Tailings as a Growth Medium: Eliminating Topsoil Dependency

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Introduction

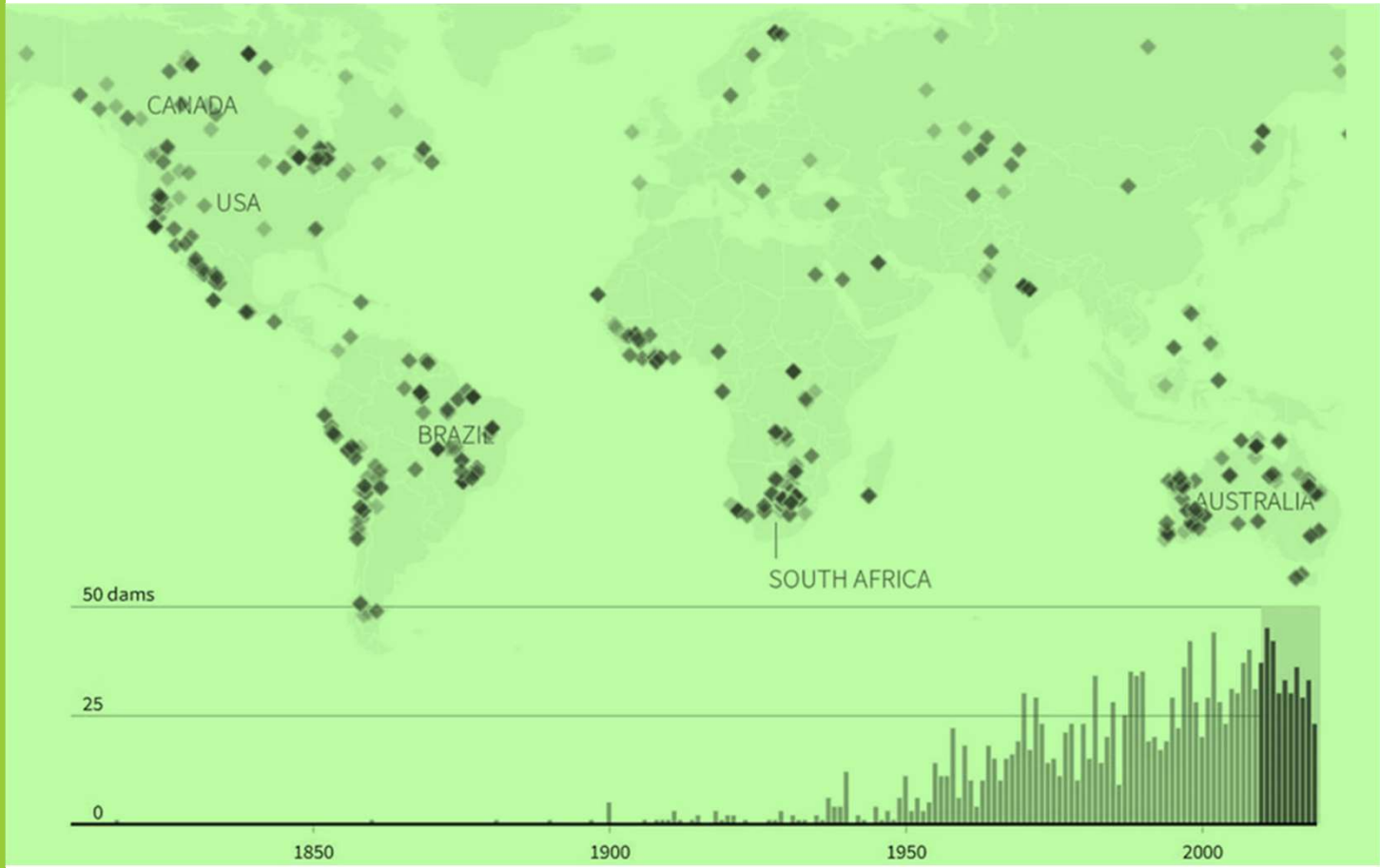
Upwards of 320 new tailings storage facilities (TSFs) were constructed between 2010 and 2020, more than any previous decade*

TSFs are often barren or sparsely vegetated

Resulting in erosion which may lead to environmental contamination

Rehabilitation is crucial for this increasing environmental hazard

Mining companies are under growing pressure to showcase their current efforts to reduce environmental impact



***Warburton, Hart, Ledur, Scheyder & Levine (2020)**

Introduction

The most used technologies involve constructing an inert or biological cap over mine tailings, such as topsoil, rock, or gravel*

Expensive and environmentally detrimental

The goal is to foster germination and the establishment of a vegetative cap, leading to plant succession and the eventual formation of a stable vegetative community on the site.

