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Camellia Propagation from Cuttings

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Summary

This paper describes the protocol for production of camellias from rooted cuttings. *Camellia japonica, C. sasanqua*, and *C.* hybrids are propagated by semi-hardwood cuttings. Cuttings are fully submerged in a 114 L (30-gal) tank of Jet-Ag® Solution (hydrogen peroxide, and peroxyacetic acid) to prevent diseases such as *Pythium* and *Phytophthora*. The semi-hardwood cuttings are trimmed to three or four leaves, approximately 15 cm (6-in.) in length, with green mottled tan or solid tan stems. The lower leaf is removed leaving a node about 2.5 cm (1-in.) from the base. No wounding is necessary. Bundles of cuttings are basal quick-dipped for 5-sec with 8,000 ppm IBA solution using Hortus IBA Water Soluble Salts® (20%). Misting is controlled with a Phytotronics® VPD clock to maintain well-hydrated unrooted cuttings. The misting system is composed of Tavlit® 866 mini-compact sprinklers. Mist applications are significantly reduced upon root initiation. Four weeks after root initiation, both *C. sasanqua* and C. japonica cultivars will have rooted, and misting is discontinued. *Camellia japonica* cultivars require six to eight weeks to initiate rooting.

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INTRODUCTION

Bennett's Creek Nursery is a wholesale container growing operation located in Smithfield, Virginia (USDA hardiness zone 8A). A wide variety of plant material is produced on the 150 ha (400-acre) site (Fig. 1). Container production of woody ornamental shrubs, flower and shade trees, herbaceous perennials, and seasonal bedding plants are the main crops (Fig. 1).

Figure 1.
(Top) Aerial photograph of Bennett's Creek Nursery Smithfield location, and (bottom) camellia production in containers.

Among the ornamental shrubs are forty varieties of camellias: *C. japonica, C. sasanquas*, and a few hybrids are produced (Fig. 2). This paper describes the protocol for production of camellias from rooted cuttings.

