

The prospects for propagating elite material of Sitka spruce by tissue culture methods

Tree Improvement Programme

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Introduction

- **Background**
- **Tissue culture of Sitka spruce at Forest Research**
 - The current project
 - Using somatic embryogenesis to propagate plants
 - What is *Multi-Varietal Forestry* and why
 - Some details for where we are with Sitka
 - Pros and cons
- **Future work**
- **Prospects for other species**
- **Further information**

Project for Sitka spruce :

To develop tissue culture approaches for supporting the breeding and clonal forestry of Sitka spruce



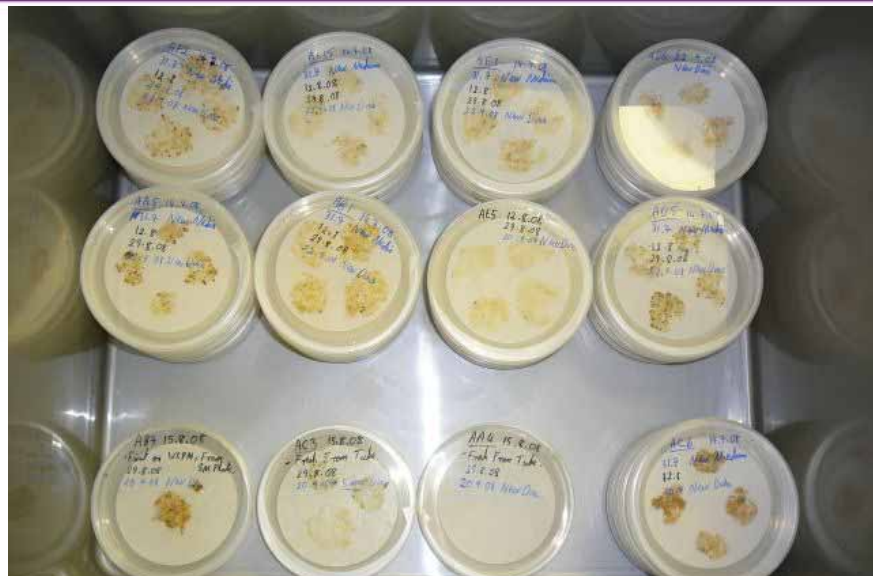
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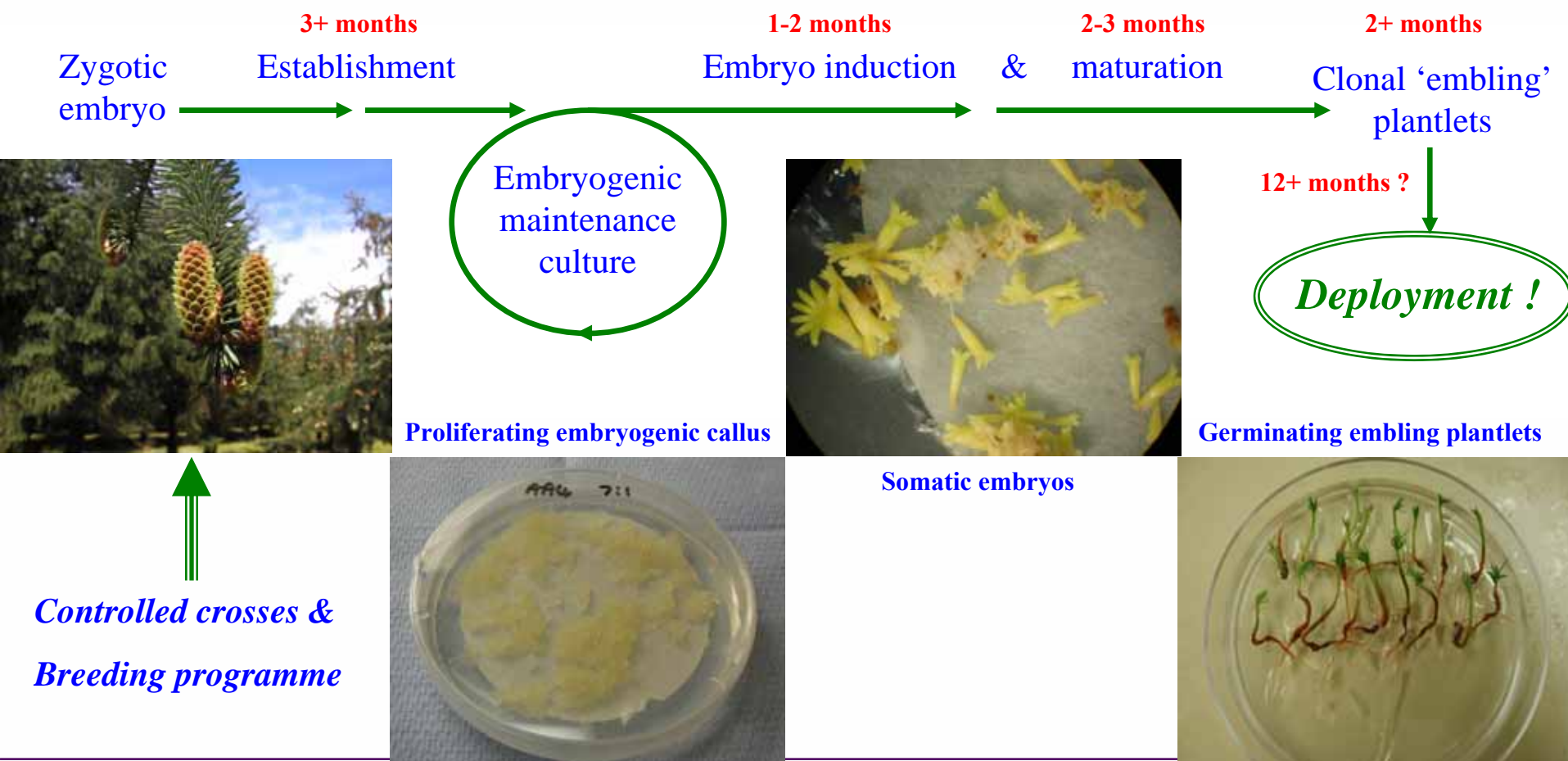
Made up of two components :

