Evaluation of mini-cuttings as a propagation system for *Eucalyptus* hybrids©

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Abstract

Clonal asexual propagation by cuttings is an efficient technique for capturing genetic gain in forestry. However, selected clones (selected for growth, wood properties and stem form) often prove to be difficult to root, thereby limiting the rate of deployment for further field testing and subsequent commercialization. This constraint will also delay the time taken for new clones to be identified. It is thus imperative that a propagation system runs efficiently and economically to realize genetic gain. It is widely hypothesized that rooting ability of clones is under genetic control. Although true for some clones, this study showed that the sand bed mini-hedge system resulted in improved rooting percentages through rejuvenation, better nutrition and improved climatic control of hedges. Additional benefits of this system included a more robust root system, faster growth and improved plant quality of mini-cuttings, which are favourable traits to reduce transplant stress when planted in-field.

INTRODUCTION

According to Stape et al. (2001), de Assis et al. (2004), and Titon et al. (2006) the following observations can be made regarding clonal asexual propagation on Eucalyptus:

- Clonal propagation is an efficient technique to capture genetic gain.
- The inability to root is often a constraint to the deployment of some clones.
- Three factors are crucial in the rooting success of *Eucalyptus*:
    - Condition of the mother plant
    - Rooting environment conditions
    - Genetic disposition

CONVENTIONAL MACRO-CUTTING AND MINI-CUTTING PROPAGATION

Macro-cutting propagation

1. Conventional vegetative propagation using macro-cuttings in the open (Figure 1).

- Hedges in the ground, widely-spaced (clone bank)
- Semi-lignified coppice harvested
- Cuttings set (8 to 10 cm)

2. Limitations of conventional vegetative propagation approach.

- Controlling hedge nutrition
- Climatic extremes
- Maintaining juvenility

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Figure 1. Conventional vegetative propagation using macro-cuttings from hedges grown in the open.

Mini-cuttings

1. Characteristics of mini-cutting.

- Mini-hedges in sand beds under cover (Figure 2)
- Stock plants are closely-spaced
- Herbaceous coppice harvested
- Daily irrigation and nutrient supply
- Smaller cuttings (4 to 7 cm)

2. Expected outcomes of the mini-cutting approach.

- Good hedge nutrition results in better rooting
- Hedges sheltered from climatic extremes
- Cuttings retain their juvenility

Figure 2. Mini hedges in sand beds under cover.

AIM AND OBJECTIVES

- To measure hedge productivity between the macro-and mini-hedge methods
- To compare rooting from mini-hedges with macro-hedges
- To compare plant quality and field survival

MATERIALS AND METHODS

Planting procedure

- Six clones [SG (*E. smithii* × *E. grandis*), NG (*E. nitens* × *E. grandis*), GU (*E. grandis* × *E. urophylla*)] spanning three taxa planted into sand beds (Figure 3).
  - o Temperate hybrids (alternative to *E. nitens*)
  - o Sub-tropical (alternative to *E. grandis*)
- A layer of stone was first placed in the bed followed by washed, sieved river sand.
- Hedges were planted at approximately 10×15 cm and irrigated using drippers.

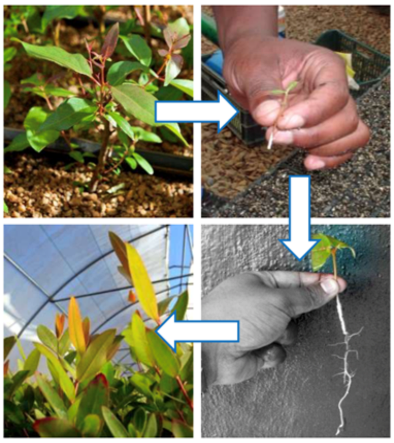

Figure 3. Planting procedure.

Trial analysis

The trial was designed and analysed according to the following model:

Y_{ijk} = u + $taxa_i$ + propagation $system_j$ + (taxa * propagation system)$_{ij}$ + $\sum_{ijk}$

where:

- y = parameter of interest (productivity, rooting, plant quality, field survival)
- μ = overall mean
- taxai = fixed taxa effect (*n* = 3)
- propagation systemj = fixed propagation effect (macro or mini)
- Taxa * propagation system = factor interaction
- Σ = random error associated with the i^{th} taxon, the j^{th} propagation system and the k^{th} plant

Data were collected over a period of 3 years.

RESULTS

Hedge productivity of the clone GU (*E. grandis* × *E. urophylla*)

Number of cuttings per hedge per harvest, number of hedges m^{-2}, and number of cuttings m^{-2} for clone GU (*E. grandis* × *E. urophylla*) are shown in Figures 4 and 5. Measuring hedges per square meter and number of cuttings per square meter is based on macro-hedge spacing = 0.6×0.8 m: 2 × hedges m^{-2} and 24 × cuttings m^{-2} and mini-hedge spacing = 0.10×0.15 m: 66 × hedges m^{-2} and 264 × cuttings m^{-2}. Mini hedges offer an 11-fold increase in cuttings m^{-2}.

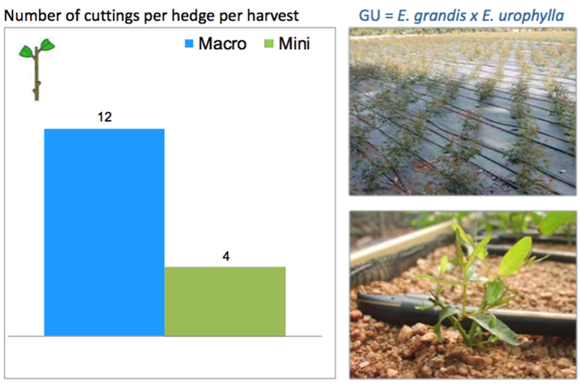

Figure 4. Number of cuttings per hedge per harvest, macro vs. mini cuttings for GU (*E. grandis* × *E. urophylla*).

