

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

## Tree Improvement Programme

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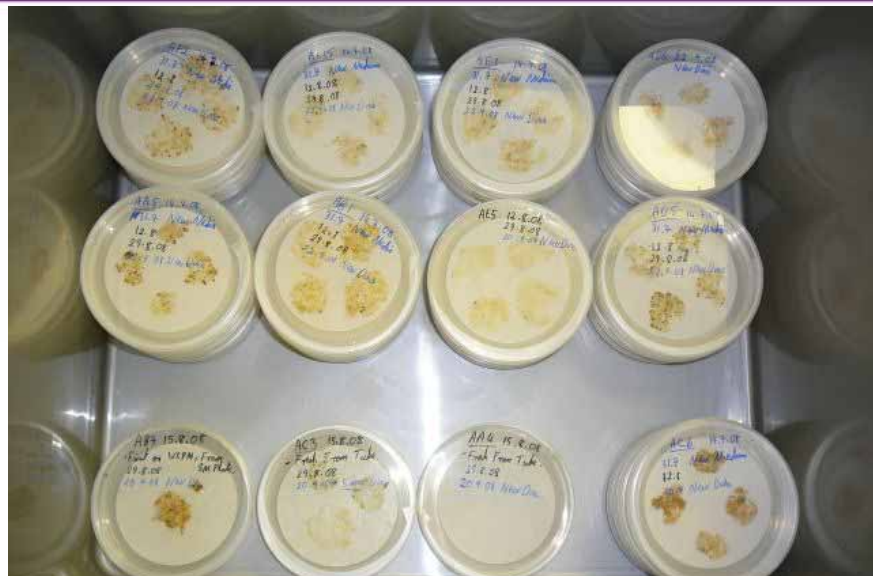
17<sup>th</sup> March 2010