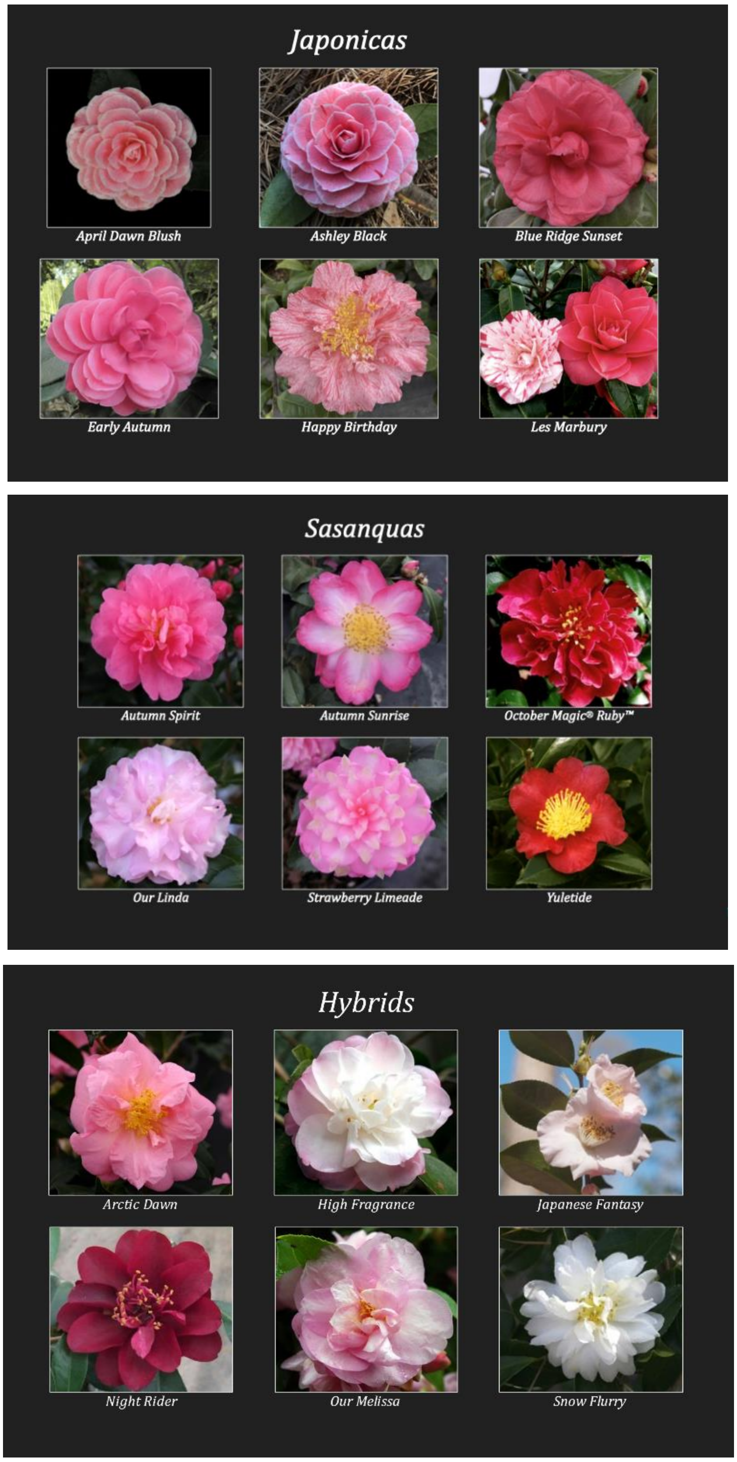
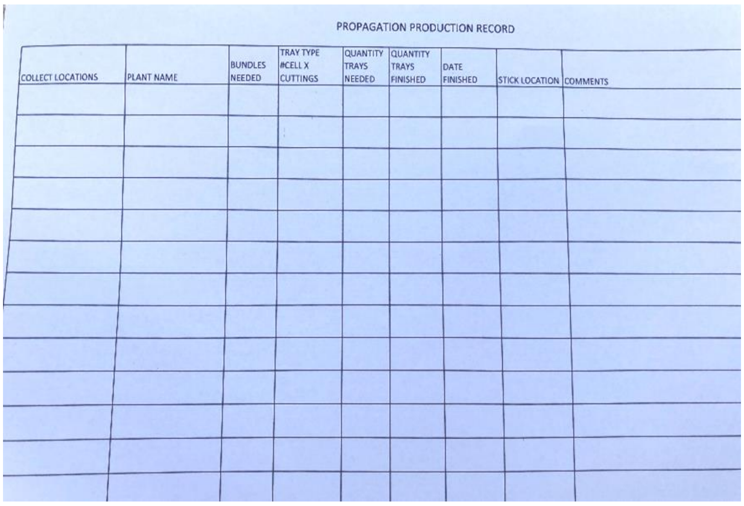


Figure 2. Images of the blooms of a portion of camellias grown at Bennett's Creek Nursery: [*C. japonica* (top), *C. sasanqua* (middle), and *C. hybrida* (bottom).

TIMING, CUTTING AND PREPARATION

All cuttings are collected on site from July through October. A production spreadsheet indicates the location and quantity of cuttings of each cultivar to cut and bundle (Fig. 3).


PROPAGATION PRODUCTION RECORD

COLLECT LOCATIONS	PLANT NAME	BUNDLES NEEDED	TRAY TYPE #CELL X CUTTINGS	QUANTITY TRAYS NEEDED	QUANTITY TRAYS FINISHED	DATE FINISHED	STICK LOCATION	COMMENTS

Figure 3. Propagation production spreadsheet at Bennett's Creek Nursery.

The cuttings are semi-hardwood with three or four leaves, approximately 15 cm (6-in.) in length, with green mottled tan or solid tan stems (Fig. 4). The lower leaf is removed leaving a node about 2.5 cm (1-in.) from the base. No wounding is necessary.

Cuttings are bundled into groups of 20 or 25 depending on the size of the cuttings (Fig. 4).

Figure 4. (left) Examples of *Camellia japonica* cuttings; (right) bundle of cuttings.

Bundles are crated and draped with damp burlap for protection from sun and desiccation (Fig 5).

The full crates are stored in a 2.7 m (12-ft) mobile air-conditioned trailer at the collection site (Fig. 5).

