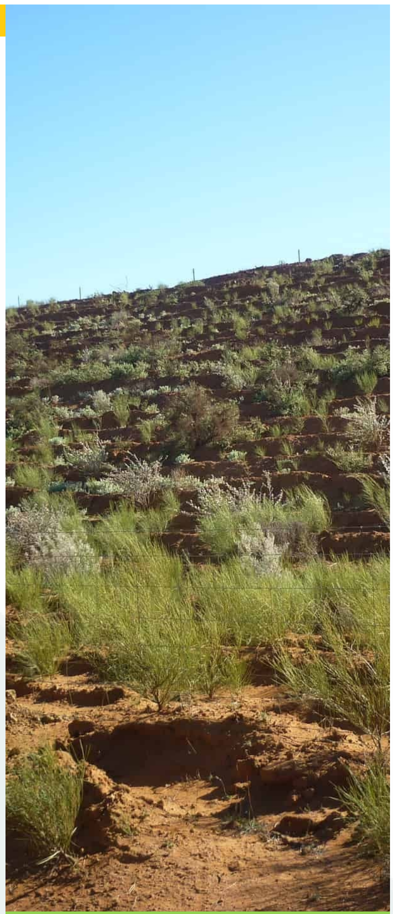


How to get the most out of your Native Seed during rehab

Brandon Ovens – Environmental Specialist

The development of a mining operation, can involve the alteration of existing landforms and hydrological conditions, remove of flora and faunal habitats, and potentially create contamination (Bennett & Lacy, 2016). At the end of mining, it is the proponent's responsibility to ensure the land is rehabilitated and closed in a manner that is safe, geo-technically stable, non-polluting and capable of sustaining an agreed post-mining land use (DMIRS, 2020). This result is generally achieved through rehabilitation, and a big part of this is revegetation. Revegetation is the act of replanting and rebuilding the soil of disturbed land. Revegetation can prove vital in assisting with ecosystem functionality, reducing the impact of salinity and landform erosion. Often the scale at which revegetation is required is immense, and the cost of collecting local provenance seed, purchasing seed and sowing is no small amount. It is therefore essential to get the most out of your available seed, but how?

Source: Vaderstad International

Native flora has spent millennia evolving and adapting to the harsh conditions present throughout Western Australia, but still struggle to set seed and grow. Typically, only 10% of the seeds sown during mine site rehabilitation, emerge and survive (Bell, 2015). Some of these natural adaptations such as woody coverings and appendages make mass automated seeding difficult, while others restrict germination unless particular conditions are present. While the importance of revegetation is well understood, scientific advances have done little thus far to drastically improve germination success in comparison to the rates observed naturally. Seed enhancement technologies aim to increase the effectiveness of direct seeding and reduce seed mortality during early plant life-stage transitions. This Insight will explore some of the seed germination enhancement techniques utilised in rehabilitation.

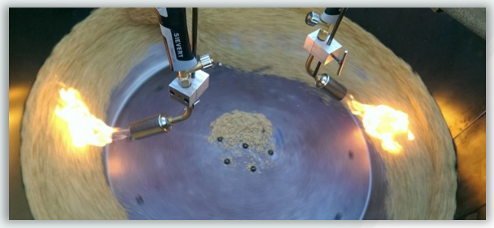
Summary/Quote

Seed enhancement technologies aim to increase the effectiveness of direct seeding and reduce seed mortality during early plant life-stage transitions.

Flash Flaming

Many native species found in WA produce seeds that are contained within florets, or possess appendages such as awns or hairs. These appendages are bulky and prone to tangling, which hinders the 'flowability' through mechanical seeding machines (Ling, Guzzomi, Merritt, Renton, & Erickson, 2019). Flash flaming is a technique that has been designed to replace traditional methods of removing the seeds outer coverings which are highly dependent on an operator, slow and limit large scale seeding efforts.

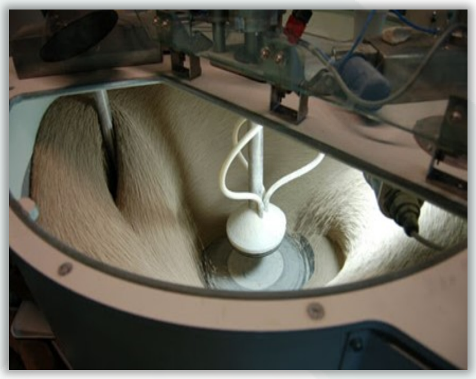
Flash flaming works by exposing a quantity of seed to a flame for short bursts within a 15 to 30-minute period, inside a rotating drum. The flaming process smooths the surface of seeds improving their flowability for direct



Flaming Seeds. Source: The University of Western Australia, Faculty of Engineering, Computing and Mathematics seeding, allows for the application of artificial coatings and reduces the size of some seeds by 30-40% thereby reducing the space required for storage (Botanic Gardens & Parks Authority, 2017).

