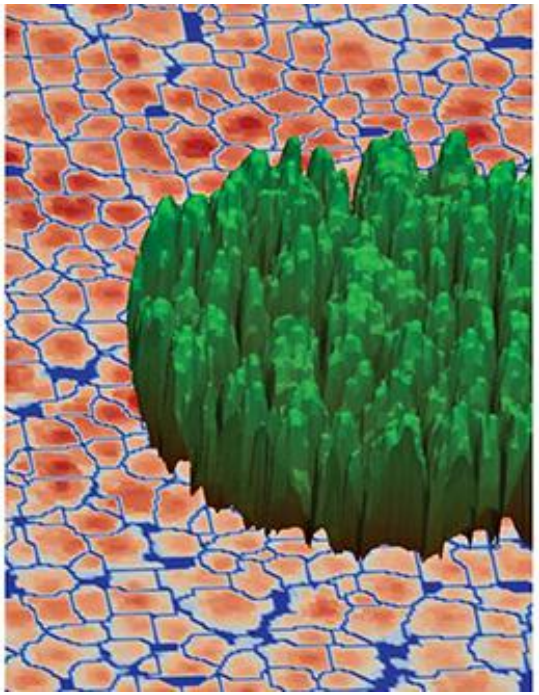
Growing confidence in forestry's future Research Programme

SCION
FORESTS ▪ PRODUCTS ▪ INNOVATION

Stimulating forest productivity and resilience