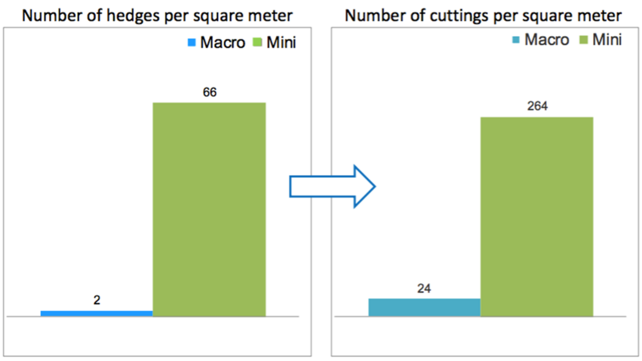

Figure 5. Number of hedges and number of cuttings m^{-2}.

Percent rooting results for the three clones SG (*E. smithii* × *E. grandis*), NG (*E. nitens* × *E. grandis*), GU (*E. grandis* × *E. urophylla*)

Percent rooting was significant for clones NG and GU (Figure 6).

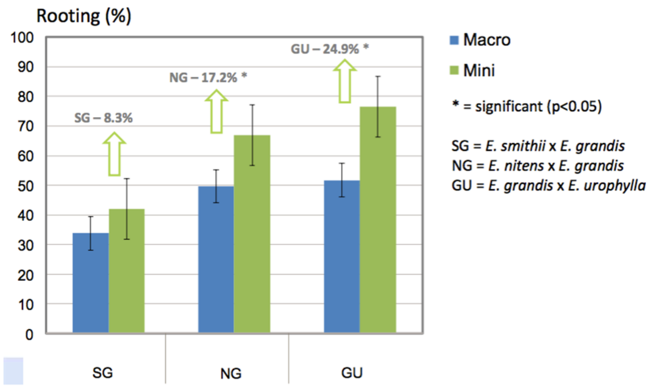

Figure 6. Rooting results for the three clones: SG, NG, and GU.

Root quality at 6 weeks of the clone GU (*E. grandis* × *E. urophylla*)

Macro-cutting vs mini-cutting (Figure 7).

- Cumulative root length (mm): Macro = 20, Mini = 246
- Root dry mass (mg): Macro ≈ 0, Mini = 55
- Shoot dry mass (g): Macro = 0.75, Mini = 1.00

Figure 7. Macro cutting vs. mini cutting.

Plant quality at 12 weeks for the three clones SG (*E. smithii* × *E. grandis*), NG (*E. nitens* × *E. grandis*), GU (*E. grandis* × *E. urophylla*)

New shoot height (cm) for macro and mini clones showed the greatest gains for clone GU and only clone SG was not significant (Figure 8). Dry mass (g) is shown in Figure 9 with root dry mass on the left two columns for each clone and the right two columns for shoot dry mass for each clone.

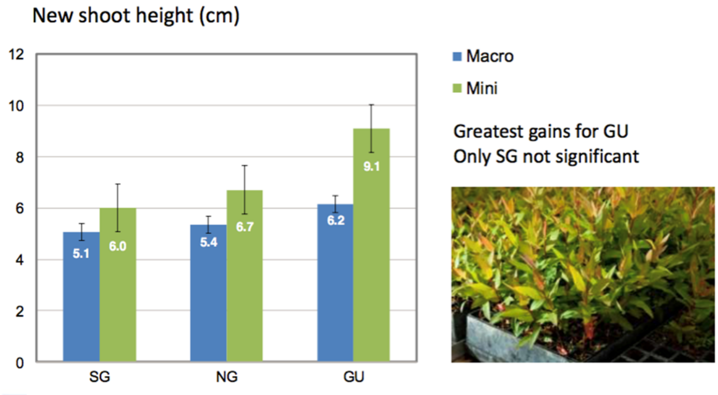

Figure 8. New shoot height (cm) for macro and mini clones.

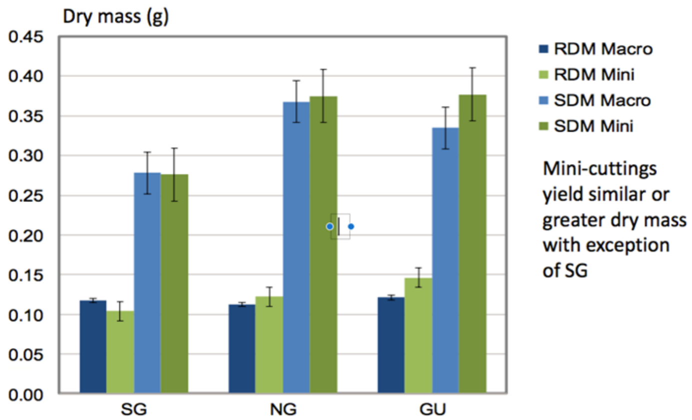

Figure 9. Dry mass (g) for the three clones.

CONCLUSION

Mini-cuttings offer many benefits:

- More juvenile, herbaceous cuttings.
- Improved control over hedge environment.
- Better productivity per square meter allows for intensive management over a small area.
- The superior rooting success results in better nursery efficiencies.
- Higher quality root systems.
- Increased rooting speed contributes to optimizing nursery capacity.
- Better plant quality results in better initial field performance.

Literature cited

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