## 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



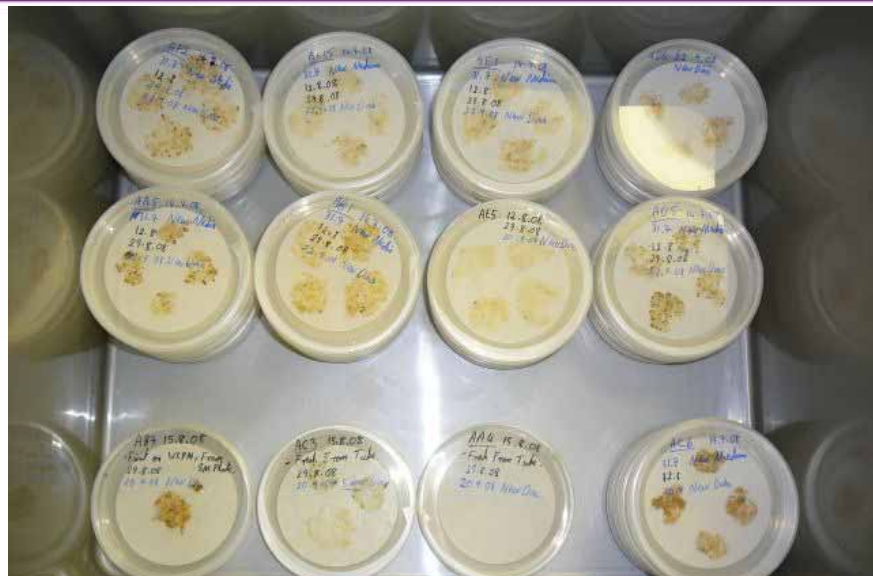
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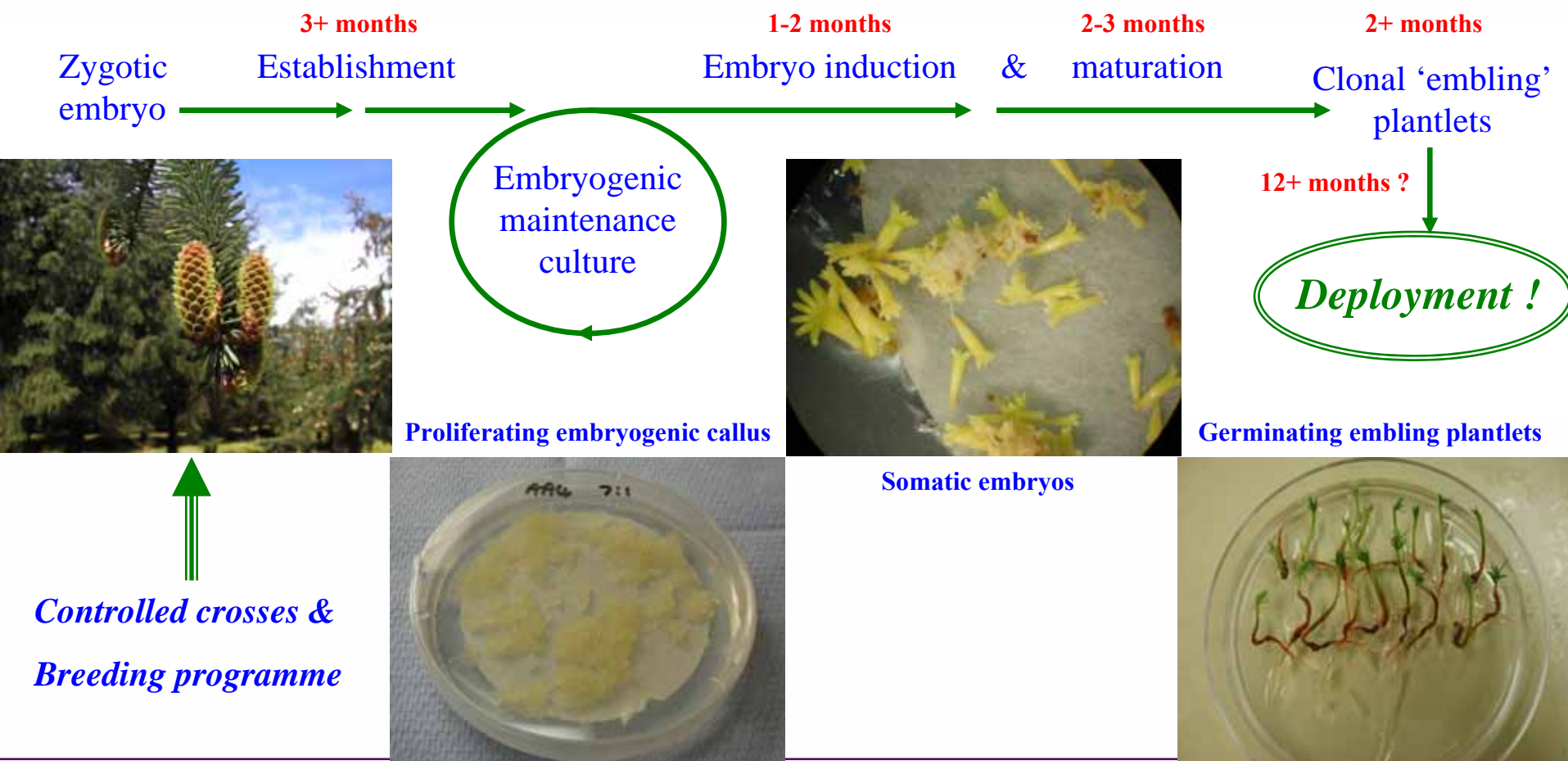
*Made up of two components :*