Simeon Smaill and many others



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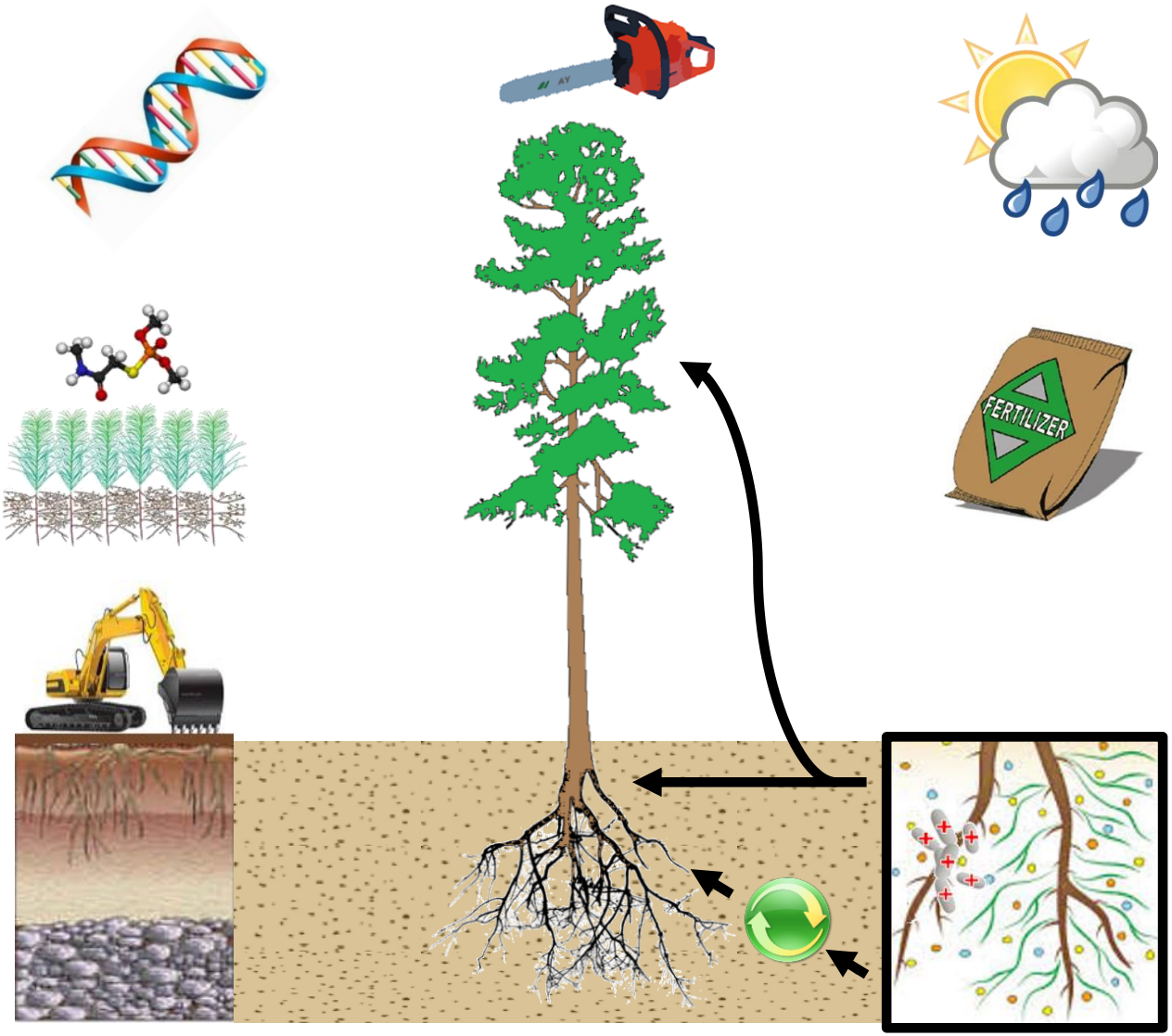
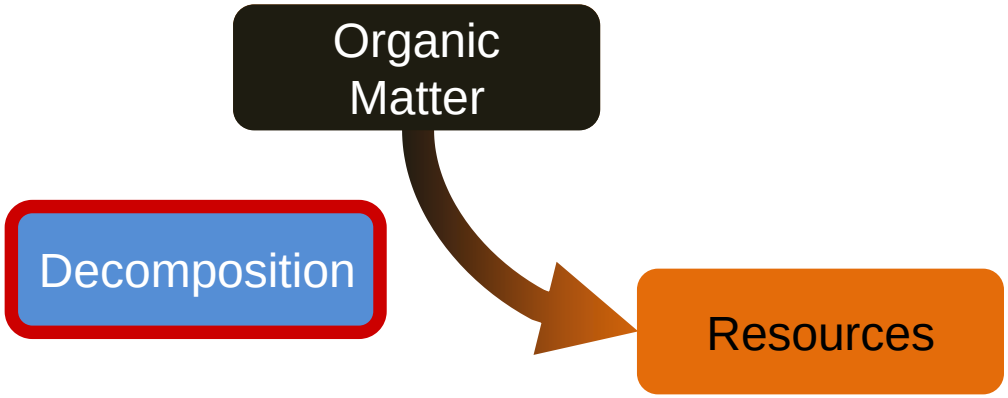
The contribution of soil microbes