Consequently, using the tailings itself as a growth medium would:

Reduce costs

Reduce environmental damage at topsoil host sites

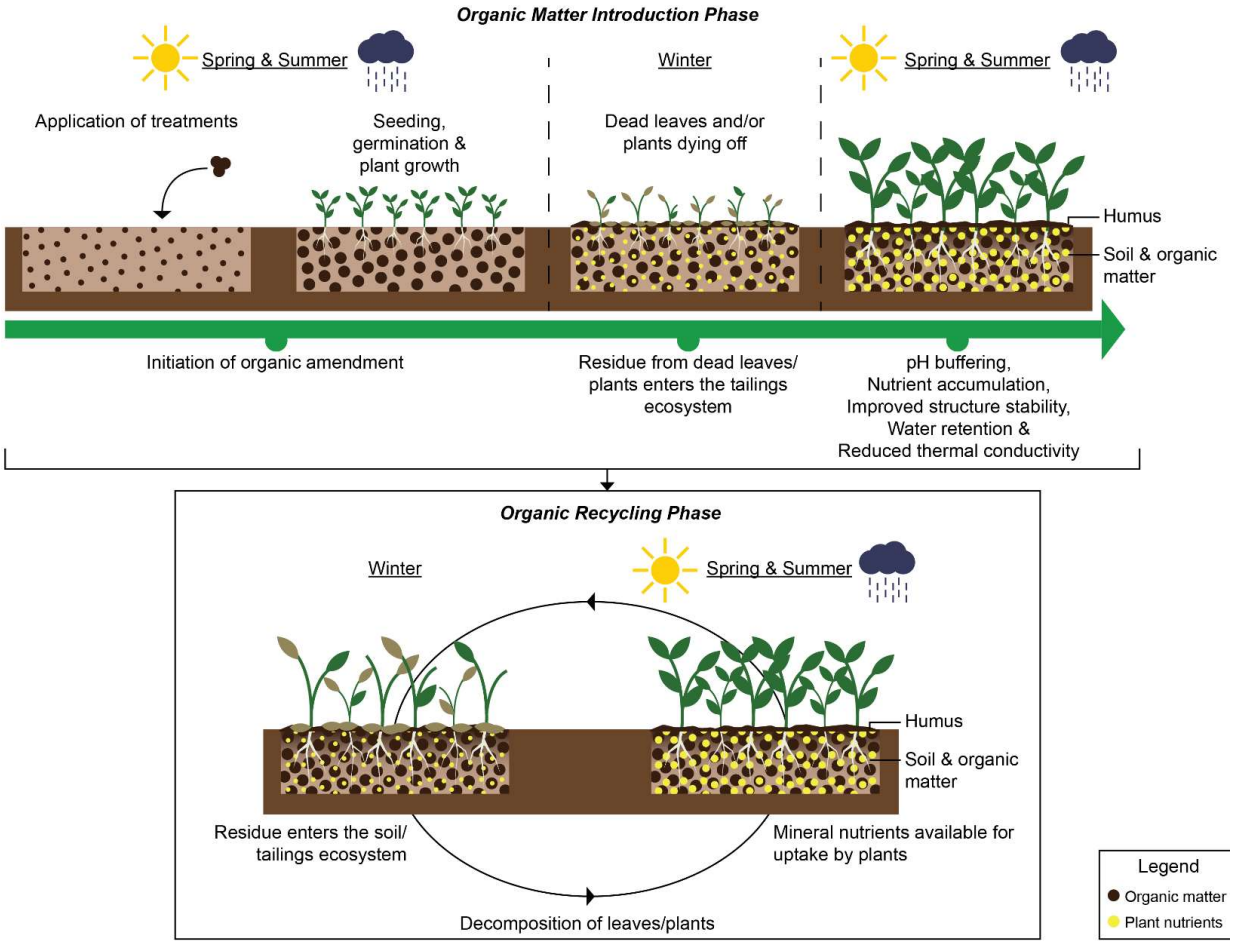
*Gil-Loaiza et al., 2016

Organic Amendment

First plant growth is poor, and the plants are not strong

The growth medium undergoes changes in structure and biochemistry

The plant growth improves as the growth medium becomes more like soil and needs less intervention