Mass propagation.

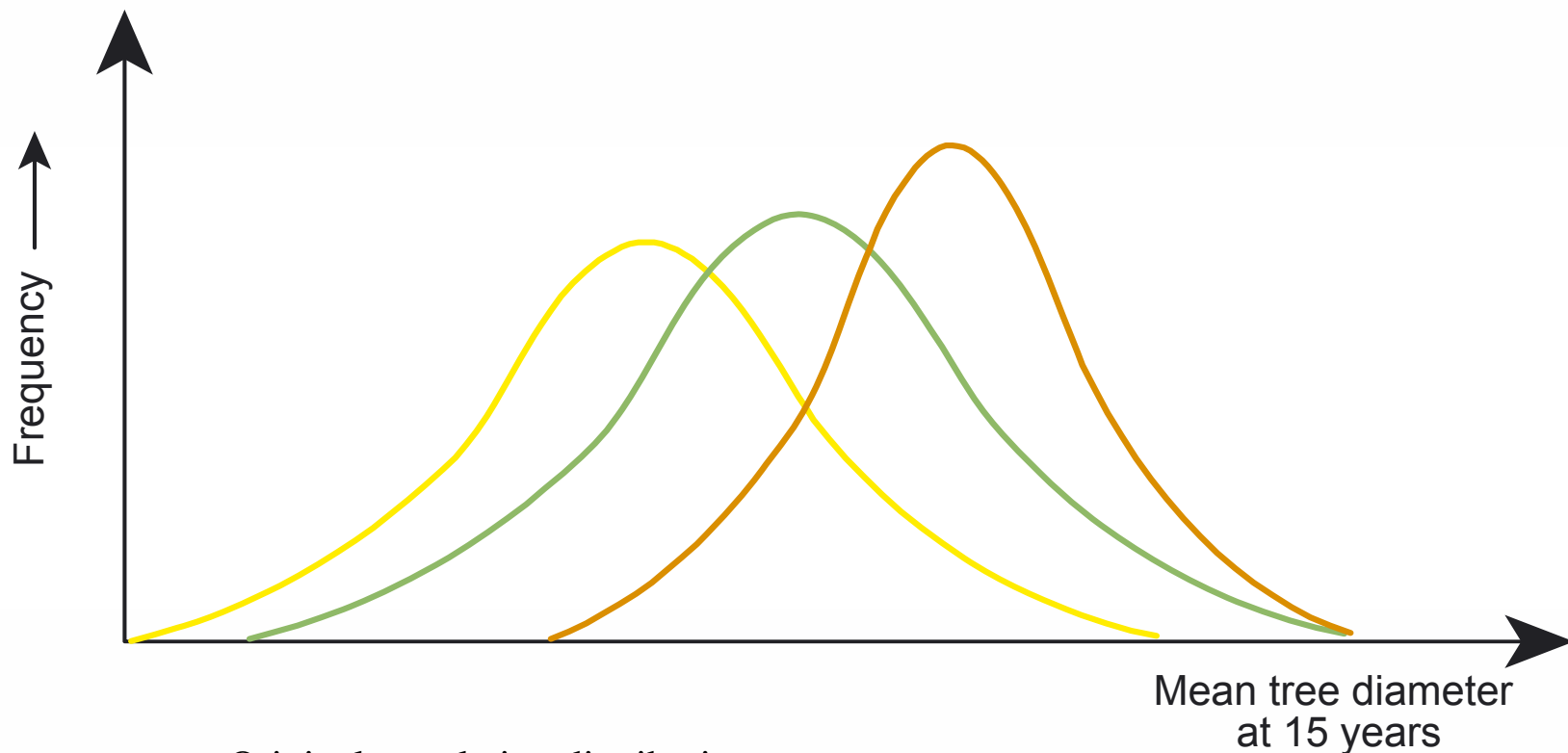
Cryo-preservation.