**Mass propagation.**

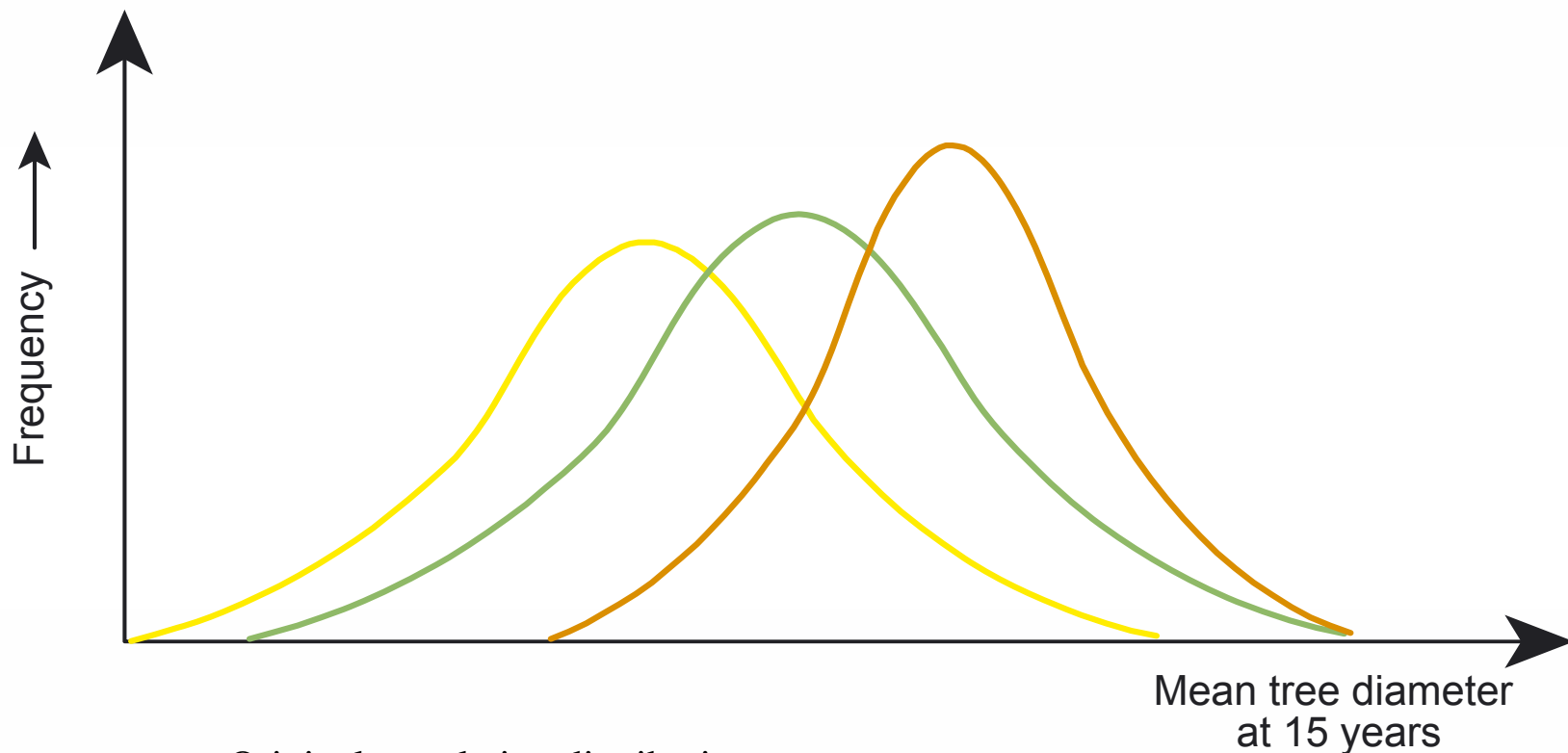
**Cryo-preservation.**






## Mass propagation of Sitka spruce by the use of somatic embryos

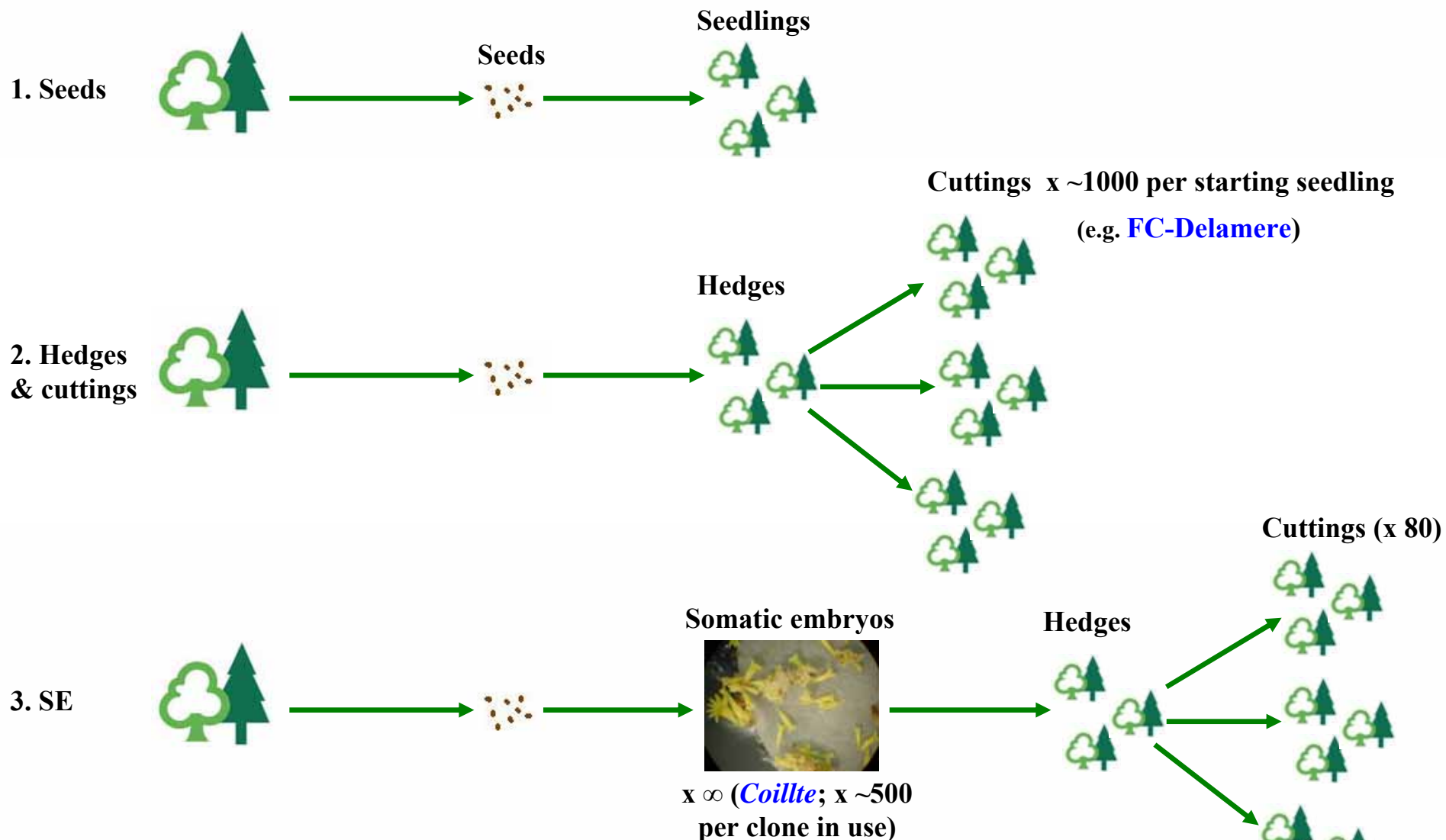