Experiment

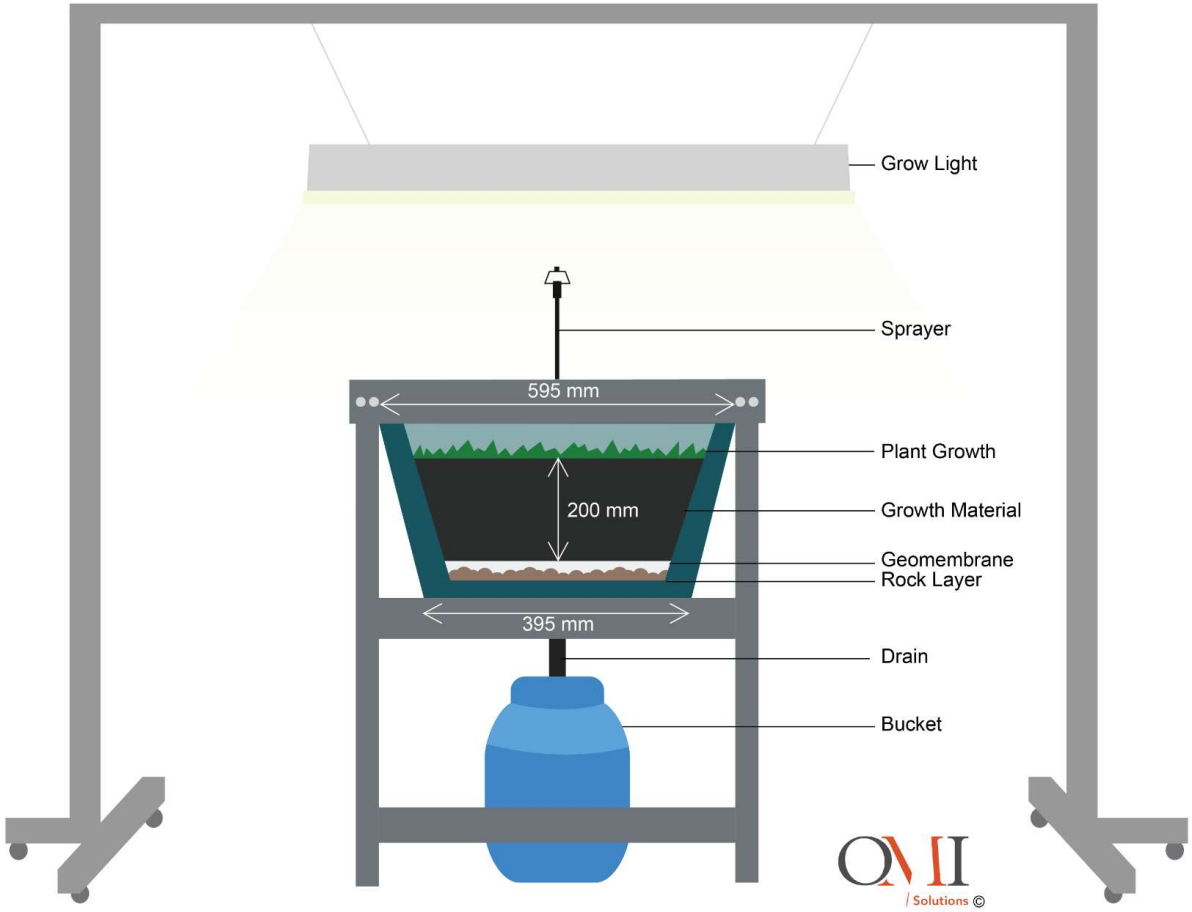
Platinum tailings samples were obtained and combined with various organic amendments in a pot experiment.

The treatments in triplicate were irrigated with either tap or process water

A positive (100% topsoil) and negative (100% tailings) control were also included

The treatments were :

- 25% compost
- 33% compost
- 33% mulch



Grass Details

Grass Name	Germination rate
Teff SA Brown	80 – 89%
Cynodon Unhulled	80 – 89%
Eragrostis	80 – 89%
Rhodesgrass	40 – 49%
Smutsfinger	20 – 29%
Borseltjie	20 – 29%

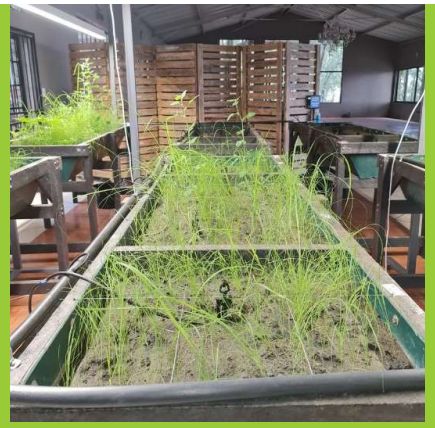
A sowing rate of **25kg/ha** for rehabilitation of impacted land or approximately 6g of seeds per pot