Mass propagation of Sitka spruce by the use of somatic embryos

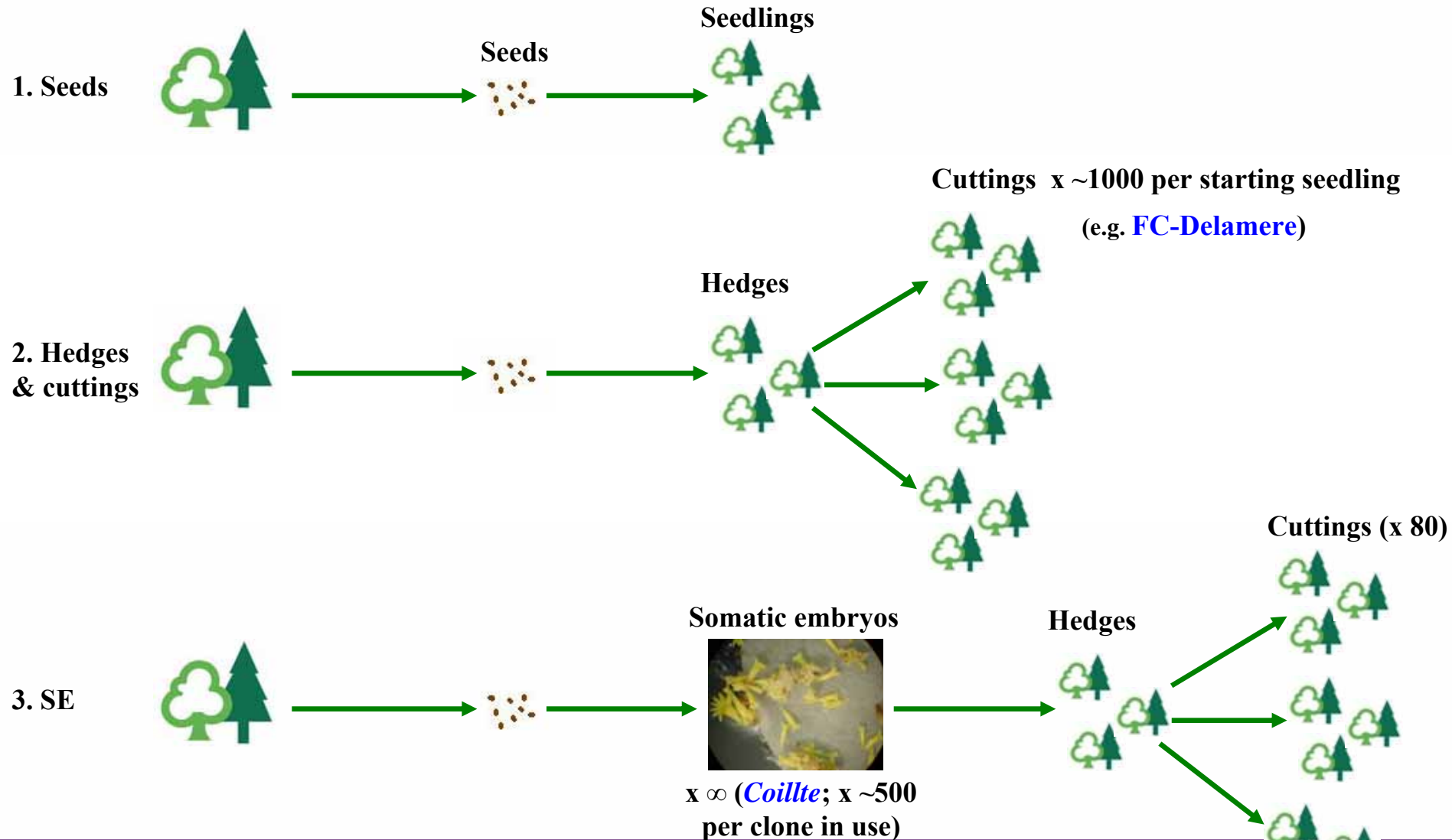


General breeding gains in forestry :

