Rapid Multiplication of Grapevines©

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INTRODUCTION

Demand for new grape (*Vitis*) cultivars and improved selections some from overseas is increasing. This is driven in part by the branding strategies and product differentiation requirements of wineries. Current propagation practices result in long lag times of up to 11 years for production of new planting material. The Australian wine industry required a more rapid way to meet local and overseas market demands for new and improved cultivars. Reducing the time it takes to make new cultivars and improved selections available to industry could only do this.

THE EXISTING SYSTEM

The current system uses the century old dormant stick propagation methods to produce dormant rooted cuttings or grafts for sale. Briefly described the old system followed these procedures: (1) Import new cultivar into Australia (2 years in quarantine); (2) Plant three vines (these plants are referred to as GM vines) into Grapevine Germplasm Collection (Fig. 1); (3) Grow until able to take dormant cuttings (time = 3 years); (4) Take dormant cuttings (approximately 25 to 30 per vine) (Fig. 2) and plant into field nursery (time = 1 year) these cuttings are referred to as generation 1 (G1) vines; (5) Plant 60 to 80 vines in a Foundation row from dormant cuttings and grow until mature (time = 3 years); (6) Take cuttings from Foundation rows (cuttings 25 to 30 per vine × 60 to 80 vines = 1500 – 2400 dormant cuttings) and plant in field nursery (time = 1 year) these cuttings are referred to as generation 2 (G2) vines; (7) Plant 1500 to 2400 dormant rooted cuttings into Vine Source Area vineyard and grow until mature (time = 3 years); and (8) Cut dormant wood from Vine Source Area and supply to Vine Nurseries for commercial propagation to industry customers (cuttings 25 to 30 per vine × 1500 to 2400 vines = 37,500 to 72,000 dormant cuttings). These cuttings are referred to as "A CLASS CERTIFIED" cuttings. The total time taken to provide a commercial quantity of vine material to commercial vine nurseries excluding the quarantine time (2 years) is 11 years.

As can be seen, 11 years is too long a lead-time to allow industry to respond to any new changes in consumer demand for new cultivars or improved selections. One need also realise that 3 years needs to be added to the above time; this allows for the wine production from grapes produced from these new plantings.

THE RAPID MULTIPLICATION METHOD

At the South Australian Vine Improvement Nursery we have modified traditional vegetative propagation and multiplication techniques so as to reduce the elapsed time between identification or release from quarantine of new cultivars and improved selections and availability of commercial quantities of planting material from 11 years to 4 years. The new rapid propagation technique follows these procedures.

The three vines released from quarantine are potted into containers and grown on in a temperature-controlled glasshouse. These pots are referred to as GM Pots (Fig. 3). The glasshouse is maintained at a minimum of 18 °C with a relative humidity of no less than 70%.

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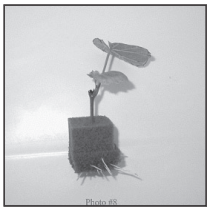

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Figure 1. Germplasm three vines.

Figure 2. Bundle of dormant cuttings.

Figure 3. Mother pots (GM pots).

Figure 4. Cuttings from mother pots (GM pots).

Figure 5. Single node cutting

Figure 6. Cuttings ready for oasis cells.

Figure 7. Misted cuttings on hot beds.

Figure 8. Rooted cutting in oasis.

Figure 9. Container system used for potting on.

Figure 10. Growing on in finished pot.

Green-shoot growths about 40 to 50 cm long are harvested from the mother pots. (Fig. 3) These green shoots are placed in fresh water that has been chlorinated to 5 ppm the day before (Fig. 4). The green shoots are cut into single-node cuttings. On average about 20 single node cuttings per GM pot are obtained, and are placed in a container of chlorinated fresh water with auxin solution (Fig. 5).

The solution we use is Esi-root containing both indolebutric acid and naphthalene acetic acid at 1.6 $g \cdot litre^{-1}$. The solution is added to the water at a rate of 10 ml to 4 litres of water. Single-node cuttings are left in the auxin solution for approximately 1 h and then put into oasis cells. (Fig. 6). The oasis cells used are the LC3 which contain 72 cells per tray. The single node grape cuttings have their leaf area reduced so as to allow 72 cuttings per tray. Reducing the leaf area also allows more air movement by reducing leaf overlap resulting in less *Botrytis* pressure. The leaf is loosely folded along the mid-rib and all leaf is cut away except for a 15 to 30 mm diameter semicircle. Once the oasis trays are filled with the single-node cuttings they are placed on hot beds at 26 to 28ºC. The hot beds have mist nozzles set up maintaining leaf moisture as per the requirement of any normal vegetative propagation technique (Fig. 7).

Table 1. Total number of pots generated per year.

