

Mass Propagation in Plugs

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Summary

Bedding and perennial plant propagation includes programs for unrooted cuttings (URC), seed raised plugs, and tissue culture

(TC) plants. The focus of this paper is our vegetative production program using cuttings.

INTRODUCTION

This paper will move through the vegetative propagation program at Ball Australia in its Melbourne facility from planning to dispatch. Our process is broken into three parts.

Part 1: Mother stock production

The mother stock production process starts with sales planning. This process starts 1-2 years ahead of the first plug being shipped. From there we will look at the Nucleus production, quarantine requirements, hygiene, and timelines. After that we will review the

main mother stock production compartments. This will review climate, harvest planning, cutting spec, cutting collection, crop maintenance, staffing, cutting transport.

Part 2: Sticking cuttings

Sticking process starts with planning the benches for production flow. We will also look at cutting storage, staffing, sticking lines, watering tunnel, and tray media.

Part 3: Finishing production

Finish the production process includes reviewing our four climate zones, vapor pressure deficit settings and theory, movement days, watering by weight, plant growth regulator (PGR), trimming, preparing for dispatch, and shipping.

Mother Stock Production

I am the Growing Manager at Ball Australia responsible for all the growing in both the mother stock and the young plants nursery.

Ball Australia is part of a global 4th generation family-owned business with its head office in Chicago, Illinois.

Ball Australia grows a wide product offering: Vegetative propagation, unrooted cuttings (URC), Seed raised plugs, and Tissue Culture (TC). The focus of this paper is our vegetative production program where we grow over 600 different varieties.

The whole process starts with a sales plan. We look at the sales curve for each variety and plant mother plants around demand. Availability is entered 18 months ahead of the current sales week. All of this is handled by our vegetative planning and product development departments. The same variety could be planted at three separate times in separate compartments to match up with the sales curve. All this planning involves long term thinking. An example of a planning/production schedule is presented in **Table 1**.

Table1. An example of a production planning schedule at Ball Australia.

Action	Timing	Notes
Liner Sales	WK 22, 2023	4 weeks to root a cutting into a liner.
Take Cuttings	WK 18, 2023	12 weeks minimum from planting to 1 st harvest 4 -6 weeks rooting 8 weeks build up (pinching)
Plant Mother Plants	WK 6, 2023	4 weeks to root a cutting into a liner.
Start Mother Liners	WK 2, 2023	13 weeks to root out Elite stock and build up MS plug numbers needed.
Plant Elite Pots	WK 41, 2022	4 weeks to root Elite TC
Root Elite TC	WK 37, 2022	TC does not all arrive on time. TC started to arrive week 10, 2022

TC is ordered 6 months to one year ahead of arrival in week 5. The planning for new products in 2024 started in early 2022.

The Elite (Nucleus) house is the heart of the mother stock facility. We have strict hygiene procedures for entry into this growing area. The procedures are listed below:

- Change from street clothes into clean scrubs
- Change shoes into area restricted shoes
- Wash hands
- Put on gloves
- Bring a disinfection bottle of chlorine 0.6%
- Walk through air shower
- Walk through foot bath

Only a limited number of certified staff can work in this area. We carry a minimum of 4 Elite plants in over 600 varieties. Each plant is labelled and tracked via crop code through our production system.

Due to Australia's strict bio security requirements we need to operate our own Mother stock facility. Other countries can import cuttings from large cutting farms. This does not work in Australia. If we cannot source TC of a specific variety, it needs to go through 12 weeks in one of our three quarantine facilities. Once cleared these are moved in sealed containers to the Nucleus house, or into a production growing space.

Hand washing, disposable gloves and disinfection spray is mandatory in the whole facility. In the Nucleus house and the backout house no outside clothes are allowed. Staff must change into scrubs before entering. In the main production houses, lab coats are required for entry. All items are changed and washed daily. Within the mother stock facility, we have five production houses. These houses contain larger blocks of each variety based on yield, number and product demand. Four compartments are rotated to supply year-round production. One is a black out facility for short day crops. Only certified staff can work on

these compartments. Each compartment is emptied and cleaned once a year for hygiene reasons. Thrip nets on all vents and concrete floors to keep pest pressure at a minimum.