Laboratory Trial Results

All treatments responded better under process water irrigation

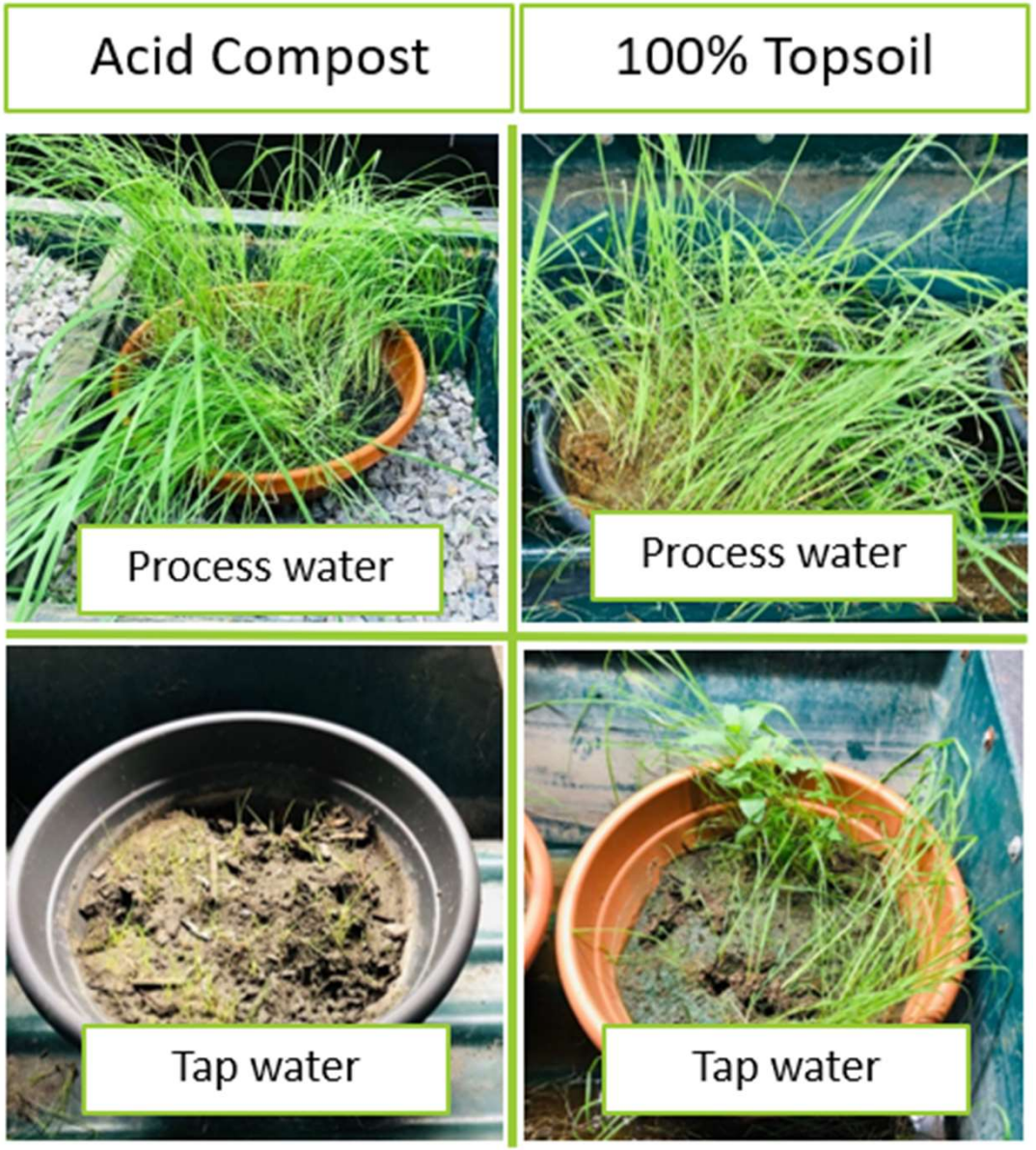
Temperatures and pH of the growth media did not show significant differences

The electric conductivity showed significant differences for all treatments irrigated with process water as well as 100% tailings under tap water irrigation



Laboratory Trial Results

Process water irrigated pots showed better plant growth than tap water irrigated pots.