Driving concept – more for less

- Exploring possible options to enhance nutrient cycling

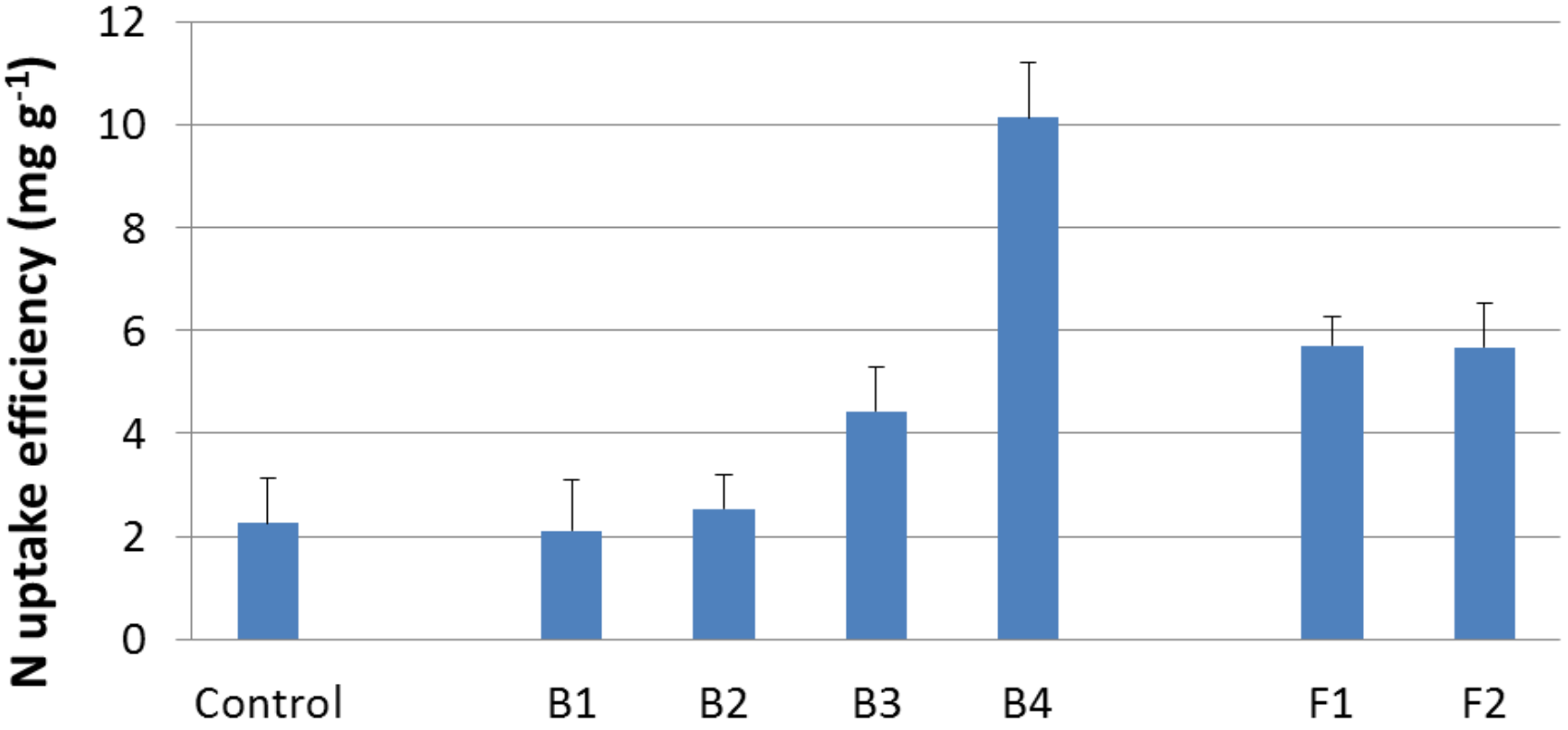


- Potential for stimulation of soil microbial activity, but issues with negative side effects for plants

- Carried out a glasshouse trial with recently germinated seedlings to examine growth and health impacts at various dose rates