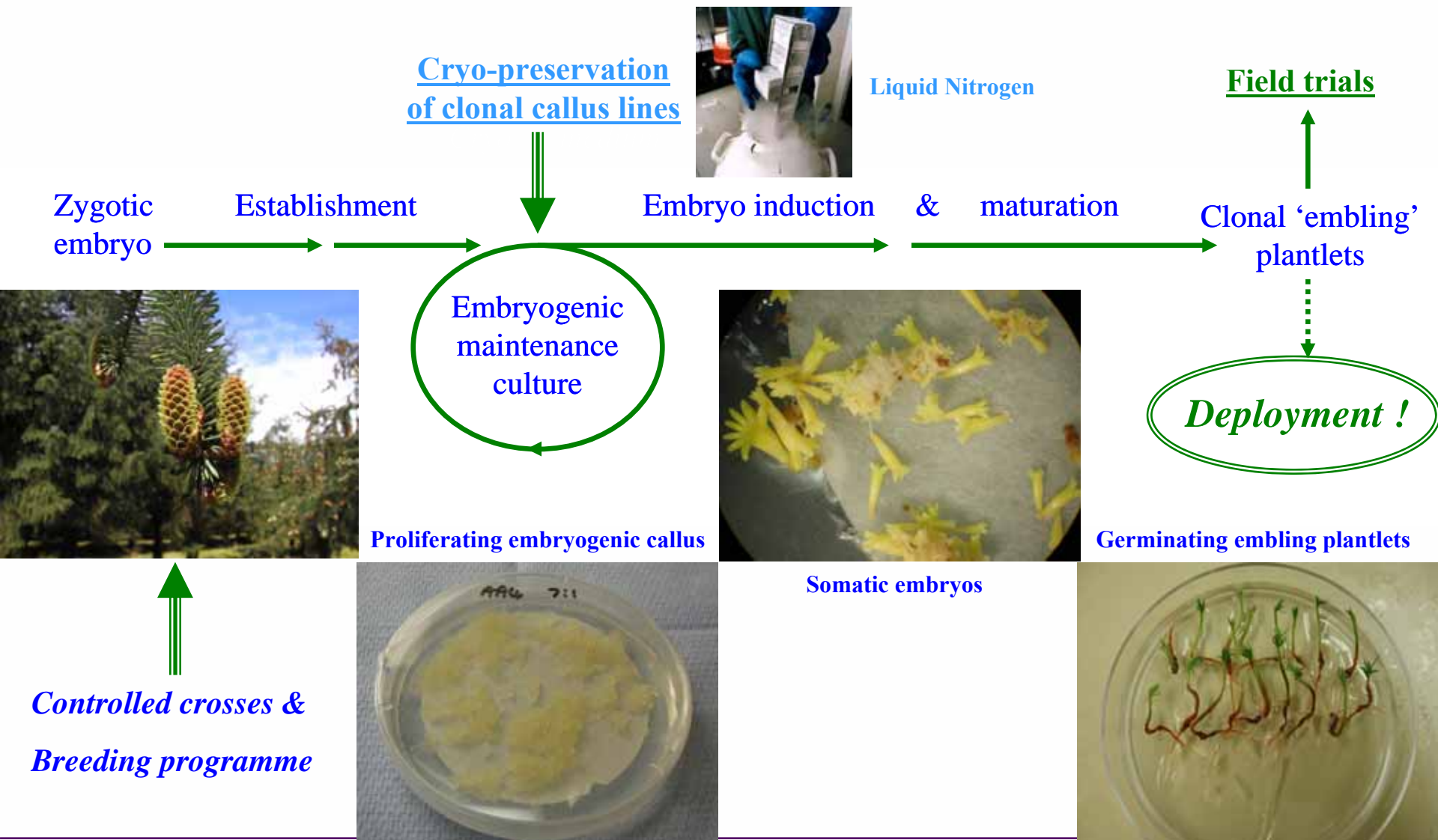


-  Original population distribution.
-  Breeding population selected after provenance trials.
-  Distribution obtainable from controlled crosses in a seed orchard (= family forestry).

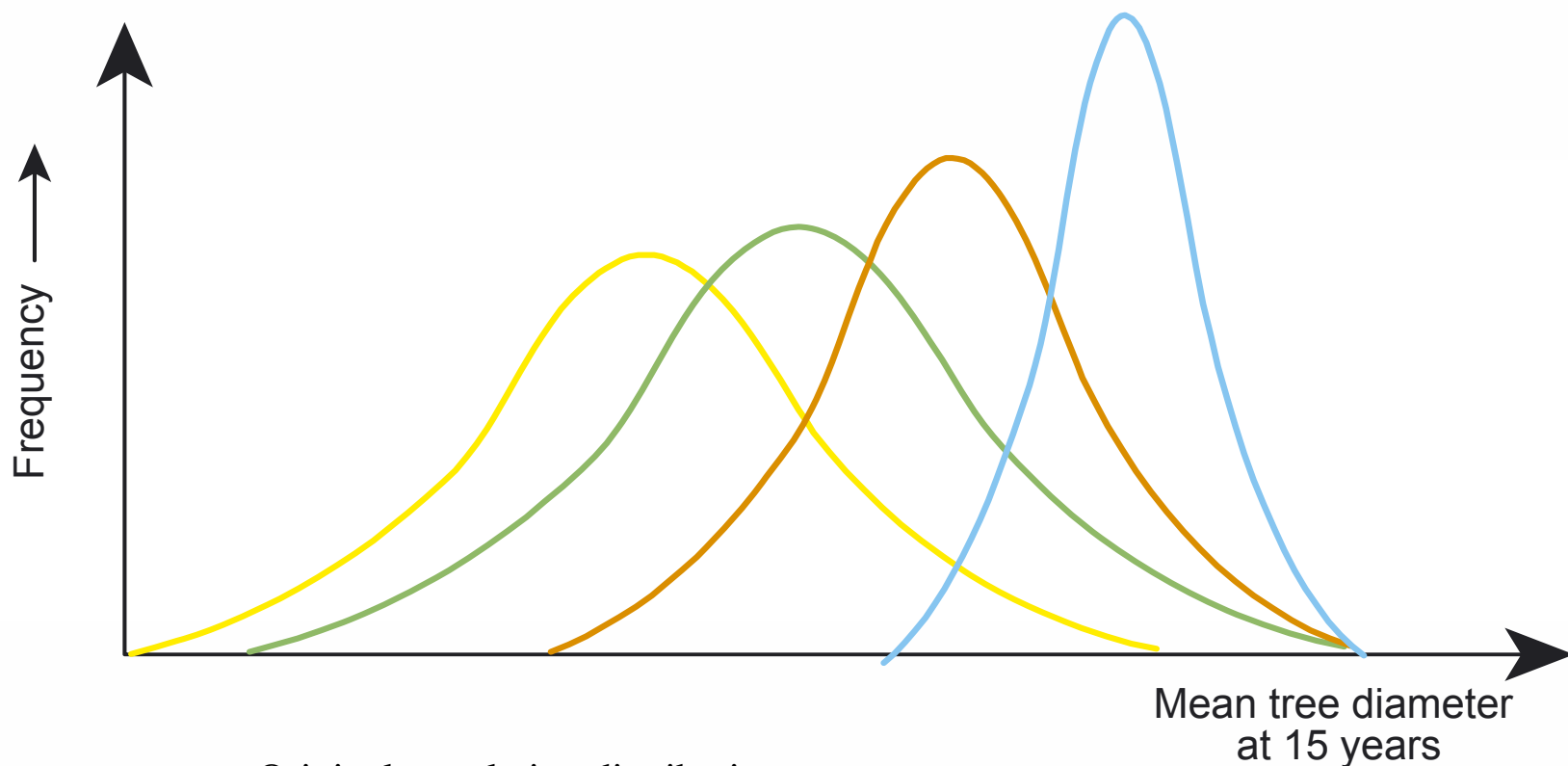
There are various approaches to propagating conifers :