## General breeding gains in forestry :

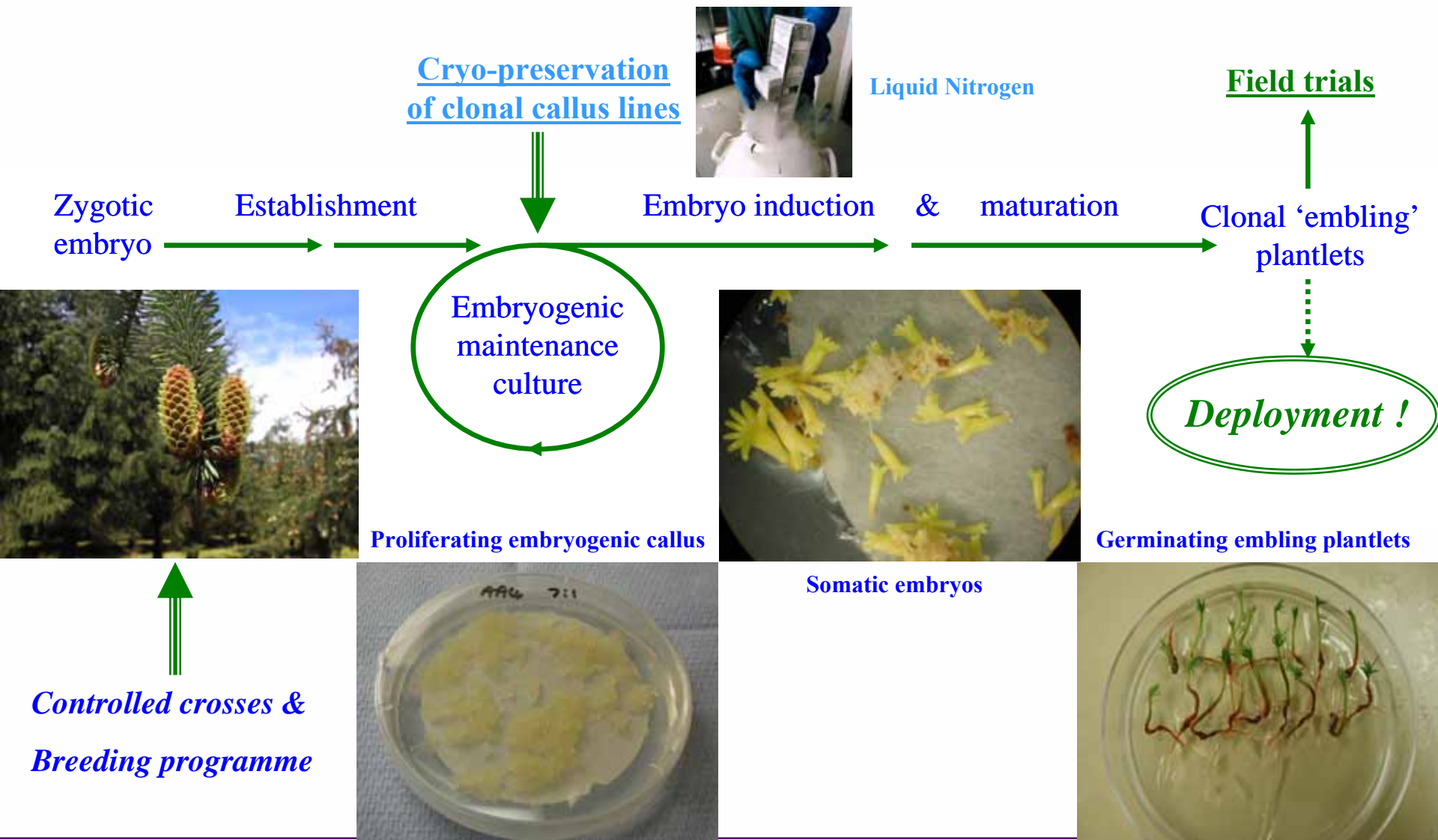


-  Original population distribution.
-  Breeding population selected after provenance trials.
-  Distribution obtainable from controlled crosses in a seed orchard (= family forestry).