Figure 5. (left) Crated bundles protected with damp burlap, and (right) a propagation crew's van and air-conditioned trailer for storage and transport of cuttings.

Next, the crates are transported to the propagation facility for pre-stick dip treatment. Crates are fully submerged in a 114 L (30-gal) tank of Jet-Ag® Solution (a.i. Hydrogen Peroxide, and Peroxyacetic Acid Acid) to prevent diseases such as Pythium and Phytophthora (Fig. 6).

For Jet-Ag®, 30 ml (1-oz) is added to each 3.8 L (1-gal) gallon of water. The tank is periodically skimmed for debris removal and refreshed daily. Each week the tank is drained and replaced. Discarded Jet-Ag® solution is strained of debris then applied as a sanitizing agent to the floors of empty greenhouses.

Figure 6. (left) The oxidizing agent, Jet-Ag®, (right) a 19 L (5-gal) container of the hydrogen peroxide-based Jet-Ag® solution with a submerged crate of camellia bundles.

AUXIN TREATMENT

An 8,000 ppm IBA solution is prepared using Hortus IBA Water Soluble Salts® (20%) and distilled water. Bundles are basal quick-dipped for 5-sec, placed back into the crate, draped with damp burlap, and color coded with ribbon tied across the prepared crate (Fig. 7). The colored ribbons are a good visual aid for preventing mixing of cultivars (Fig 7).

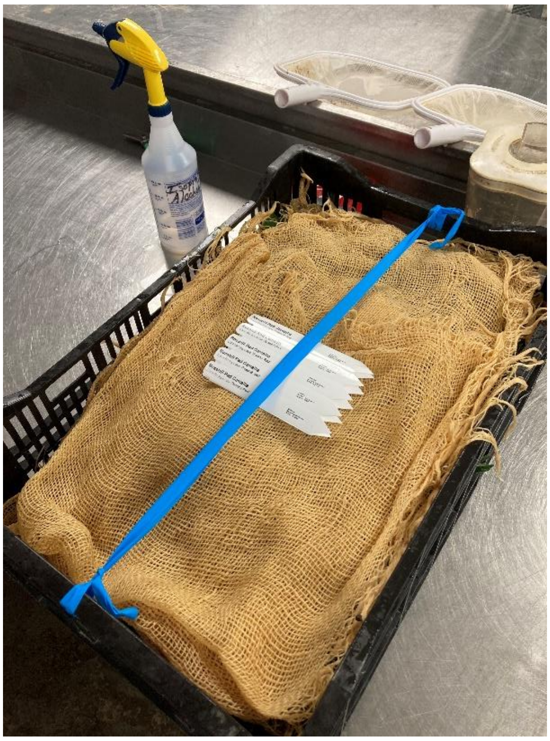


Figure 7. (left) Basal dipping bundles of cuttings with auxin solution, and (right) a finished crate of auxin-treated cuttings ready to stick.

SUBSTRATE

The components of the propagation rooting substate are detailed in Fig. 8. The rooting substrate is prepared daily in a 3.8 m^3 (5 yd^3) paddle mixer. A front loader is used to load the bulk aged pine bark (Fig. 9).

Figure 8. Blended ingredients to produce the rooting substrate.

Figure 9. (left) Loading course perlite into 3.8 m^3 (5 yd^3) paddle mixer, and (right) loading bulk aged loblolly pine bark into the paddle mixer.

FLAT FILLING

Twenty-one cell trays are filled with the rooting substrate inside the propagation building. As they exit the filling process, they are triple stacked on the trailer for transport to the greenhouses (Fig. 10).

Figure 10. Filling trays with rooting substrate.

STICKING TECHNIQUE

Cuttings are direct stuck, two per cell (Fig. 11). Emphasis is on proper depth and contact of the cutting stem with the media. Maximum depth is 4 cm (1.5-in.) with solid contact in the substrate. Each tray is tagged with the cultivar name.

Figure 11. (left) A propagation crew direct sticking into 21-cell trays, and (right) a tray of cuttings recently stuck.