Mass propagation of Sitka spruce by *multi-varietal forestry* and SE.

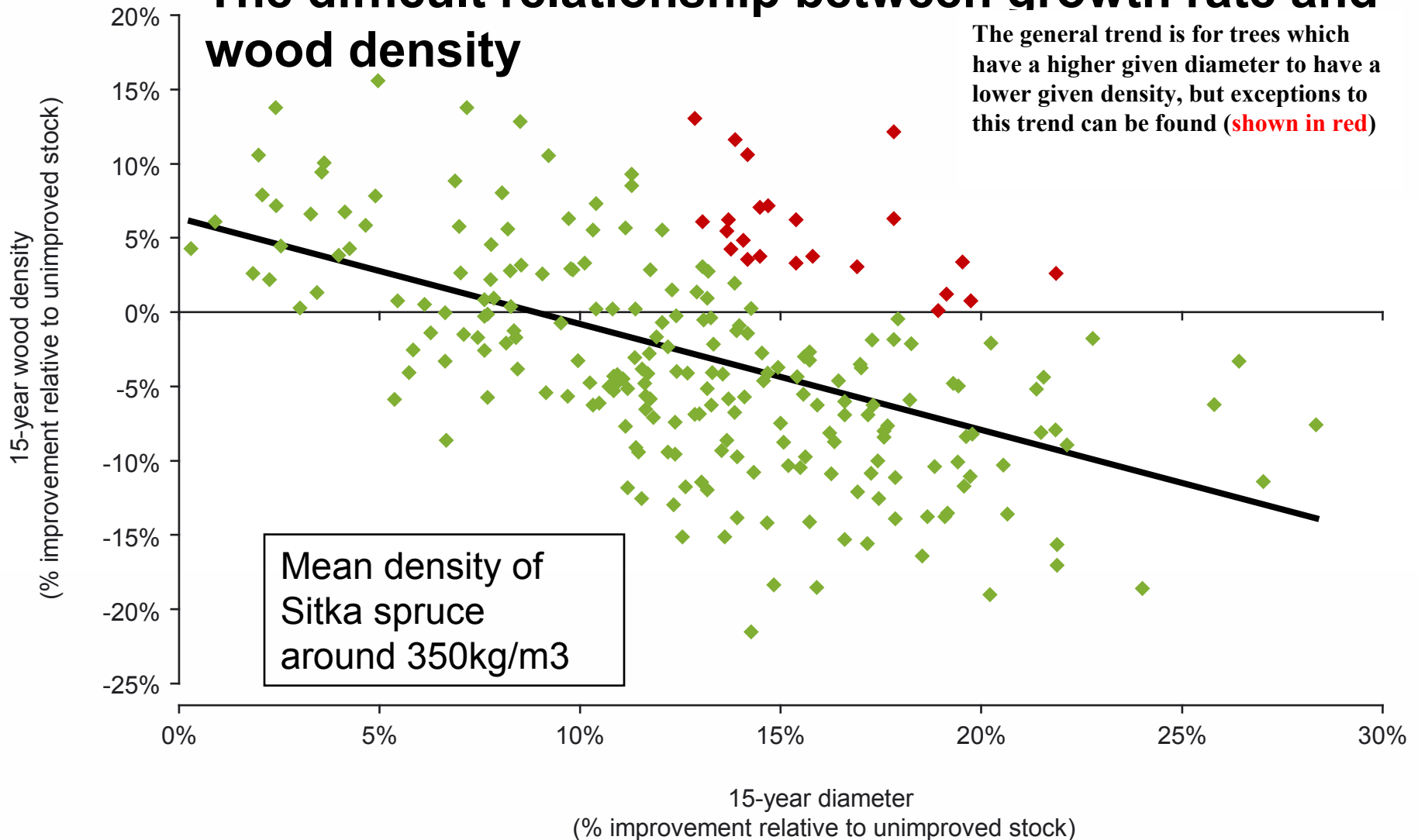


General breeding gains in forestry #2, with *multi-varietal forestry* :