There are various approaches to propagating conifers :

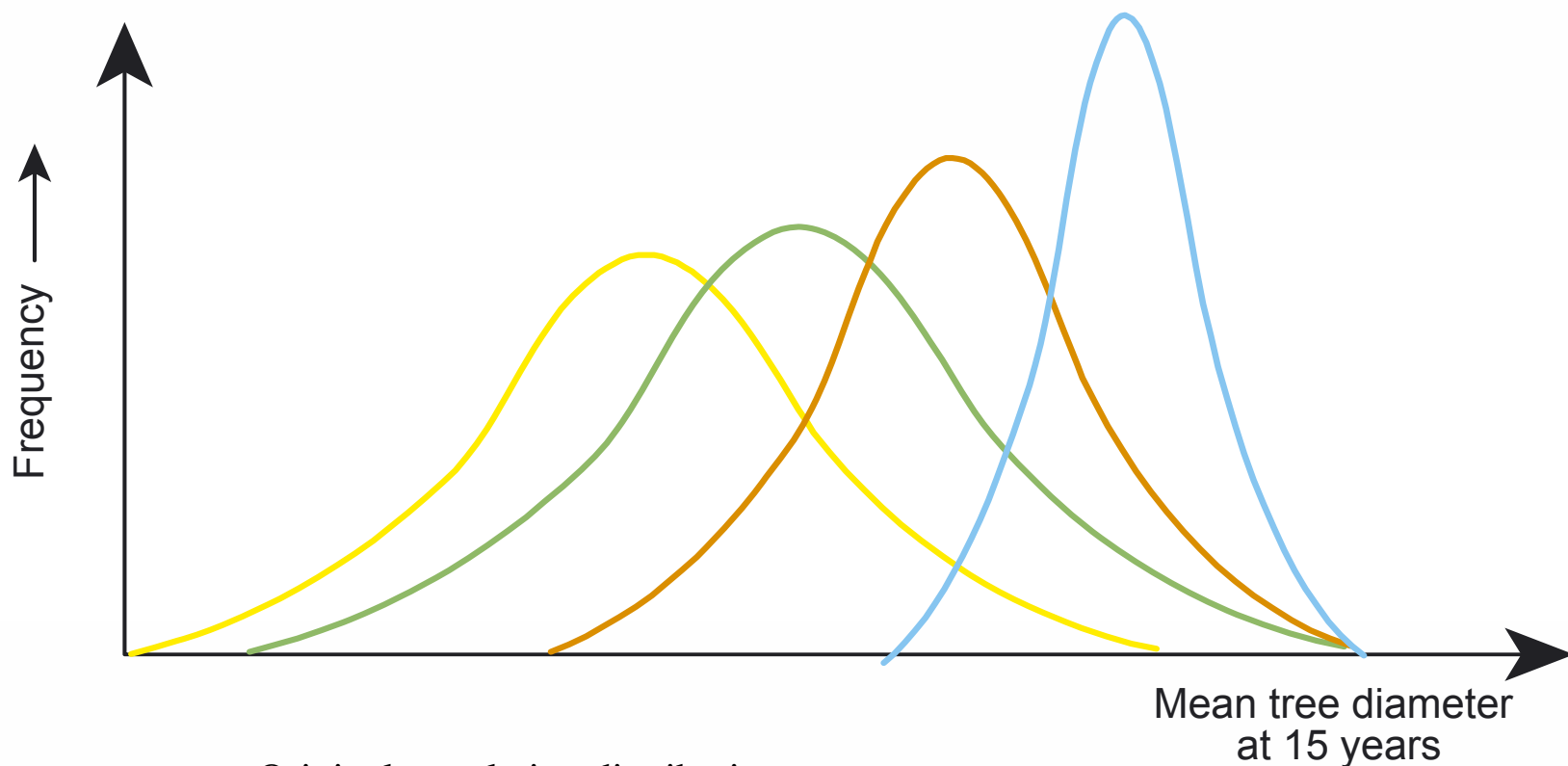


## Mass propagation of Sitka spruce by *multi-varietal forestry* and SE.



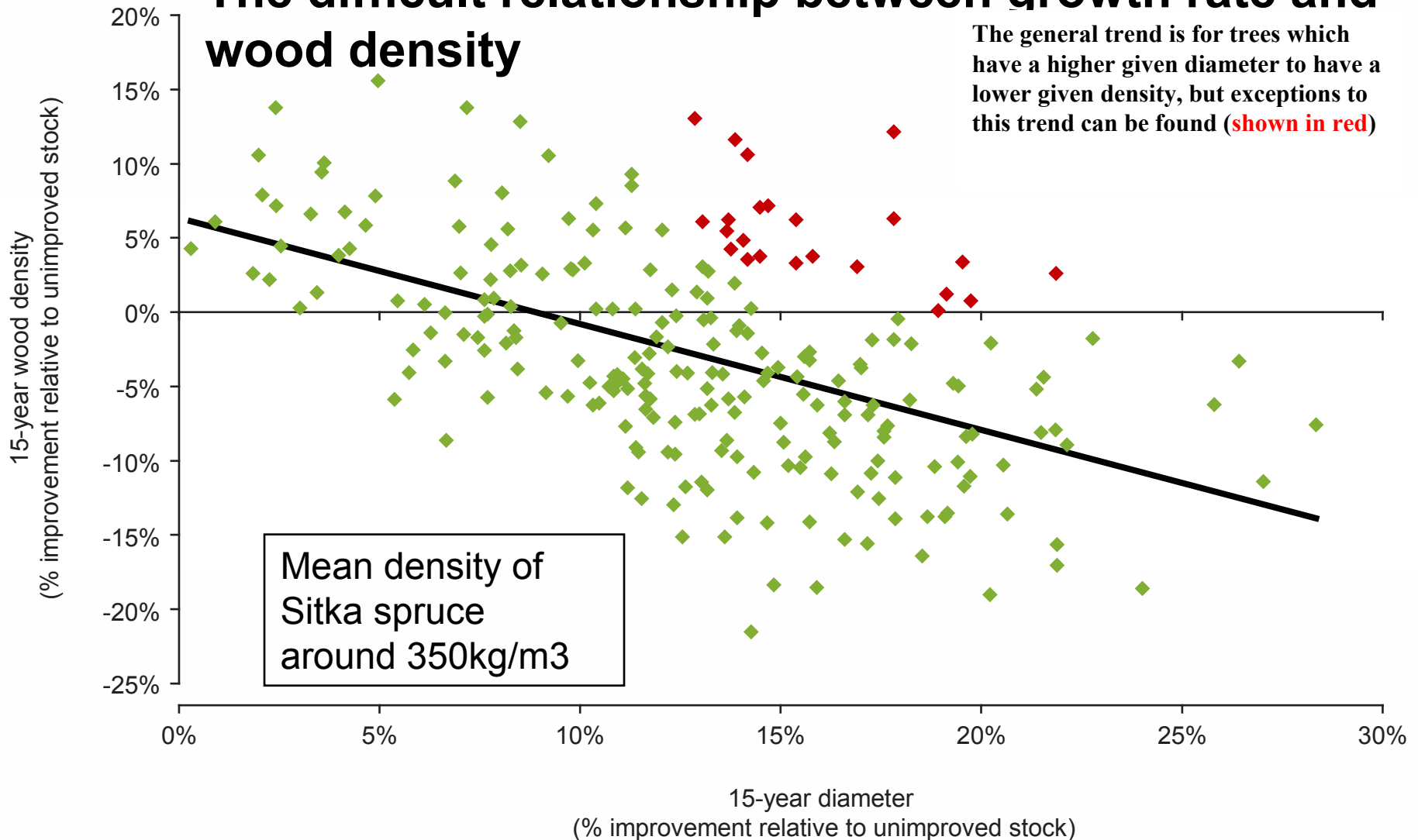


## General breeding gains in forestry #2, with *multi-varietal