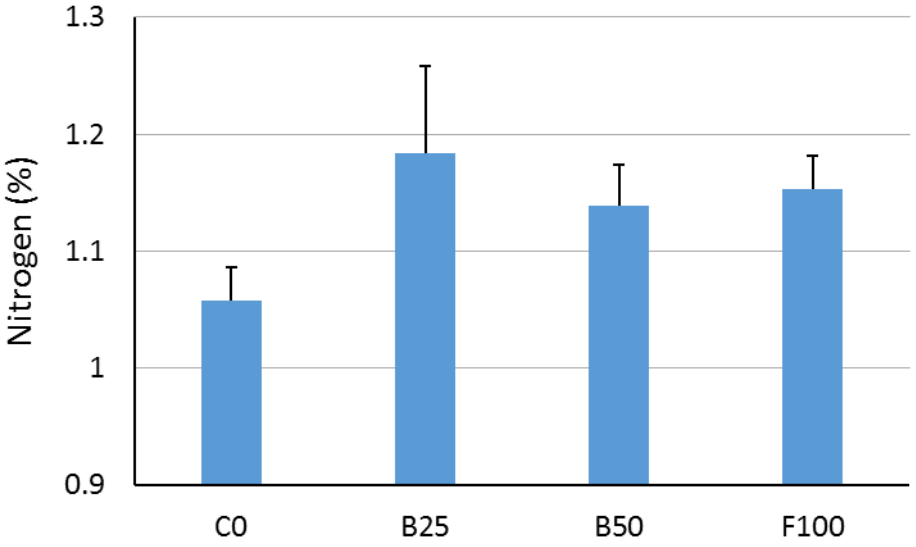
Initial outcomes of work with stimulant

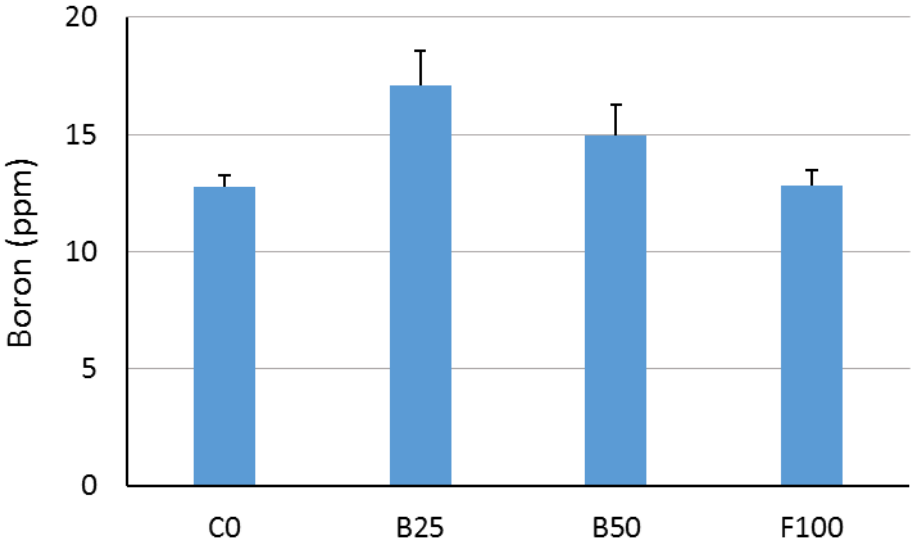
Positive results - good growth and no toxic effects even with repeated doses



Taken to operational scales at Tokoroa

- Improved growth rate identified in previous talk, what about nutrition?
- Maintained seedling N concentrations, despite lesser dose
- Increased boron concentration with ¼ dose N

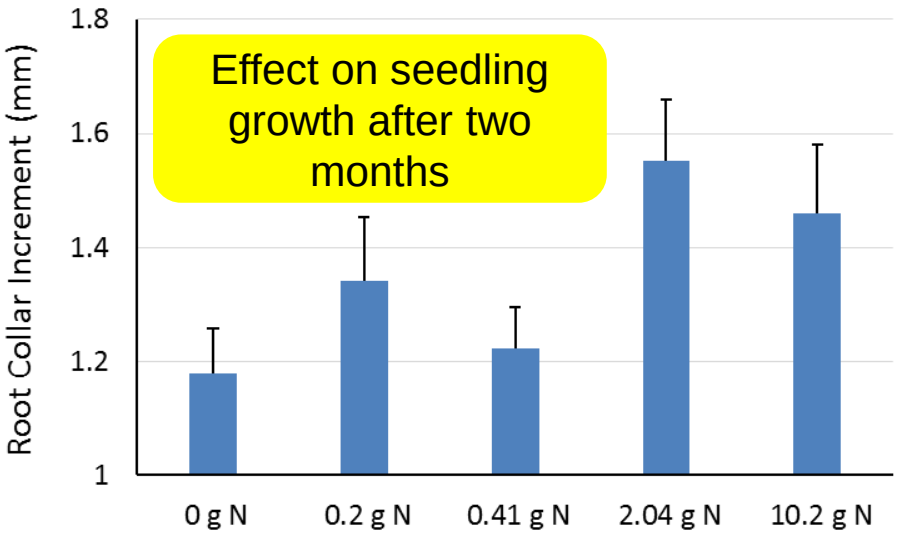




Still needed to test negative effects at high rates

- Existing trials involved relatively low application rates – not relevant to rates used in the field
  - What is the level where toxicity occurs?
  - How does this relate to application levels being considered to bridge productivity gaps?
- Established a trial in the Scion nursery using one year old seedlings, using exposure rates that varied from 0 – 10.2 g nitrogen per seedling