Seed Coating

Seed priming and coating are methods of seed enhancement that have been long used in farming or horticultural spaces. Much of the land in Western Australia is either saline, nutrient poor or water deficient making condition sub-optimal for plant growth. The coating acts to improve the establishment potential of seeds by providing additional resources to assist with nutrient supply and water retention.

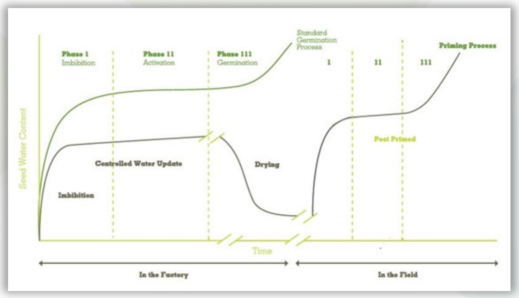

Seed Pelleting Equipment. Source: seedpelletingequipment.com

Polymer seed coating – is a process that involves applying fine-grained soil/mineral products and binding agents to seeds. There are a variety of advantages associated with this method which help with distribution and germination. Once coated seeds are more uniform in size and shape, allowing them to pass through mechanical seeders with ease. The polymer coating itself provides the opportunity to cover the seeds in stimulants, herbicides and chemical or biological agents that assist in early seed establishment (Erickson, et al., 2019).

Extruded seed pelleting – works similarly to seed coating however differs in that the seeds are embedded in a product rather than coated. The pelleting process involves mixing the seeds and pellet ingredients such as soils/ minerals, water-holding gels, organic matter and chemical agents, into a wet dough and then extruding the material into uniform sizes. Pellets containing a number of seeds and organic products are then dried and stored ready for seeding (Erickson, et al., 2019).

Seed Priming

Seed priming uses controlled hydration to take the seed through the first biochemical processes, without allowing germination to be completed. Before radicle emergence, seeds are removed from the priming conditions and re-dried to arrest germination. Seeds are then dried until required. During subsequent germination, primed seeds exhibit faster and more synchronised germination, and young seedlings are often more resistant to abiotic stresses than seedlings obtained from un-primed seeds (Erickson, et al., 2019; Lutts, et al., 2016; Germains, 2016).



Seed Priming Process. Source: Germains

Species found within semi-arid environments often exhibit an evolutionary adaptation to fire. Research has found that many forage species experience a period of dormancy, delaying germination until environmental conditions are optimal. Many of these adapted species require smoke to be deposited as a residue, washed through the soil by rainfall to reach the seed bank and trigger germination. Over 400 native species of seeds respond to smoke treatment, and as such, the application of smoke water or aerosol smoke to seeds is a common priming agent (Botanic Gardens & Parks Authority, 2020). There are many techniques of seed priming (Waqas, et al., 2019) such as:

- Hydro-priming: seeds are soaked in water for a period of time then dried to a specific moisture level before sowing;
- Osmo-priming: seeds are hydrated to a controlled level to allow pre-germination metabolic activities;
- Nutrient Priming: seeds are saturated with a specific concentration of either macro- or micro-nutrients for a particular period of time;
- Chemical Priming: seeds are primed with natural or synthetic chemicals which may increase plant growth, and obtain resistance to various abiotic stresses;
- Bio-priming: combines physiological soaking with biological agents (micro-organisms);
- Priming with Plant Growth Regulators is known to mitigate the effects of some environmental stresses.

Seed priming can also be carried out through the use of physical agents such as magnetic fields, UV radiation, gamma radiation, X-rays and heat. Priming is strongly affected by various factors such as temperature, aeration, light, priming duration, and seed characteristics (Waqas, et al., 2019).

Ground Preparation

Erosion, water retention, infiltration and wind (sand-blasting) are major factors influencing seedling emergence. Strong winds or runoff are capable of displacing topsoil and seed, thereby impacting rehabilitation efforts. In contrast, poor water retention and infiltration can impact germination and sand-blasting can kill emerging seedlings. Understanding climatic conditions of the revegetation area and the properties of the available growth medium is therefore vital in getting the most out of seeds.