forestry* :

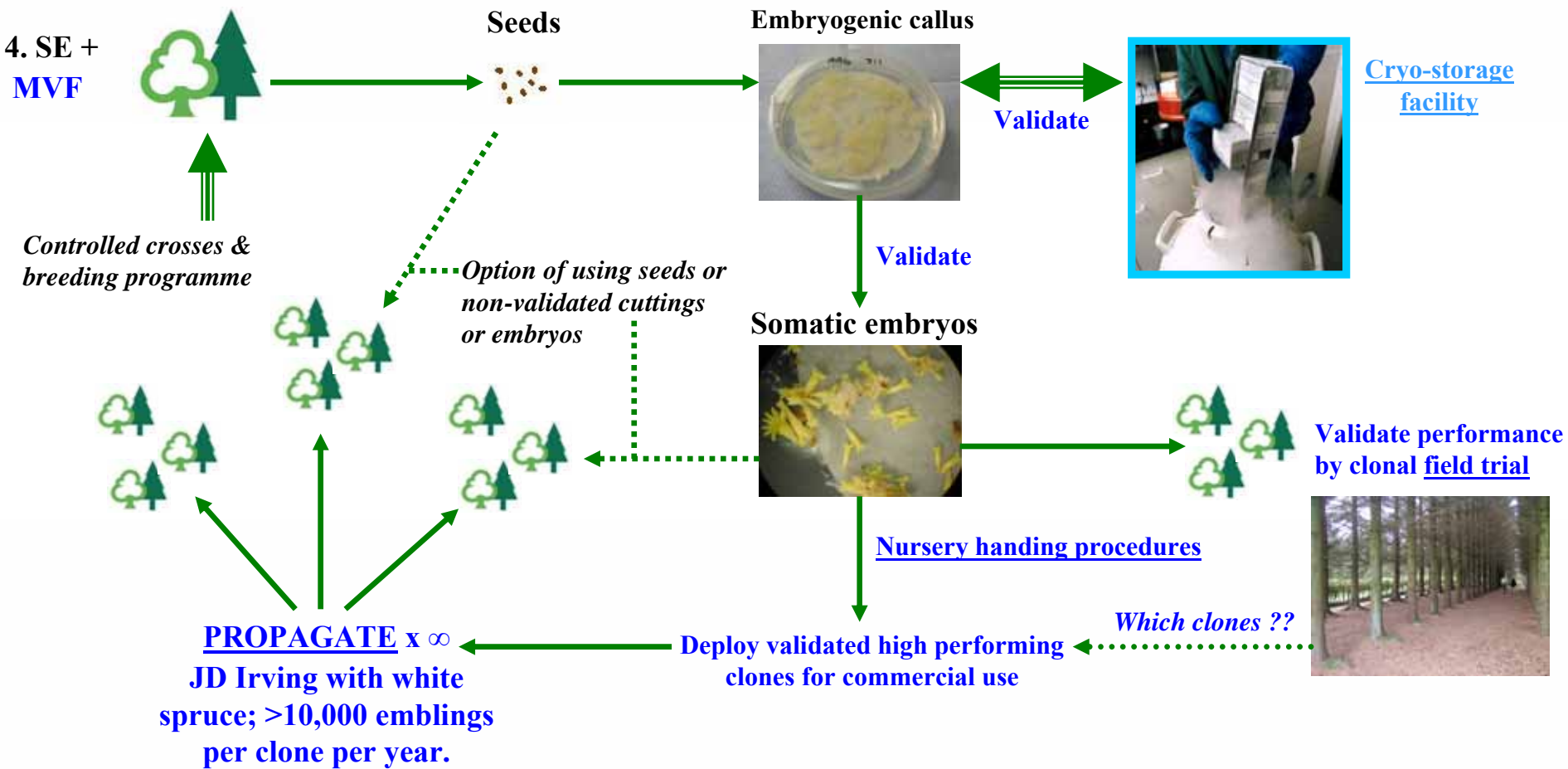


- Original population distribution.
- Breeding population selected after provenance trials.
- Distribution obtainable from controlled crosses in a seed orchard (= family forestry).
- Extra gains possible from using selected clones as part of the **MVF strategy**.

