

RIAWA Seminar

Pelleted seeds, an improved method for
application of native Australian seeds



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Alan Savage - Nurture Revegetation

Tony Pekin - Nurture Revegetation

Seed Pelleting - Background

- Seed pelleting has its origins in intensive agriculture
 - With more recent applications in rangeland management in the USA
- Nurture Revegetation has a background in clay mining, clay technology and agricultural biotechnology
- Over the last four years we have developed processes for embedding native seeds in clay pellets for arid zone and extensive revegetation
- Development work has been done with Kings Park Botanic Gardens
- We are an Industry Partner with Kings Park and UWA on a ARC Linkage Grant - Innovative seed technologies for restoration in a biodiversity hotspot
- We have approved vendor status with BHP Billiton, Newcrest Mining and Northern Star Resources amongst others
- Our first substantial field trial was conducted at Northern Star Resources Jundee Gold mine at Wiluna



Requirements for successful germination of seeds

- Endogenous factors, potential for a seed to germinate
 - Seed quality, age, energy reserves, physical condition
 - Seed dormancy, 'removal' deactivation of physical and internal dormancy factors
- Light or dark cues
- Temperature cues
- Hydration, soil water content, matrix potential, duration of optimal soil moisture conditions

The challenge with seeds

- Seedling establishment from direct seeding is the most unreliable and unpredictable aspect of land form rehabilitation
- Consequences of failed or sub-optimal plant establishment can be serious
 - Environmental impacts: erosion, instability of sloped areas, pollution from leaching and run-off
 - Failure to meet mandated and regulatory requirements
 - Public awareness and complaints

The challenge with seeds - continued

- Use of raw seed in arid zone revegetation is extremely inefficient, 1% success rate is an excellent outcome
 - 8kg per ha is ~ 1 million seeds, target might be 5,000 - 10,000 plants. This means a lot of wasted seed
 - Seeds are expensive and demand will only increase
- There are many reasons for this
 - Human factors, bad timing, sub-optimal distribution
 - Transport and loss of seeds due to wind and water run-off and predation
 - Physical and environmental: water availability, seasonal factors, soil chemistry and structure
 - Biological reasons, dormancy, seed quality

Seed germination

- Germination rates of seeds under optimal conditions are normally high, 50 - 90%, so losses and inefficiency is not due to this alone
- A major reason for seeds not to germinate is a failure to hydrate properly
 - Seeds hydrate by absorbing water from soil moisture, water needs to move through soil to contact the seed by capillary action
 - A seed sitting on soil surface, in a void or in loose, coarse soil cannot absorb the moisture required for germination
 - For this reason modern agricultural practice applies serious attention to seed placement, depth, coverage, and soil compaction around the seed
 - This technology is not really available in most revegetation systems

Seed Pelleting - Benefits

- The microenvironment around the seed is critical for seed germination and for seedling establishment.
- Seed pelleting is a way to manipulate the seed microenvironment and improve germination and establishment of seeds under sub-optimal environmental conditions
- Pellets increase the size of the package, increasing contact with soil and facilitating seed hydration
- The seed pellet matrix is mainly clay, this absorbs and holds water around the seed, improving hydration and creating a microenvironment around the germinating seed and the seedling

Seed Pelleting - Benefits continued

- Protection of seed, physical and environmental and from predation by insects, rodents and birds
 - Seed survival is higher,
 - They can be applied for an extended period before the rain season
- Logistical
 - Storage and protection
 - Pre-blended mixes, customised for location and site
 - Delivery and application of seeds to rehabilitation areas
 - By hand, people on foot, for inaccessible and steep contoured areas, or small sites
 - By mechanical spreaders mounted on vehicles, machinery, 4WD bikes, drones, helicopters

Seed Pelleting - Inclusions

- The pellet is relatively large, so there is scope to include range of beneficial additives in the mix:
 - Soil conditioners
 - Soil wetting agents, surfactants
 - Nutrients or trace elements
 - Local top soil containing useful microbes, including mycorrhiza, rhizobia and other bacteria and fungi.
 - Herbicides to control competing weeds is a current project with Kings Park
 - Ongoing research may define useful germination stimulants that could be included, this would be very useful for species like spinifex and some grasses that are currently not germinating in useful time frames

Benefits for direct seeded revegetation

- Revegetation projects are often completed by contractors
- Seeds of varying size and quantities prepared into a uniform size ready for application
- The requirement of each revegetation project will differ
- Project works are completed all year round and not necessarily at optimal times for raw seed applications
- Available to work with consultants to produce blends of seeds for particular localities
- Suitable for in-fill of previously revegetated sites with sub-optimal results

Cost Benefit Raw Seed vs Pelleted

Raw Seed

- Comparable cost on a \$ per ha basis
- Substantial and complex onsite preparation of seeds as part of application process
- Application costs are substantial as often completed by professionals
- Timing of application is critical due to pre-emptive seeding exposing the seed to physical and predatory losses
- Germination and recruitment outcomes are unpredictable due to seed losses from wind, rain and predators
- Revegetation outcomes are always subject to seasonable and environmental conditionals of the year

Pelleted Seed

- Less seed required however preparation costs higher
- Minimum onsite preparation as seed pellets are supplied ready to apply in the correct ratios
- Application of pellets can be done by contractors or unskilled employees
- Timing of application is less critical as seeds are protected from physical and predatory threats
- More predictable outcomes because of the protection offered by the pelletisation and additives
- Revegetation outcomes are always subject to seasonal and environmental conditions of the year but lower application costs can mitigate these risks

Pellet trials - Jundee Gold Mine (Wiluna)

- New earth works to rehabilitate Waste Rock Dump (WRD)
- Single application December 2016 on 2.5ha
- First surveyed March 2017
- Pelleted seed, raw seed and controls (nil seed)
- Pelleted seed outcomes better than raw seed
- Importantly, ease of delivery

Current trial work - Jundee Gold Mine (Wiluna)



- On prepared sites seedling establishment rates similar to naked seed, but at lower application rates, so more efficient with respect to seed quantities required for the revegetation
- Seeds can be scarified or pre-treated to enhance germination prior to pelleting.
- Easier to apply granules than naked seed, can be applied manually, by machine spreader, or by drone or helicopter
- Seeds of different species, with different sizes and densities can be manufactured into pellets of same size. This allows for easier distribution, and efficient dispersal of seeds

Jundee Gold Mine Success

nurture
REVEGETATION



December 2016



May 2018

Questions