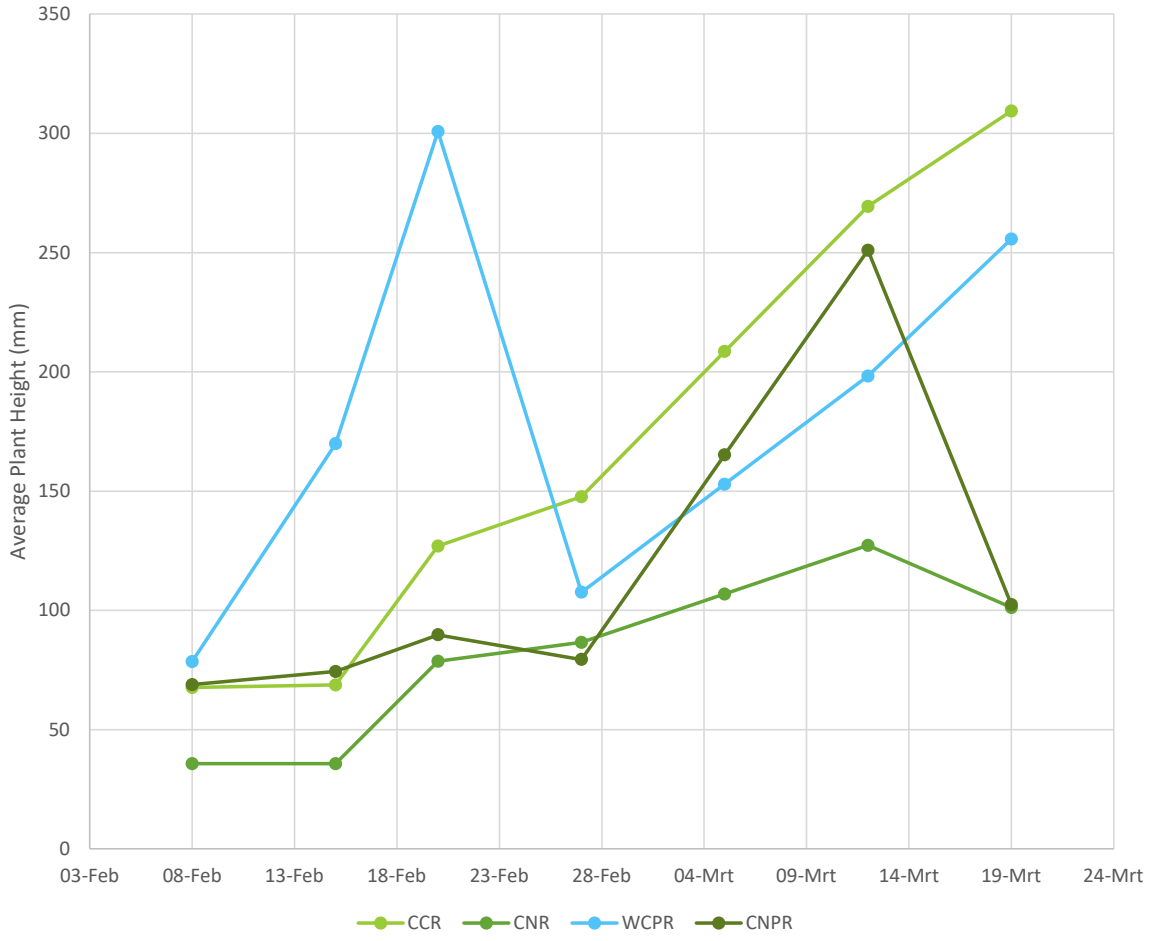
Results and Discussion:
Comparison of controls

CCR: 100% topsoil irrigated with tap water

CNR: 100% tailings irrigated with tap water

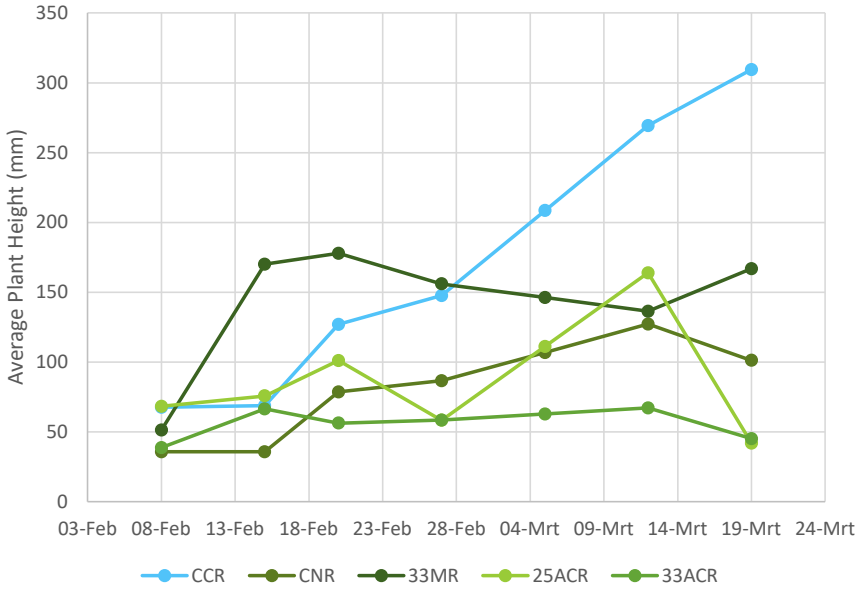
WCPR: 100% topsoil irrigated with process water

