Ecological restoration in Saudi Arabia

The Thumama Park Restoration Trial

Proven (knowledge driven), Cost Effective, Scalable restoration solutions

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Why our approach

“To achieve the restoration of biodiversity and ecosystem services, restoration actions need to be tightly coupled with ‘state-of-the-art’ scientific progress”


Target Plant Concept

- Quantifiable seedling attributes that are linked to outplanting success

Courtesy Anthony Davis
Drylands of the world

41% of the earth’s surface; sustain 38% of the global population*; Drylands store
45% of the global terrestrial carbon; support 50% of world’s livestock; one third of
global biodiversity hotspots.

Losing soil at up to 10cm per annum

Estimate of desertification: up to 20%
Drylands reach degradation tipping points
What makes arid land restoration challenging
But exciting!

- Rapid degradation.
- Limited understanding.
- Pulse-driven (rain)— timing of restoration.

We achieve barely 5% restoration success rates*.

These are pulse driven systems – 20 minute rainfall event
The summer winter rainfall divide driving contrasting plant phenologies in Australian deserts

Knowledge based decisions

Water in the environment at three scales

Landscape                Local           Plant-scale.
Thumama Park Restoration Trial

The Target Plant Concept
Quantifiable seedling/direct seeding attributes that are linked to outplanting success

Understanding water in the plant and the environment – seedling age, water delivery, timing, stress
Thumama Park Restoration Trial: restoring framework communities

Three *Acacia* framework trees; framework shrubs
103,000 plants, 128 treatment combinations + precision seeding
Focusing water in the establishment niche

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<td>1</td>
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<td>No Water (controls)</td>
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<td>SA drip</td>
<td>Seasonal Average for Riyadh per month</td>
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<td>3</td>
<td>Low drip</td>
<td>1L/plant – Monthly</td>
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<tr>
<td>4</td>
<td>High drip</td>
<td>3L/plant - 2 times per week</td>
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<tr>
<td>5</td>
<td>SA deep pipe</td>
<td>Seasonal average for Riyadh</td>
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<tr>
<td>6</td>
<td>Low deep pipe</td>
<td>1L/plant – Monthly</td>
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<tr>
<td>7</td>
<td>High deep pipe</td>
<td>3L/plant - 2 times per week</td>
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Deep pipe (20cm) infiltration

Very deep (2m) pipe infiltration
Plant protection and optimising transplanting success

Salicylic acid (Aspirin)

Trinexapac-ethyl (Moddus)
Smarter seed use: a key to unlocking restoration potential

Improving seed use efficiency – currently <10%

First use of:
Direct seeding of wild species
All species (blue) and *Acacia gerrardii* (blue).
All species (blue) and *Acacia gerrardii* (blue).

![Graph showing survival rates for different treatments](image)

- **Nil**
- **Drip (surface)**
- **Low (1l/month)**
- **High (24l/month)**
- **Seasonal Av (SA)**
- **Deep (20cm pipe)**
Control Salicylic Acid

Acacia gerrardii

Nil Water
Seasonal Av Deep Pip
1l/month Deep Pipe

High water not shown
>90% survival across all treatments
Knowledge based decisions

Predicting restoration success – using Restoration Ecophysiology
Ecophysiology informing plant capability – Greenstock plantings

Give plants access to more water and they will use it

Benefit of deep pipe

A (Photosynthetic rate) = \( \mu \text{mol.m}^{-2}.\text{s}^{-1} \)

Take home messages: Greater water application allows for more growth potential (photosynthesis), a reduced amount of water stress but also allows plants to have a less efficient water use strategy. Deep pipe irrigation reduces water stress.
Ecophysiology informing plant capability – Anti-stress compounds

$A$ (Photosynthetic rate) = \( \mu \text{mol.m}^{-2}.s^{-1} \)
**Key Take Home Messages**

Precision in water delivery is more important than quantity

Nutrient amendments were detrimental (low rainfall systems)

Salicylic acid is a cost-effective plant growth and survival improver

Aspirin, low water, deep pipe (1l per month for year) – 40% survival

**NEXT STEPS:**
- Business case – cost:benefit analysis
- Refine natural catchments that deliver water to depth.
- Slow release SA
- Expand trial to range of soils, environments in the Middle East
Precision Seeding

- Soil texture
- Moisture retention
- Impedance
- Infiltration rate
- Seed burial depth

**Outcome**: sand dominated soils matter – low impedance, water infiltration to depth, emergence free from soil crusting
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Ecophysiology informing micro-site capability – direct seeding

Take-home message: direct seeded plants have 14% of the PS capacity of natural recruits

\[ A \text{ (Photosynthetic rate)} = \mu\text{mol.m}^{-2}.\text{s}^{-1} \]
Deep ripping improves emergence in direct seeding

Microsites possible using boxed microcosms
Broader benefits for the Middle East

• More effective water use in restoration (50 liters per plant per week vs 2 liters per month).
• Use of native species for water wise landscapes
• Up-scaling of cost-effective restoration
Globalising dryland restoration

The Dryland Restoration Initiative (DRI)

*Linking SER with science leaders, leading global institutions, the UN, national governments*

- Build the science and practice toolkit.
- Enhance ecological restoration capacity and networking with dryland champions.
- Liaise, collaborate and seek funding with individuals, communities, governments and industry partners.
- Be a restoration innovation hub.