an annual deficit of rainfall to evaporation. For 70% of Australia, there is not one month in which rainfall exceeds evaporation. In India, for instance, 38% of the rainfall enters the rivers, compared with the Australian figure of 5% to 10%. Mountains are rainmakers, and our dry climate is a reflection of our very old, eroded, and flat land form. Our highest mountain reaches only 7316 ft., and the whole continent averages only 900 feet above sea level. The central area known as Lake Eyre is actually about 39 ft. below sea level.

Certainly there are areas of very high rainfall in Australia, such as parts of the west coast of Tasmania and a narrow strip of the northeast coast of Queensland. Both areas receive between 100 and 200 in. or more of rain annually. However, even there some plants show adaptations that indicate that somewhere in their past their parents suffered periods of severely dry conditions. The adaptations that evolved then are still evident today in the germination of the seed.

The very harsh conditions that have such a profound influence on the development of our plants resulted from both droughts and fires. The plants are both tenacious and persistent, as any farmer

who has ever cleared land will vouch. They can grow very rapidly and flower prolifically when conditions are favourable, and hang on to life, if necessary, through many years with little or no rainfall.

Australia has both a pyrophylic or fire-loving flora and a desert flora which each containing plants with specialised germination requirements that may pose difficulties for would-be growers.

PYROPHYLIC PLANTS

Pyrophylic plants have developed fire-resistant fruits, fire-resistant seeds, or fire-resistant vegetative organs. Some difficulties experienced in germinating seeds of these plants result from a lack of understanding of the phenomena of seed release and pre-germination requirements.

Fire-resistant fruits are hard, woody structures, large or small, that may persist on the plant for many years, thus building up successive crops of fruit. They persist until a bushfire razes the area and, in fact, such species generally occur in a highly flammable type of bushland. Fruit which has been severely charred by fire will often open quite rapidly as the fire cools, releasing the seed, some of which may be several years old.

Species with fire-resistant fruits include eucalyptus, leptospermum, melaleuca, and callistemon, as well as hakea, banksia and xylomelum. There are practical advantages for these plants in releasing their seed on to freshly burnt soils. These include elimination of competition, elimination of pests such as borers that become active in the period between fires, partial sterilisation of the seed bed, provision of a loose ash seed bed, and release of basic nutrients in the ash.

The seed of species such as most of the banksias which hold the seed very securely in the fruit can be damaged by physical attempts to extract it. It will fall out quite freely within a few hours of the fruit being charred in a flame.

Fire-resistant seeds, on the other hand, generally have an extremely hard seed coat. This is characteristic of the seeds of most of our acacia, cassia, our huge range of brilliant peaflowered plants such as oxylobium, bossiaea, gompholobium, mirbelia, and hardenbergia, and other showy plants such as boronia, eriostemon, and the dodonaea or hop bushes. These seeds ripen and are dropped or thrown onto the ground each year, but because of the hard, impermeable seed coat, little germination takes place until the area is burnt. Heat cracks the hard seed coat, and subsequent germination is usually prolific.

Growers need to treat seed to ensure germination. Although elaborate methods such as acid treatments have been devised, filing each seed with a small three-cornered file is the most positive

treatment, but is too tedious to be practicable for other than very small batches. Boiling water treatment is simple, and good enough give an acceptable level of germination. It consists of placing the seed in a suitable container, pouring in boiling water, allowing it to cool in the water overnight and then planting it without drying.

Fire-resistant vegetative parts are another adaptation I should mention. In addition to either fire-resistant fruit or seed, some of the pyrophylic plants have also developed fire-resistant organs called lignotubers. These are woody tuber-like structures at the base of the stem and just below ground level. A bushfire may severely scorch or completely burn off the above-ground plant parts, but the lignotuber is safely insulated in the soil. Soon after a fire, vigorous shoots appear from the lignotuber and develop very quickly.

Species that regenerate from lignotubers include many of the Myrtaceae, such as eucalyptus, leptospermum, melaleuca, and baeckea; in Proteacea, banksia and some hakea; and in Rutaceae, boronia and eriostemon. I can think of only one showy acacia, *A. complanata*, that regenerates from the base.

Pyrophylic plants generally grow in dense mixed populations in areas subject to burning every few years. Such areas are usually spectacular natural wildflower areas, and are at their showiest for three or four years after burning. In following years, plants gradually become leggy and less floriferous, building up fruits and pests such as borers. Some of the weaker hard-seeded species such as boronia may, depending on the time between fires, become over-shaded and die out. However, they usually reappear vigorously after fire.

DESERT PLANTS

It has been stated that more than half of Australia at the present time is either continuously or seasonally arid. Many plants from the arid and semi-arid areas have developed very specialized fruit or seed structures to ensure seed resists the heat and desiccation. Some have highly complex inhibitors to ensure the seed germinates only when there is sufficient rain or soil moisture to allow the establishment of young plants.