Stage or activity	Units	Range Lower	Mid	Upper	Time years
Mother pots in glasshouse	mother pots	3	3	3	
Frequency of harvest	harvest per year	6	7	8	
Harvest green single nodes	nodes per mother pot	16	18	20	
Generation 1 pots produced	G1 pots per year	288	378	480	
Success rate		80%	85%	90%	
Generation 1 pots produced	G1 pots per year	230	302	384	
Frequency of harvest	harvest per year	6	7	8	
Harvest green single nodes	nodes per G1 pot	4	5	6	
Generation 2 pots produced	G2 pots per year	5530	10,584	18,432	
Success rate		80%	85%	90%	
Generation 2 pots produced	G2 pots per year	4424	8467	14,746	1
The old dormant stick system produced		1500		2400	11

It takes approximately 3 to 4 weeks for root initials to appear depending on the cultivar propagated. (Fig. 8). At this point the rooted cells are potted into a container pot system that we use for growing on. These pots are referred to as Generation 1 (G1) pots. The pots are partly filled with potting mix and the cutting with the cell attached is then placed into the top of the pot.

The pots fit into a 50-pot container system and have root trainers down the side with air pruning on the bottom to encourage lateral root branching (Fig. 9). The potting mix used is washed river sand and 6 mm composted pine bark (12.5 : 87.5, v/v). To each cubic meter is added 0.5 kg iron, 2.4 kg dolomite, 0.5 kg flowtrace, and 0.5 kg wetter. Slow-release fertilizer is also added at a rate per cubic m of 2.0 kg 140 day, 1.0 kg 270 day, and 1.0 kg 360 day. The pots are then placed onto hot beds set at 20 °C to grow on so that they can then be used as a source of cutting material for the Generation 2 (G2) pots (Fig.10). The GM pots and the G1 pots are the only ones used as the source of cutting material. The G2 pots are supplied to the Vine Improvement groups around Australia to be planted into vineyards as source blocks to ultimately supply "A CLASS CERTIFIED" cuttings to the grapevine nurseries. The GM and G1 pots have their EC levels monitored fortnightly to maintain maximum growth whilst in glasshouse growing conditions. After the green growths have been cut from the GM and G1 pots a complete mineral mix is used as a top-dress fertilizer. A slow-release top-dress is used once buds and new leaves have shot. Monitoring the EC levels is very important as the pots being held for 12 months at a time very quickly run out of nutrient. The success of the callusing of the single node cuttings is very dependant on the stored nutrient levels in the cutting. The G1 pots being smaller than the GM pots average about 6 to 10 single-node cuttings every 4 to 6 weeks. A spray is also applied to the GM and G1 pots when the green growths are cut to stop *Botrytis* from spreading due to the sap flowing from the cut. Sulphur burners are also running in the glasshouses to help minimise disease pres-

sure. The glasshouses as well as being environmentally controlled also have lights programmed to maintain a minimum of 18-h light, to enable growth all year round without letting the GM and G1 pots to go dormant.

The total number of pots generated in this way per year is shown in Table 1.

CONCLUSION

Planting material is required for vineyard expansion or replanting with improved varieties, clearly this technique provides major advantages in substantially reducing the time between expression of demand and supply of sufficient planting material. It also allows for an increase in the scale of multiplication of improved genetic material. The elapsed time between identification or release from quarantine of a desired variety or clone and availability of commercial quantities of planting material has been reduced from 11 years to 4 years.

The Concept of Urban Horticulture, and Its Implications in the World of Plant Propagation©

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The world of ecosystems, interdependence of organisms, and interdisciplinary studies were all terms that began to take on new meaning in the late 1970s. In the early 1980s, the Center for Urban Horticulture (CUH) became the first formal academic and outreach institution affiliated with a major university to actually create a place where the traditional plant sciences were mingled with the social sciences. It embraced the idea of interdisciplinary studies and ecology.

Physical development of the CUH began in 1984 and four new buildings completed the site in 1987 with all the funds provided by private donors. CUH has served as a model for many other such programs in the years hence by providing a place where faculty, students, and the public can work together to create a showplace for environmental horticulture and urban forestry.

During the 1990s and into the beginning of this millennium, the program grew to include the contributions of seven full time faculty. Graduate enrollment averaged approximately 55 annually, and a newer undergraduate program had attracted 35 students. The outreach programs at CUH and the 230-acre Washington Park Arboretum site have reached over 35,000 annually, the second highest on the University of Washington (UW) campus (collegiate athletics is first). During this twenty years, many community organizations, both large and small, were formed that focused on environmental issues in contrast to the more traditional plant societies which were active during the mid and late part of the last century.

Also the Miller Horticulture Library became one of the foremost repositories of horticultural books for academics as well as the public, accumulating over 14,000 volumes. In addition, a comprehensive Master Plan for the Washington Park Arboretum (WPA) (proposed $45 million) was unanimously passed after 7 years of planning and public process. The WPA is a 230-acre site, just south of the main UW campus. It is one of the more important collections of woody temperate plants in