CNPR: 100% tailings irrigated with process water

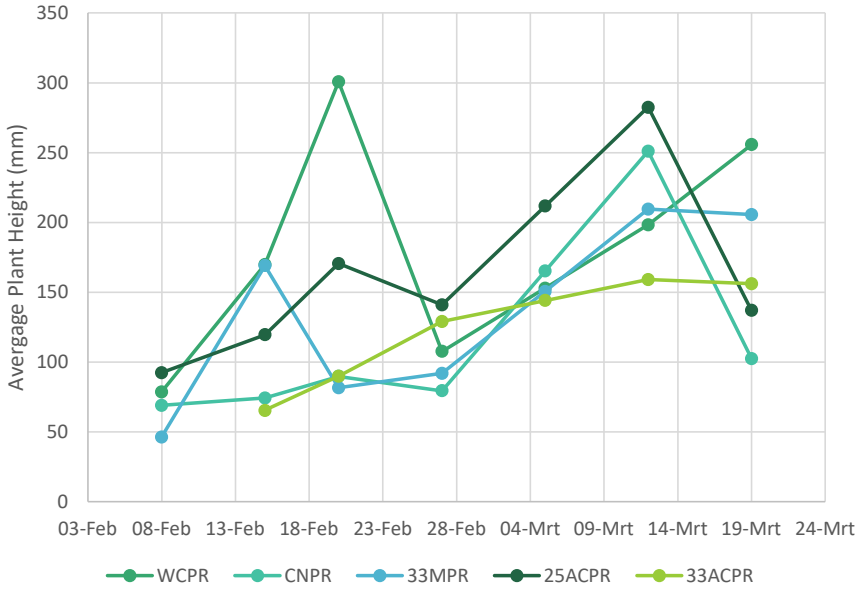


Results and Discussion: 25% and 33% compost and 33% mulch under tap and process water irrigation

TAP WATER



PROCESS WATER



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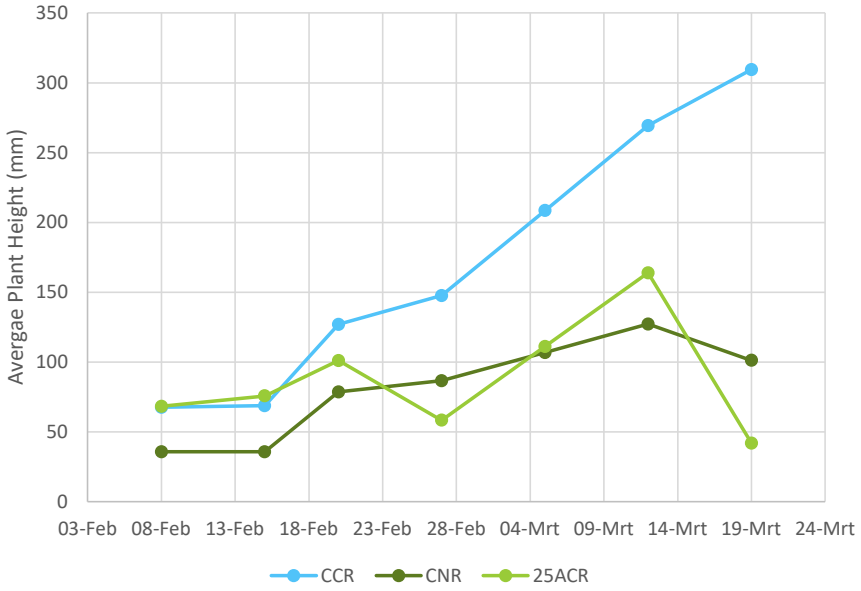

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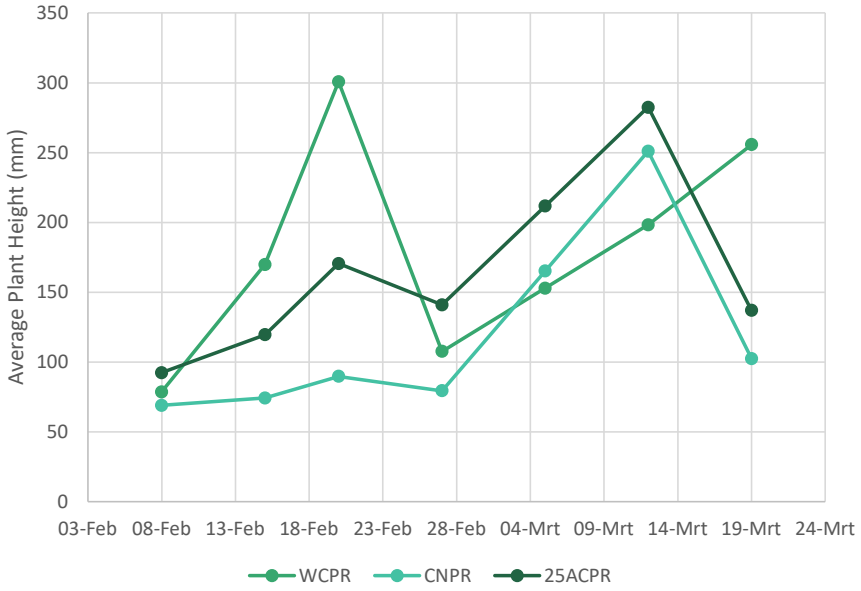