Climate is monitored daily for discrepancies. This ensures the same quality cutting is available year-round. Some rows have day length extension lighting giving a longer supply season for some crops or, the ability to supply outside natural growing seasons. All areas use fog to cool and maintain humidity during warmer months.

Total harvest and maintenance team is 18 people. These staff are trained over a 6-month period. Each variety has a cutting specification. Harvesting teams use this to compare each week. This ensures consistency every week and helps with training new staff. Product is counted into bags of 105 and stored in cool room until sticking. The bags are collected in the greenhouse and moved to a fridge at 6 degrees in each compartment. Within an hour they are collected to a temperature-controlled transport cart and moved to our main cool room. There they are stored at 9 degrees for up to two weeks before sticking.

Sticking Cuttings

This section reviews the sticking procedure. Carts are prepared before sticking. Each shelf of a cart is one bench of product. Benches are created based on rooting timelines, movement days, and growing requirements. This is done by two staff at the end of each week to prepare for the start of the next week. We use two types of media, a loose filled that we fill on our sowing line and a Proforma glue plug. Specific crops are grown in each media. This depends on the final growing requirements of the specific variety.

We use a progressive sticking method. There are 5 staff members on the sticking team. Each staff member is responsible for a portion of the tray. The tray moves down the belt. The last staff member

finishes and checks the tray before it goes through the watering tunnel.

Finishing Production

This section will finish the production process. During production we use a few different processes to ensure that our plugs are

consistent every week. The first tool is vapour pressure deficit (VPD) cameras. Each fog zone has a VPD camera. These cameras measure plant leaf temperature, relative humidity, and humidity deficit. VPD is calculated each minute, and a running sum is tracked (**Fig. 1**).

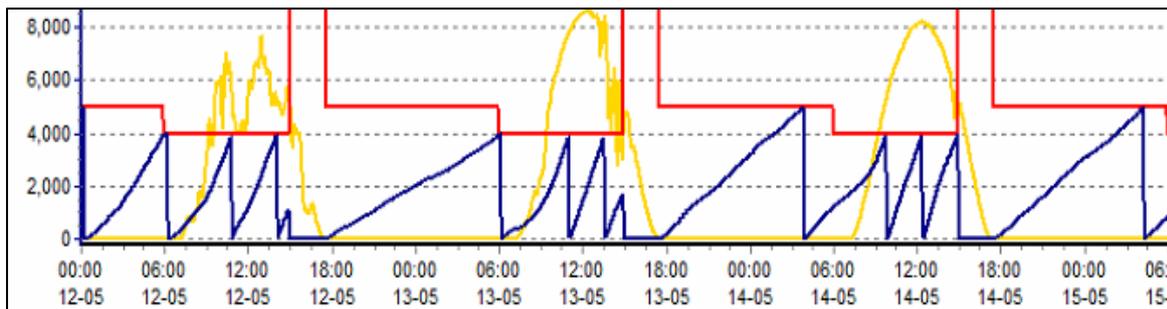


Figure 1. An example of an output from a Vapour Pressure Deficit (VPD) camera in a fog zone in the production facility of Ball Australia (Yellow line - radiation, red line - VPD sum target, blue line -the measured VPD sum).

Each time the VPD sum meets the target the watering boom is started to rehydrate the plants. This results in more passes during sunny days and less during overcast days. Also mean less thinking for the grower and a more consistent product

with Melbourne’s ever-changing weather. By day 10 we have gradually increased the VPD, reduced the mist and moved the product out of our fog compartments. **Figure 2** illustrates the VPD set points for different types of crops.