## 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



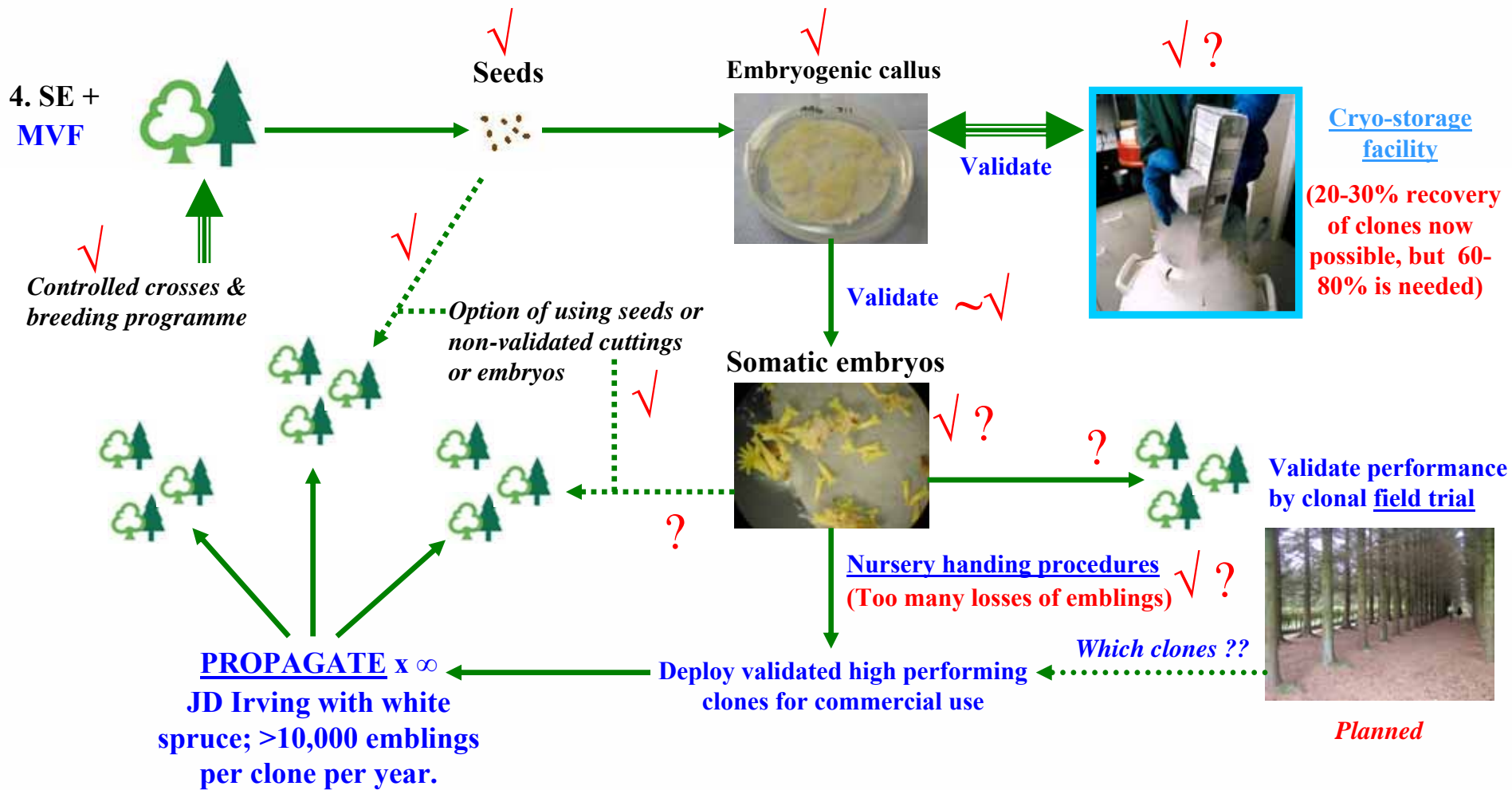
**Field trials** are needed to validate the performance of the clones, if this approach is ever to be more than simply a means of mass plant propagation.