Some species have dense or leathery and impermeable seed coats or indehiscent fruit, and include the ubiquitous acacia (of which we have some 835 species), cassia, pea-flowered plants, dodonaea, and some pimelea, and some grevillea. Other species have woolly or papery covers enclosing the seed, such as the indehiscent dried flowers, or else woolly seed coats. Such seed usually requires at least one summer baking in the scorching soil surface—or is it to partially decompose the covering or seed coat so that germination can take place? There is no doubt that some of these are even more complex,

and actually contain a chemical germination inhibitor that has to be leached away by repeated or substantial falls of rain.

These kinds of fruit or seed will often respond to alternate periods of wet and dry. This is achieved by keeping seed pans moist for some weeks or months, and then placing them out in the scorching sun to dry and bake for weeks or months before returning to moisture. Germination in the open sunlight is quite important in any case. I know of seed pans of verticordia that continued to yield seedlings by this method for well over a decade.

Perhaps the most complex genus is eremophila, our beautiful so-called native fuchsia. All species are restricted to arid and semi-arid areas. They have physical, chemical and temperature barriers to germination, and have successfully frustrated most attempts at germination. The seed is enclosed in a tough, leathery, indehiscent fruit, and a hard, bony endocarp. There is also a strong chemical inhibitor that takes time to leach away and, in addition, the one species that has been intensively studied would germinate only on substantial winter rainfall. No amount of summer rainfall would cause germination, and only fruit that had lain in the soil for more than 2 years would respond to winter rain. Presumably, seedlings would scorch if they germinated in summer or after light rain.

Some small successes in germinating eremophila seed have been achieved by using old fruit that had accumulated under plants, soaking them for 2 to 3 weeks, and then storing in a household refrigerator for 4 to 6 weeks before sowing.

Perhaps suspending fruit in a cloth bag in a toilet cistern for a period would be a useful leaching treatment. I know of one instance where a quantity of eremophila seed was inadvertently left in a wheelbarrow of water for 2 weeks after a storm. Some germination occurred after the barrow was emptied on a garden bed.

OTHER GERMINATION FACTORS

After-ripening is a requirement of some species of eucalypt, and may be an unrecognised factor in other genera. Freshly extracted eucalyptus seed often gives a very poor germination, or may not germinate at all. However, if the seed is stored for some months, the germination percentage will rise dramatically and, depending on storage conditions, will remain high for several years.

Small seeds are a characteristic of genera such as callistemon, melaleuca, baeckea, leptospermum, and some eucalyptus. Some of these plants have seed as fine as dust, quite remarkable for woody plants. Such small seed is unlikely to germinate and survive unless kept continually moist for periods of at least several weeks. We are unlikely to see spontaneous seedlings of these plants in the garden even though they produce large quantities of seed, unless there is

a dripping tap in the area. This is probably quite fortunate for us in Australia, otherwise we would long ago have been smothered by these plants.

The natural germination of these small-seeded plants is associated with floods and droughts. Drought often triggers a heavy release of seed, and this, falling on the band of wet soil or sand along the receding water line of a river or dam, produces a forest of tiny seedlings. Fortunately, nearly all are washed away in the flood that eventually follows.

Moving seeds are characteristic of a few plants with seed (actually fruit) that moves in response to moisture or wind, and literally buries itself in the soil.

Our various spear grasses are examples where the awn or awns on the seed twist and untwist with alternating moisture and dryness, pushing the seed along to an obstruction or soil crevice and then down into the soil.

The beautiful genus, *Calytrix*, has dart-like fruit with long hairs on the persistent calyx lobes. These hairs are moved by the wind and twist the seeds into the soil.

RAINFOREST PLANTS

I referred earlier to the fact that some rainforest plants show adaptations that suggest their evolution was influenced by drought. It is an involved story that encompasses continental drift, the Gondwana origin of Australia, dramatic changes in climate, the migration to Australia of successive waves of primitive people—the aborigines—and their intensive use of fire in land management. More parts of the story are the shrinking of previously extensive rainforests to refuge areas and, starting well before Captain Cook discovered the east coast, a return to a wetter climate and the expansion once again of rainforests.

Some rainforest plants such as ceratopetalum and syzygium have seeds with a very short viability that will not survive drying. Others such as aceratium and some cryptocarya have relatively large seeds that take 4 years to germinate. Some seeds will send down a root and establish a woody crown deep in the soil, but the plumule does not appear until about the fourth year. Little has been devised yet that will speed up the germination of these seeds.

As you can see, the germination of some Australian native plants is quite complex, but an understanding of the factors involved assists in overcoming the problems.