ROOTING ENVIRONMENT

During the summer, greenhouses are covered with shade cloth and side curtains to provide adequate protection from direct sunlight and drying winds (Fig. 12). In late September, greenhouses are converted for cool season propagation (Fig. 13).

Ambient air temperature is maintained below 29 C° (85°F) by a thermostatically controlled vent fan. In addition, each greenhouse is equipped with a propane fired hot water in floor heating system to maintain 21 C° (70°F) in the rooting substrate (Fig 13).

Figure 12. (left) A 9x44 m **(**30x145 ft) greenhouse covered with 50% shade cloth and 2 m (6-ft) plastic side curtains. (right) Applying a double layer of clear plastic to greenhouse using boom attachment.

Figure 13. (left) Greenhouses converted for cool season propagation, and (right) wall mounted propane fired hot water heating system.

MISTING SYSTEM

Misting applications to maintain well hydrated unrooted cuttings is controlled by a Phytotronics® VPD clock (Fig. 14). Misting frequency is automatically adjusted based upon a continuous monitoring system. Ambient air temperature, relative humidity, and leaf surface temperature data is collected every ten seconds and are used to determine the vapor pressure deficit (VPD) (Fig. 15). The propagator enters a target based upon the level of moisture desired on the cuttings. Once VPDs are accumulated to the target, a misting event occurs. As temperature, humidity, and leaf surface temperature increases, VPDs are accumulated faster, and the misting frequency is increased.

The misting heads (Mini-Sprinklers) in the greenhouse are mounted inverted and overhead on weighted drop tubes (Fig. 15.). This design allows for an open floor area and accommodates unobstructed access for workers and equipment. The Mini-Sprinklers are manufactured by Tavlit®. They are the 866 mini-compact sprinklers and can accommodate a variety of color-coded spinners which have different flow-rates (Fig. 16). An anti-drip device is included in the design to quickly discontinue the misting event. It is engineered to open at 21 psi and close at 10 psi.

Figure 14. Phytotronics 12-zone vapor pressure deficit (VPD) controller.

Figure 15. (left) A data collector unit, and (right) a propagation house of recently stuck camellia cuttings with misting heads (Mini-Sprinklers) mounted overhead and inverted on weighted drop tubes (arrow).

Figure 16. (Top, bottom left) Mini-Sprinklers are manufactured by Tavlit®. They are the 866 mini-compact sprinklers and can accommodate a variety of color-coded spinners which have different flow-rates. (Bottom right) An anti-drip device is included in the design to quickly discontinue the misting event.

WATER TREATMENT

Surface water is treated and supplied to the propagation greenhouses. It is filtered, acidified (target pH of 6.2), and chlorinated (target 2-ppm free chlorine). The irrigation system is computer controlled, variable flow, and maintains 55 psi. Acid and chlorine injection are also computer controlled to maintain the targets at various flow rates (Fig. 17).

Figure 17. (top left) Interior view of pump house, (top right) a Yardney sand filtration system with automatic backflush, (bottom left) chlorine gas cylinders with a regulator, and (bottom right) a Wallace and Tiernan® S10k gas feed chlorine metering system.

SPRAY PROGRAM

Unrooted cuttings are sprayed on a seven-day rotation to prevent algae, insect, and disease (Fig. 18). Maximum time between the spray application and mist applications resuming is accomplished by spraying after the final mist application for the day. Rotation between chemical classes (mode of action) prevents resistance development by insects and diseases. Once cuttings are rooted scouting determines application needs. In general, fully rooted cuttings are sprayed on a 30-day rotation to maximize growth rate and health.