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 !*** ←

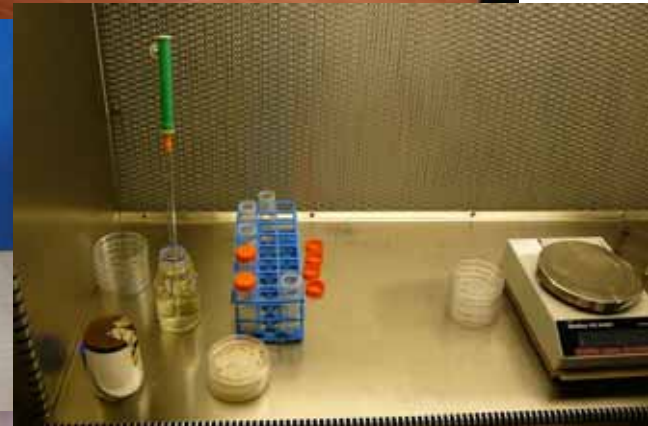
## So where are we with developing **multi-varietal forestry** for Sitka ?



## 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)

## Acknowledgments :

### *Forest Research*

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- David Thompson

### *INRA, Orléans, France*

- Marie-Anne Lelu-Walter

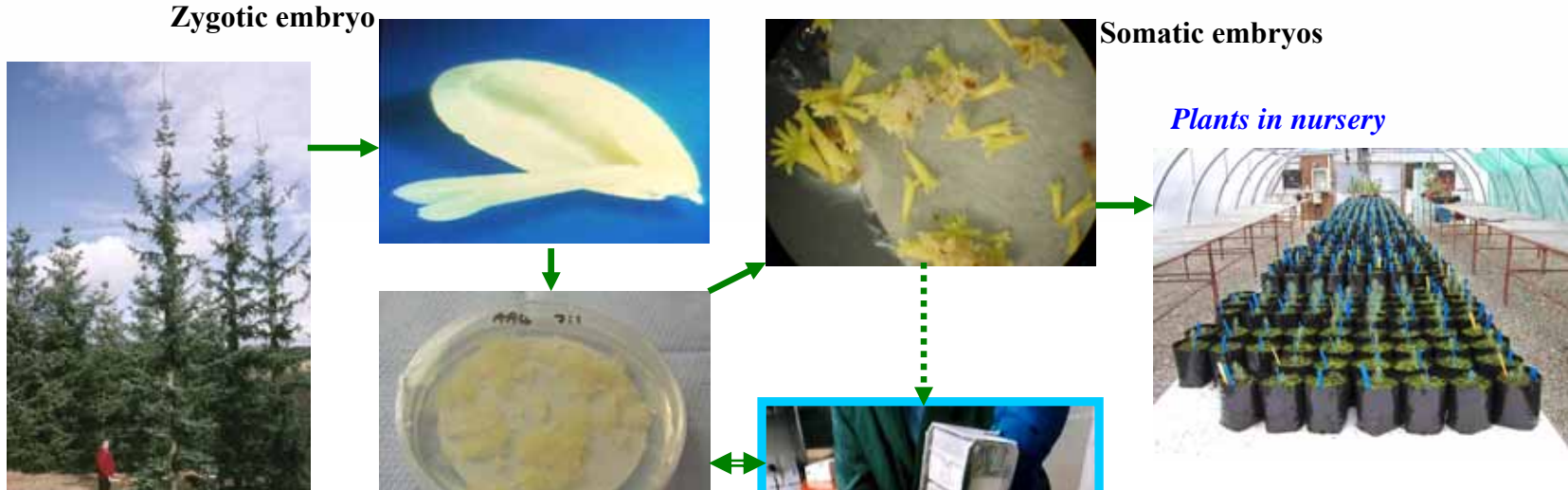
### *Forest Genetics, New Zealand.*

- 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)