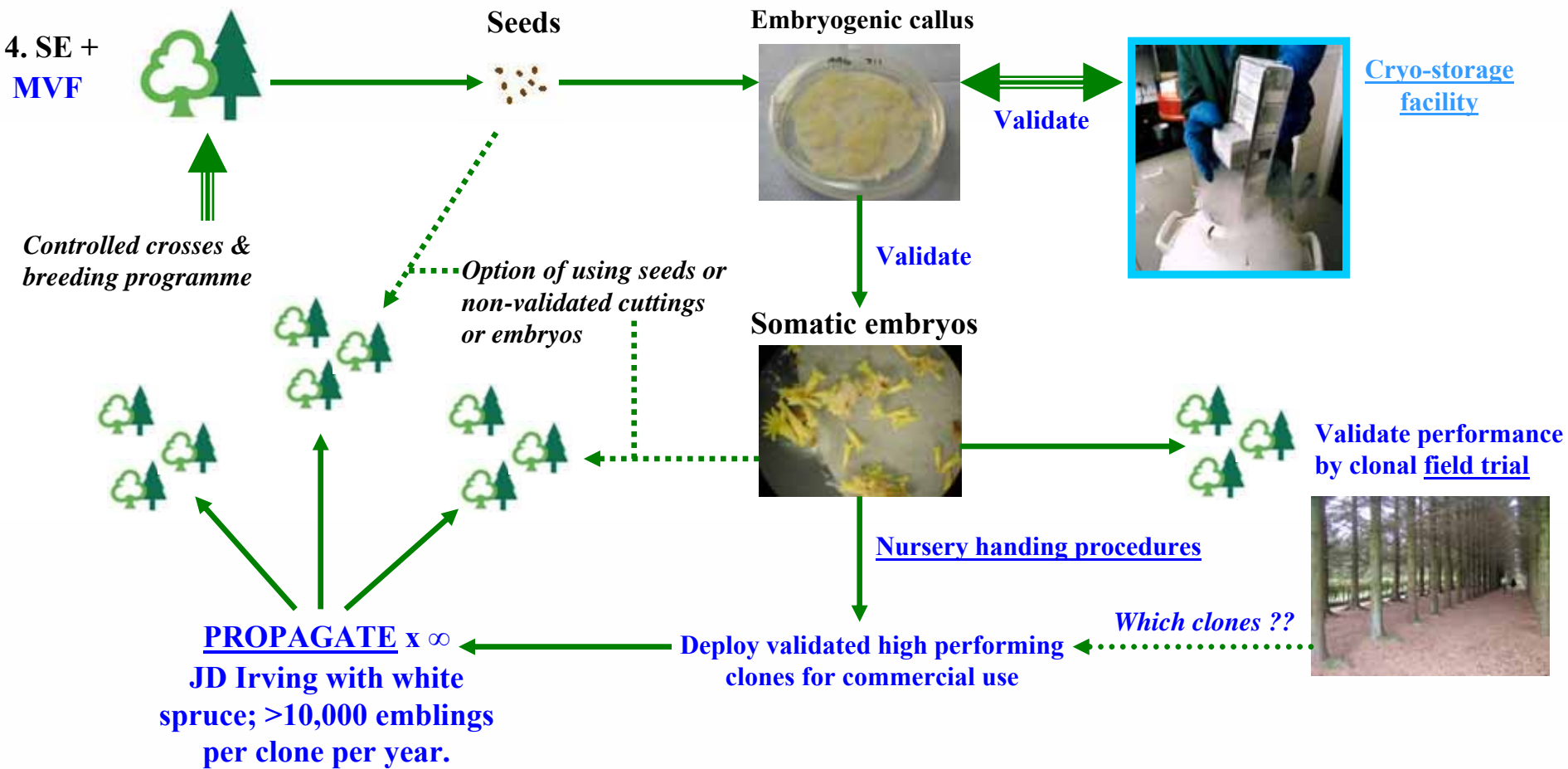


- Original population distribution.
- Breeding population selected after provenance trials.
- Distribution obtainable from controlled crosses in a seed orchard (= family forestry).
- Extra gains possible from using selected clones as part of the **MVF strategy**.