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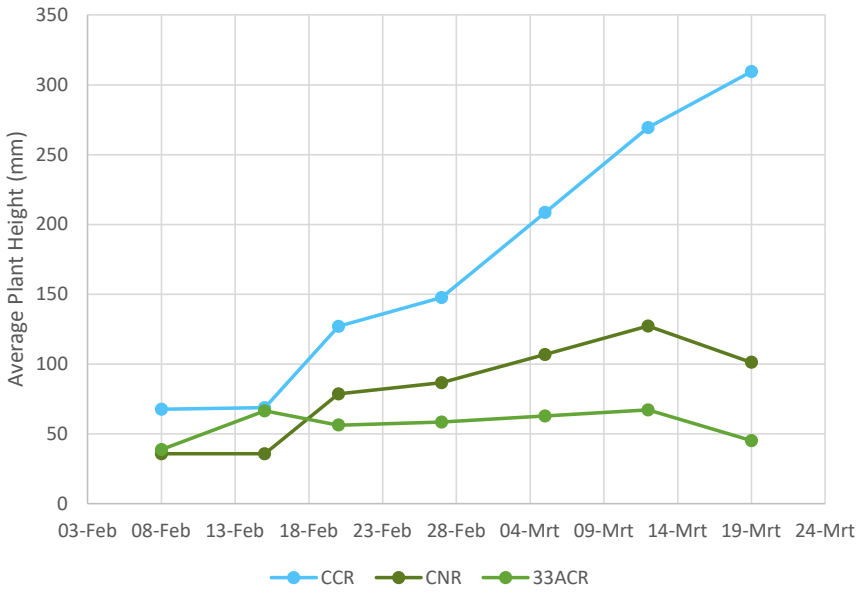

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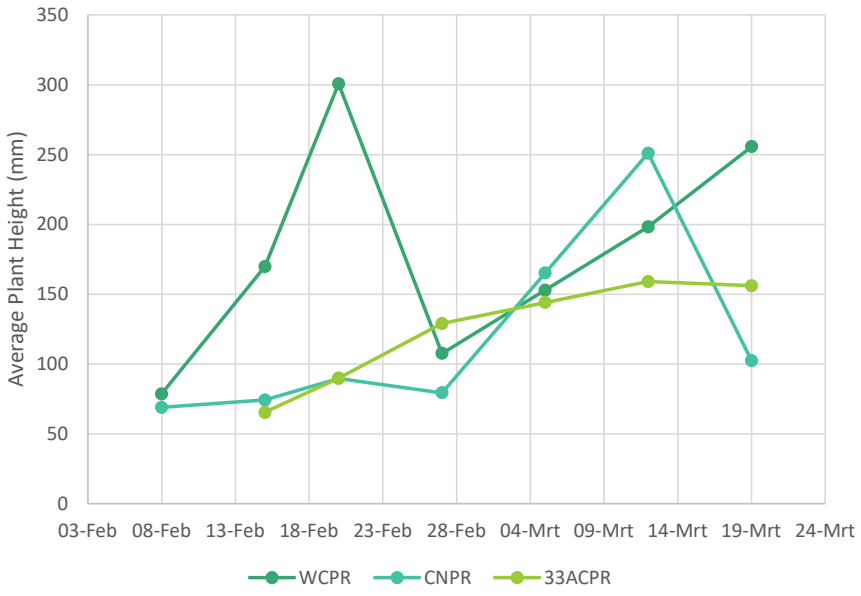