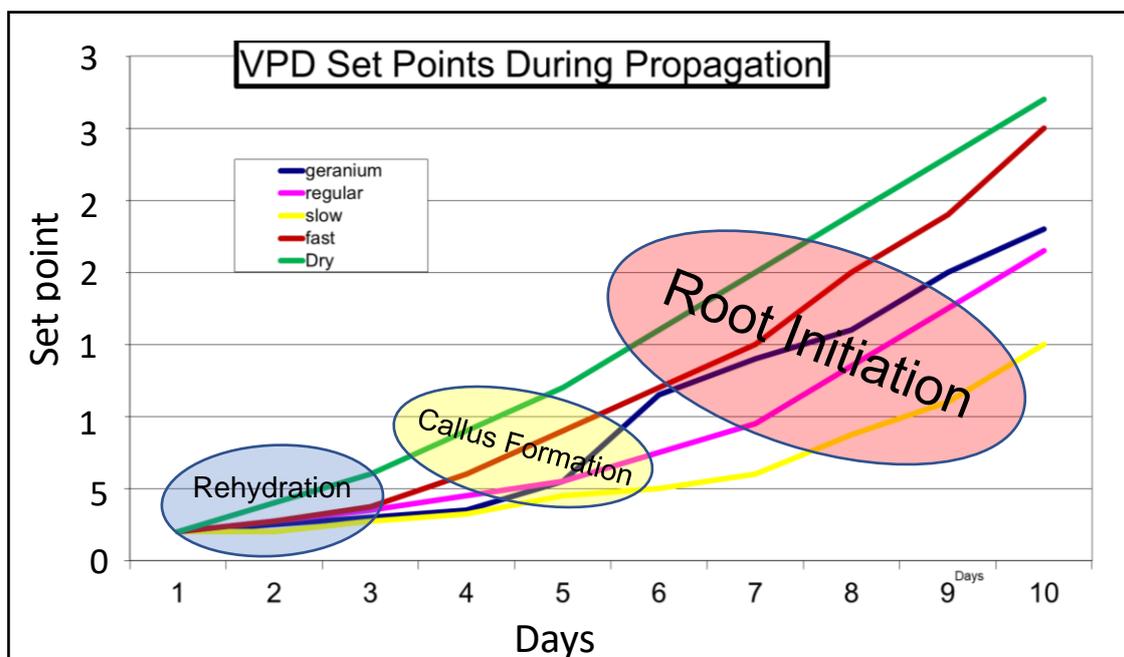


Figure 2. Vapour Pressure Deficit set points for crops with different requirements during propagation with geranium as a control (mid-range of requirements).

To water the crops, we use a water by weight system. All this data is tracked by an app that we designed in-house. We weigh indicator crops twice a day to measure dry back and calculate water up events. This teaches growers to keep the trays within the required range. There is no “too dry”, or “too wet”, only the weight.

For example, the discussion could go like this: “The tray weighs 900 grams this morning, it is losing 200 grams in 24 hours. The target weight to water up at is 700 grams. We will water it tomorrow”. This also aides in diagnosing crop issues. We can tell if a crop has been over-watered or dried back too hard.

The next area of discussion is the different climate zone for each stage of propagation. The first stage of propagation is Fog 1: average temperature 24 degrees, average humidity 90%. Plants spend between 5 and 7 days in this zone.

The next area is Fog 2: average temperature 21 degrees, average humidity 86%. Plants spend between 2 and 7 days “Zoned On”. Then they spend 3 to 5 days “Zoned Off”. This means that the watering is controlled by the VPD (zoned on) or controlled by the grower (zoned off). This

is where water by weight starts. Once first roots start, they are moved to the next climate zone.

The next stage is Climate Zone 3: average temperature 21 degrees, average humidity 70%. Plants spend between 7 to 14 days in this zone. Temperature sensitive varieties never leave this zone. Plants finish rooting in this climate zone. Once roots are established, they are moved to the next climate zone and trimmed if necessary.

The last zone is the Dispatch Zone: average temperature 16 degrees, average humidity 70%. Plants spend between 7 to 14 days in this zone. This is also where we harden off plants. This is also where they are tagged ready for dispatch to our customers. This is a cabrio style open roof building. It is maintained very close to the outside temperature. If the plants need to be trimmed this is completed two weeks before dispatch. Each variety has a set trim height specification. Some varieties will get up to 3 trims before dispatch.

The plants leaving this week were part of the sales planning process over two years ago bring us back to the beginning again.