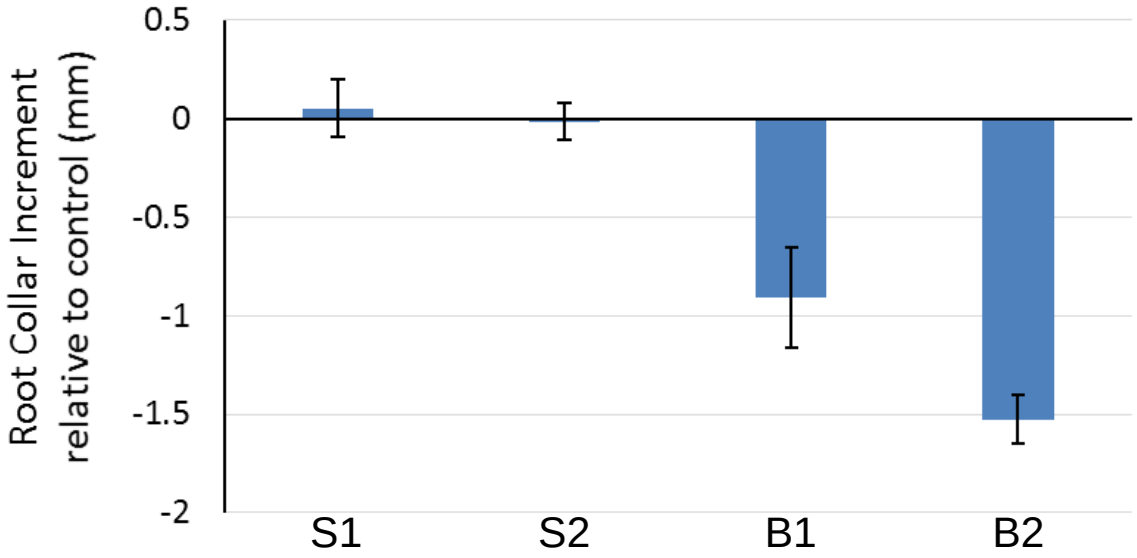
Seedling toxicity test results



- Needle burn, associated with high N exposure – still no true phytotoxicity for radiata pine
- No reductions in growth rates

Final stimulant toxicity nursery trial

- Added equivalent of 20 tons of N per ha to seedlings – no mortality at all, kept growing
- Urea application at similar rates was detrimental
- Final conclusion – only toxicity to radiata is from N overload



	S1	S2	B1	B2
Mortality after a month	0%	0%	33%	67%

Further implementation

- Further testing in the operational trial established at Tokoroa ArborGen in 2016
- Applied to the first accelerator trial, specifically to stimulate access to locked soil nitrogen
- Being applied at five site modification trials to improve understanding of site interactions
- Focus of new FGLT funded extension work to try and put the phytotoxic effect of stimulants to good use – is it also an effective weed control option?