The difficult relationship between growth rate and wood density



The **multi-varietal forestry** approach to propagating and deploying SE derived clonal conifers :



Propagating Sitka spruce by tissue culture



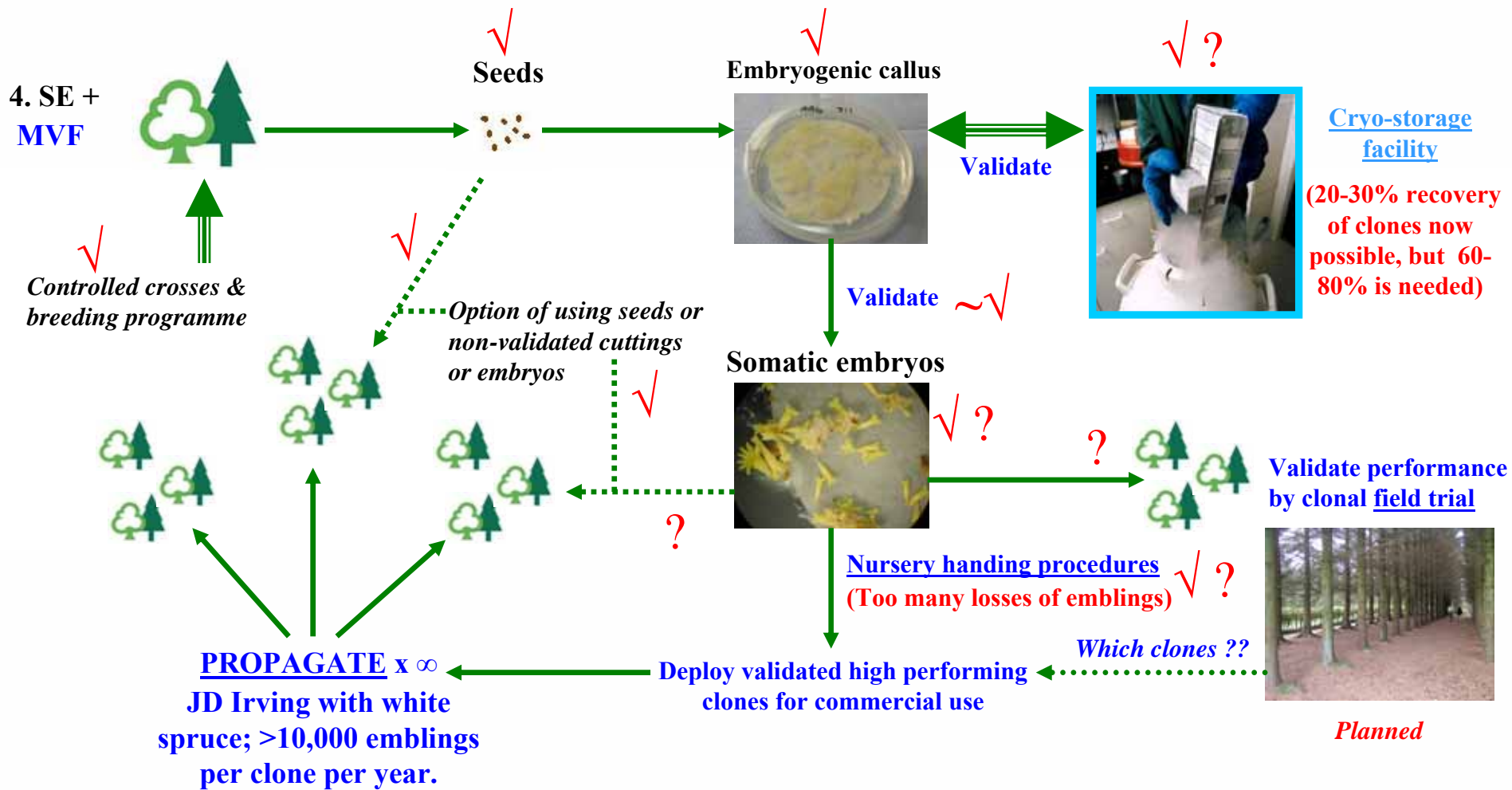
Field trials are needed to validate the performance of the clones, if this approach is ever to be more than simply a means of mass plant propagation.

The term **Multi-Varietal Forestry** (or **MVF**) has been coined for forestry that uses specific clones that have been identified as having superior performance or other useful traits.



PREDICTABLE OUTCOMES NEEDED ! ←

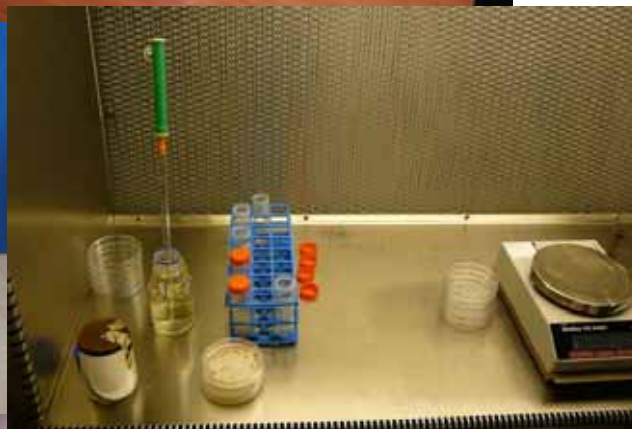
So where are we with developing **multi-varietal forestry** for Sitka ?