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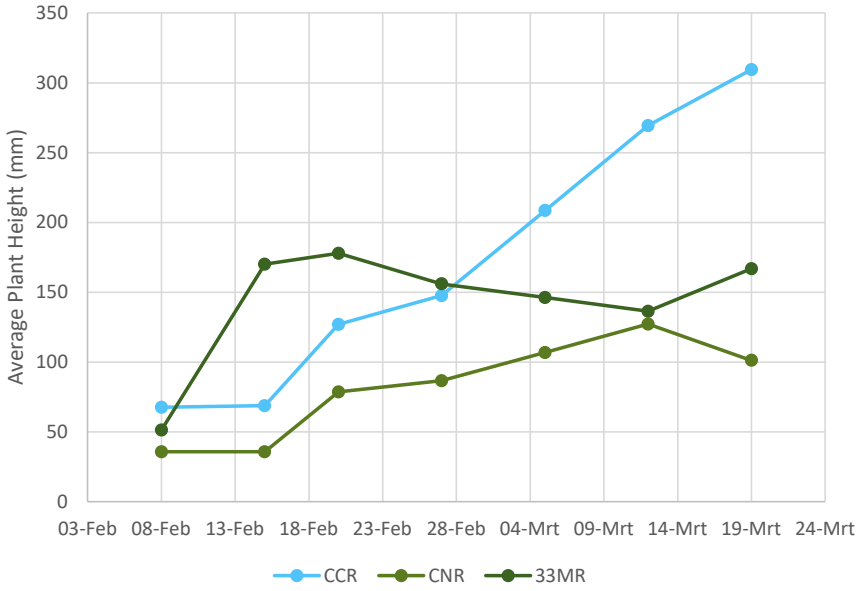

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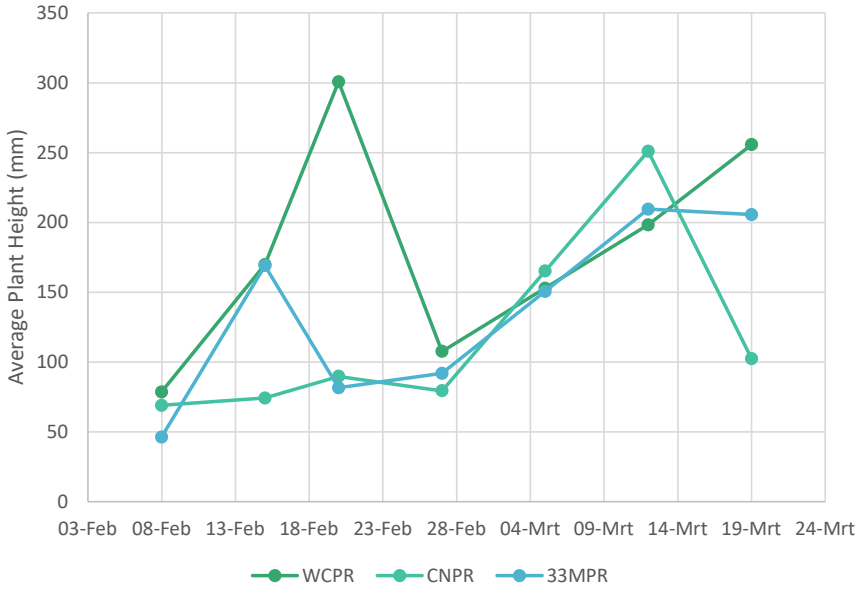

Material Costs Comparison Between Organic Amendment and General Capping Method

Treatment	Step 1	Step 2	Step 3	Step 4	Step 5	Outcome	Actions in year 2	Outcome
Topsoil	Truck in topsoil	Bulldozing topsoil	Seeding (Hydro-seeding)	Second seeding (Hydro-seeding)	Erosion control; monitoring	Erosion evident; alien invasive plants	Amend erosion. Plant more seeds. Remove alien invasive plants	Successful plant growth but continued alien plant eradication measures needed
Compost	Truck in compost	Mix compost with tailings	Seeding	Irrigate seedlings	Erosion control	Little erosion; healthy plant growth	Monitoring	Successful plant growth; sustained monitoring
Mulch	Truck in mulch	Mix mulch with tailings	Seeding	Irrigate seedlings	Erosion control not needed	Healthy plant growth	Successful rehab	Return of animal life

Discussion

Using process water will reduce the amount of clean water used by the mine

More focus should be on species diversity

Indigenous plants should be used during rehablitation

Further addition of the amendments during the course of plant growth may further reduce alkaline pH levels and enhance nutrient absorption by plant roots creating a more favourable environment for vegetation establishment

Just transformation and infrastructure

Transformation Goals:

- Enhance safety standards and mitigate environmental risks.
- Improve operational efficiency and long-term sustainability.

Environmental Considerations:

- Incorporate habitat restoration measures to mitigate ecological impact.
- Implement water management strategies to minimize contamination risks.
- Community Engagement:
- Engage local communities in decision-making processes and risk communication.
- Foster partnerships with stakeholders to ensure transparency and trust.

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