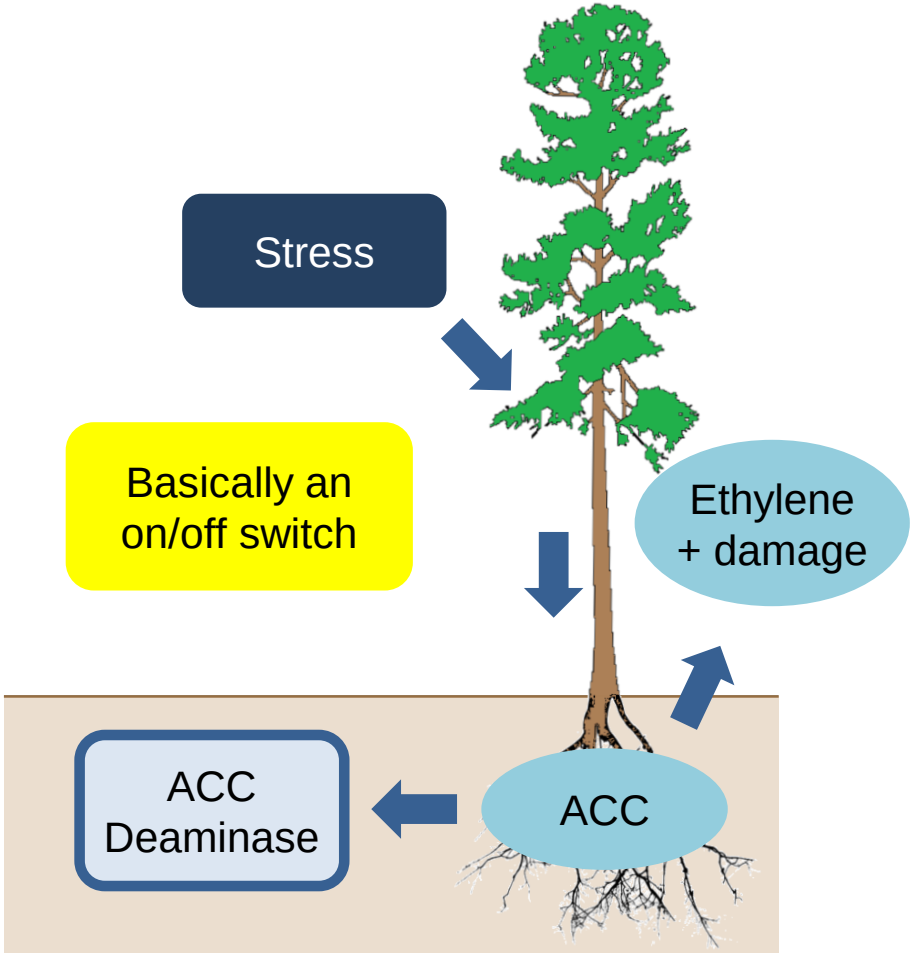
Soil microbes and stress tolerance

Soil bacteria can make plants tougher

The response of plants to stress is to make lots of ethylene from ACC

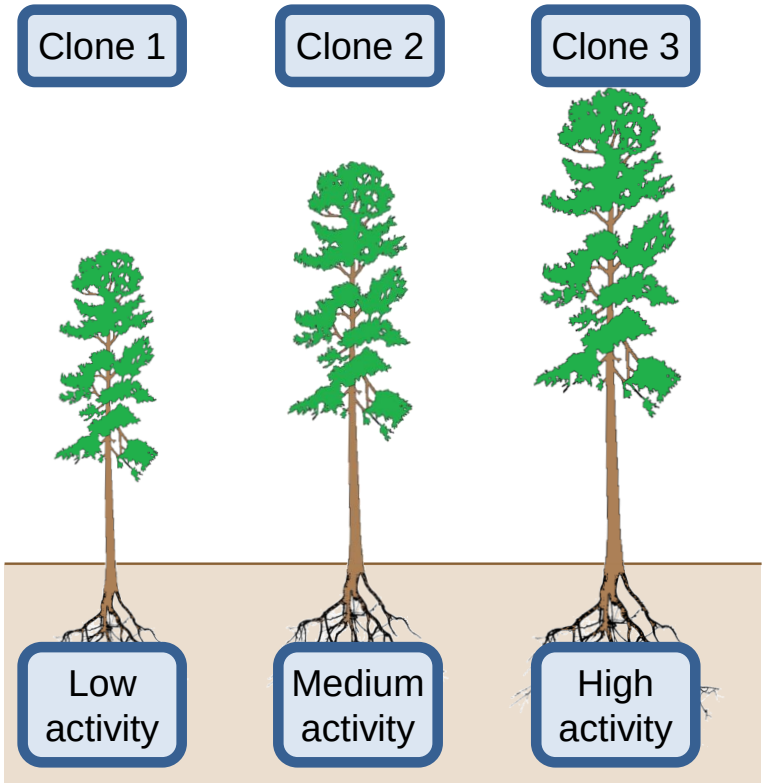
Soil bacteria slow the ethylene stress response by using an enzyme to break down ACC in soil