Cryo-preservation

- Rapidly growing healthy embryogenic tissue
- Overnight cultivation with anti-freeze agents
- Addition of further anti-freeze agents
- Transfer to cryo-vials
- Controlled cooling to $-80\text{ }^{\circ}\text{C}$
- Transfer to liquid nitrogen
- *Rescue and recovery when needed.*

This allows clones to be stored until the highest performers have been identified, which can then be deployed with full confidence about their growth traits.



Advantages and disadvantages of using tissue culture methods in multi-varietal forestry

Advantages

- The best clones can be ‘captured’ within the breeding programme.
- Enables clones to be selected which are high performers for **multiple desirable traits**.
- The best clones can be **multiplied up almost infinitely**.
- **More genetic gain** possible than from controlled crosses in a seed orchard.
- **Flexibility** to deploy suitable varieties from the cryo-storage to cope with new challenges.
- **Increased predictability**, uniformity and repeatability.

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Disadvantages

- Higher cost base than for veg prop. = [more expensive plants](#).
- [Long term field trials](#) are needed to assess the performance of *all* the clones.
- Requires [an ever expanding storage system](#) for the clones (cryo-preservation).

Future Work :

- Improve efficiency and reliability of cryo-storing embryogenic cultures & their recovery.
- Full optimisation of the protocols for embryo production in Sitka.
- Optimising the transfer of the emblings to nursery conditions and then planting in the field.
- Need to plan long-term field trials.
- Extend the use of tissue culture approaches to other species of interest ?



Greg Adams, *JD Irvings* Sussex nursery, NB, Canada



Further sources of information

“Vegetative propagation and deployment of varieties (a.k.a. clonal forestry) - the scope for Europe.”

Workshop on the state of play of clonal forestry currently being practised around the world and investigating the possibilities for Europe. Liverpool, 21st to 23rd April 2009

web link : <http://www.forestresearch.gov.uk/fr/INFD-7KHFW>

And

“Advances in biotechnology: powerful tools for tree breeding and genetic conservation”

Forestry Commission Information Note FCIN59

Web link : [http://www.forestry.gov.uk/PDF/fcin059.pdf/\\$FILE/fcin059.pdf](http://www.forestry.gov.uk/PDF/fcin059.pdf/$FILE/fcin059.pdf)

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Forest Research

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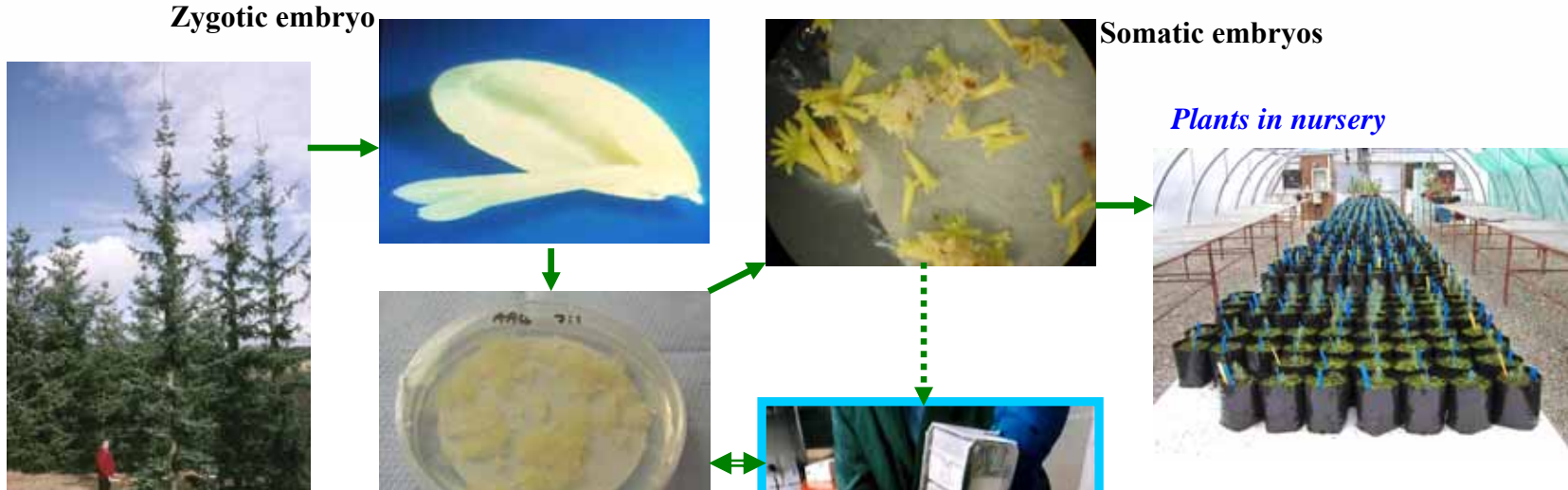
Forest Genetics, New Zealand.

- Mike and Sue Carson



There are two general approaches for the tissue culture of trees :

1. Somatic embryos
(favoured for conifers)



2. Shoot cultures
(favoured for broadleaves)