By understanding the environmental conditions, ground preparation techniques can be appropriately applied to improve seedling establishment. Some forms of ground preparation may include:

- Soil ameliorants (e.g. Gypsum, lime or fertilisers) can be used to alter the soil chemistry to provide more optimal conditions;
- Mulches or artificial soil crust agents such as diluted bitumen emulsion can be used to stabilise the soil surface against wind erosion (Dobrowolski, 2019);
- Biocrusts, such as mosses or lichens can be used to aid in the retention of moisture following rainfall (Minerals Council of Australia, 2016);
- Land imprinting is the physical indenting of the soils with a ridged roller to create micro-catchments that harvest water and increase infiltration and nutrient recycling (Dobrowolski, 2019).

Biocrust
Source: School of Forestry, Northern Arizona University

Utilising Coloniser Species

Native coloniser species can be used during rehabilitation to facilitate recovery and build habitat. The methodology involves sowing a site with seeds of native plants with a focus on high densities of diverse colonising species, usually understorey species. Coloniser species are opportunistic and thrive with disturbance, establish and reproduce rapidly in response to rain, replenish seedbanks, stabilise soil and contribute organic matter to a site (Horner, Christie, Williams, Scanlon, & Lemon, 2019).

New techniques and methodologies to assist with mine site rehabilitation are continuing to be developed, and a large emphasis is being placed on improving germination statistics. The team at Integrate Sustainability have a wealth of experience when it comes to rehabilitation and is excited about the advancements being made in this area. If you require further information or need assistance with rehabilitation, give Integrate Sustainability a call on 08 9468 0338 or email us at enquiries@integratesustainability.com.au.

Integrate Sustainability

Primary Business Address
Lower Ground Floor
3 Richardson St
West Perth, 6005
Western Australia

Phone: (+618) 9468 0338
E-mail: enquiries@integratesustainability.com.au

integrate SUSTAINABILITY

environment safety community

References

Bell, L. (2015). Improving native seed survival rates key to rehabilitating Pilbara mine sites. ABC Rural.

Bennett, K., & Lacy, H. (2016). Mine Closure: Leading Practice Sustainable Development Program for the Mining Industry. Canberra: Australian Government.

Botanic Gardens & Parks Authority. (2017). Flaming Brilliant Breakthrough. Perth, Western Australia: Botanic Gardens & Parks Authority, Government of Western Australia.

Botanic Gardens & Parks Authority. (2020, July). Smoke to sow and grow. Retrieved from https://www.bgpa.wa.gov.au/about-us/conservation/research/seed-conservation/2479-smoke-to-sow-and-grow

DMIRS. (2020). Environmental Objectives Policy for Mining. Western Australia: Department of Mines, Industry Regulations and Safety.

Dobrowolski, M. (2019). Combining seed burial, land imprinting and an artificial soil crust dramatically increases the emergence of broadcast seed. Mine Closure 2019 - AB Fourie & M Tibbett.

Erickson, T., Munoz-Rojas, M., Gozzomi, A., Masarei, M., Ling, E., Bateman, A., . . . Merritt, D. (2019). A case study of seed-use technology development for Pilbara mine site rehabilitation. Mine Closure 2019 - AB Fourie & M Tibbett.

Germains. (2016). What is Seed Priming? Retrieved July 2020, from Germains Seed Technology: https://germains.com/what-is-seed-priming/

Horner, B., Christie, G., Williams, B., Scanlon, A., & Lemon, J. (2019). Bang for your buck: revegetating arid sites using coloniser species. Mine Closure 2019 - AB Fourie & M Tibbett.

Ling, E., Guzzomi, A., Merritt, D., Renton, M., & Erickson, T. (2019). Flash flaming technology shows promise to improve seed-based rehabilitation outcomes. Mine Closure 2019 - AB Fourie & M Tibbett.

Lutts, S., Benincasa, P., Wojtyla, L., Kubala, S., Pace, R., Lechowska, K., . . . Garnczarska, M. (2016). Seed Priming: New Comprehensive Approaches for an Old Empirical Technique. IntechOpen. Retrieved July 2020, from https://www.intechopen.com/books/new-challenges-in-seed-biology-basic-and-translational-research-driving-seed-technology/seed-priming-new-comprehensive-approaches-for-an-old-empirical-technique

Minerals Council of Australia. (2016). Ginkgo Mineral Sands Cristal Mining. Mine rehabilitation in the Australian minerals industry, 10 - 14.

Waqas, M., Korres, N., Khan, M., Nizami, A., Deeba, F., Ali, I., & Hassain, H. (2019). Advances in the Concept and Methods of Seed Priming. ResearchGate. Retrieved from https://www.researchgate.net/publication/336709927