Gives the plant a chance to stop panicking

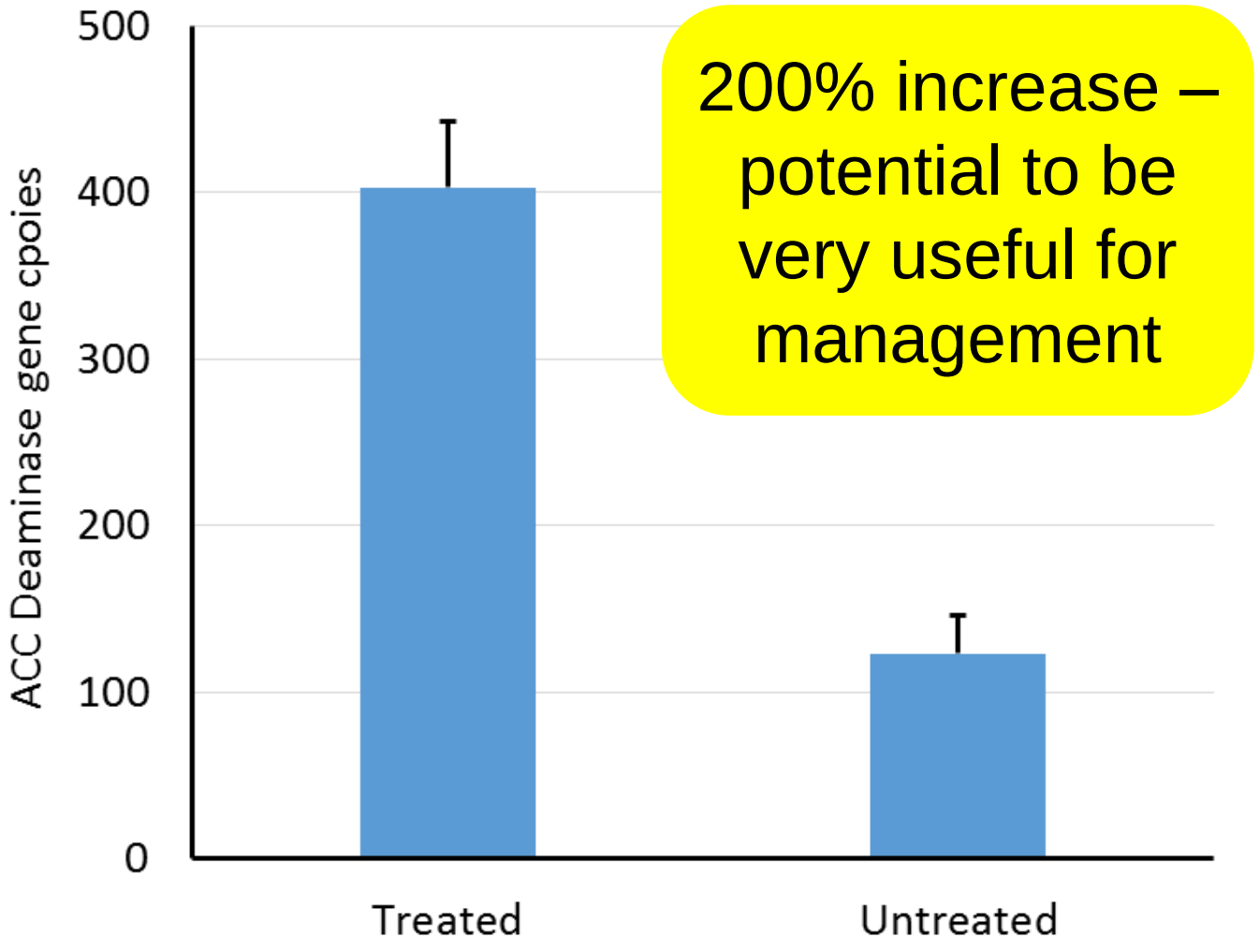


Can we make this happen more often?

- ACC deaminase activity varies significantly with radiata genotypes – something is attracting better bacteria
- Using genetic and enzyme analysis, we have observed that site practices can alter activity as well
- Based on this, started a trial to purposefully increase activity



Going from measurement to management



200% increase – potential to be very useful for management

Further forest soil microbial research

- Further work with the ACC deaminase induction trial – recently collected more data, next step is to see how much tougher the trees are
- Mycorrhiza – mostly focussed on the nursery, but also looking at forest ECM species
- Other genes of interest – we are working with the gene for N fixation, and have identified various site management practices that affect this
- Microbial production of phytohormones – biggest challenge, potentially the biggest return

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Simeon Smaill
Assistant Research Leader
simeon.smaill@scionresearch.com

http://research.nzfoa.org.nz
www.scionresearch.com
www.gcff.nz

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