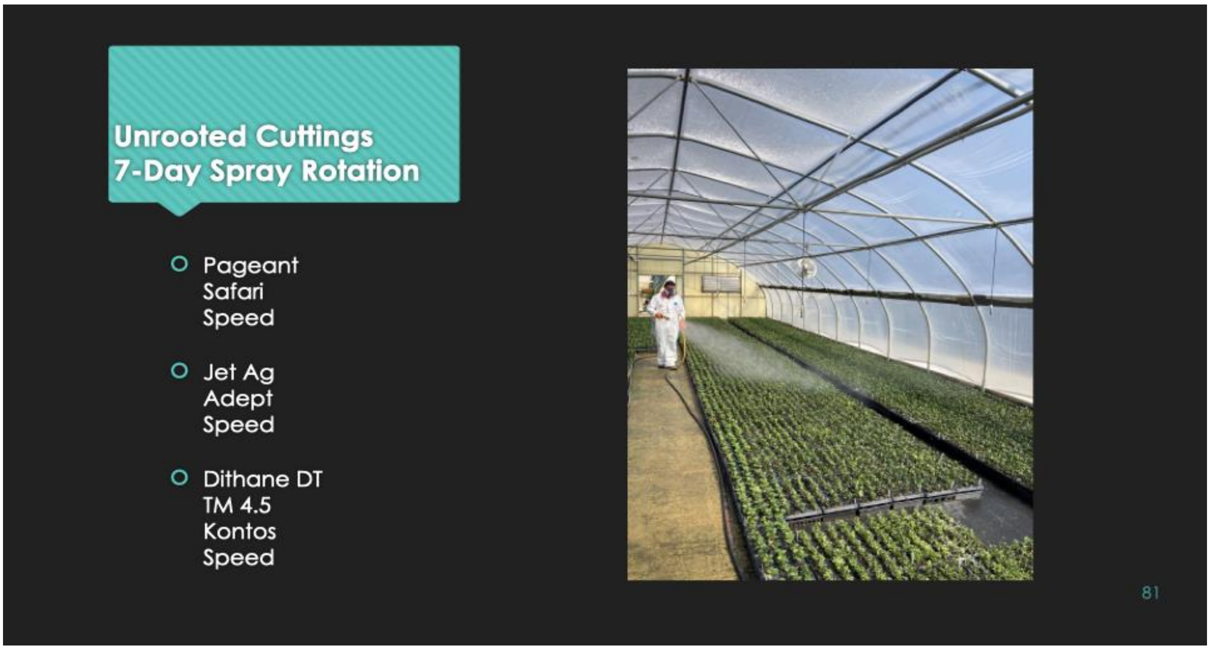


Figure 18. Spray rotation tank mixes and applicator applying preventative spray to unrooted cuttings.

ROOTING TIMELINE

The time required for root initiation varies based upon camellia species and cultivars. *Camellia sasanqua* cultivars initiate rooting in three to four weeks on average. *Camellia japonica* cultivars require six to eight weeks to initiate rooting. Mist applications are significantly reduced upon root initiation. Four weeks after root initiations, both *C. sasanqua* and *C. japonica* are well rooted, and misting is discontinued (Fig 19).

Figure 19. A 9x44 m **(**30x145 ft) greenhouse of rooted cuttings.

FERTILITY PROGRAM

The fertilizer components incorporated into the rooting substrate provide a portion of the essential nutrients required for healthy root development. Upon root initiation, additional fertilizer is applied to supplement the incorporated nutrients (Fig. 20). Water soluble fertilizer formulations can be applied through the irrigation system or as a drench application. Alternating 20-10-20 and 17-5-17 NPK will provide all the essential nutrients. One application of each, fourteen days apart, at 200 ppm nitrogen will be sufficient going into the fall and the dormant season.

The following spring, fertilizer applications resume. A broadcasted application of a granular or controlled release fertilizer is an effective way to provide a steady low rate of nutrients to the young, rooted cuttings. A controlled release fertilizer, such as 15-9-12 NPK with a 5-to-6-month release pattern, at 1.4kg/9m^2 (3 lb/100 ft^2) works well.

A complete fertility analysis of both substrate and plant tissue can determine the nutritional status of the crop and help fine tune the fertilizer program. A water analysis is also helpful because some nutrients may be supplied by the water itself.

Following the Virginia Tech pour-through protocol, a portable electrical conductivity meter is used onsite to quickly monitor the pH and fertility level in the substrate (Fig. 21). A good target range for proper pH is 5.8 to 6.2 and electrical conductivity range for a good fertility indicator is 0.8 to 1.5 when growing camellia liners. To learn more about this, the pour-through method developed by Dr. Robert Wright review document AG-717WAWA.pdf at www.nurserycropscience.info.

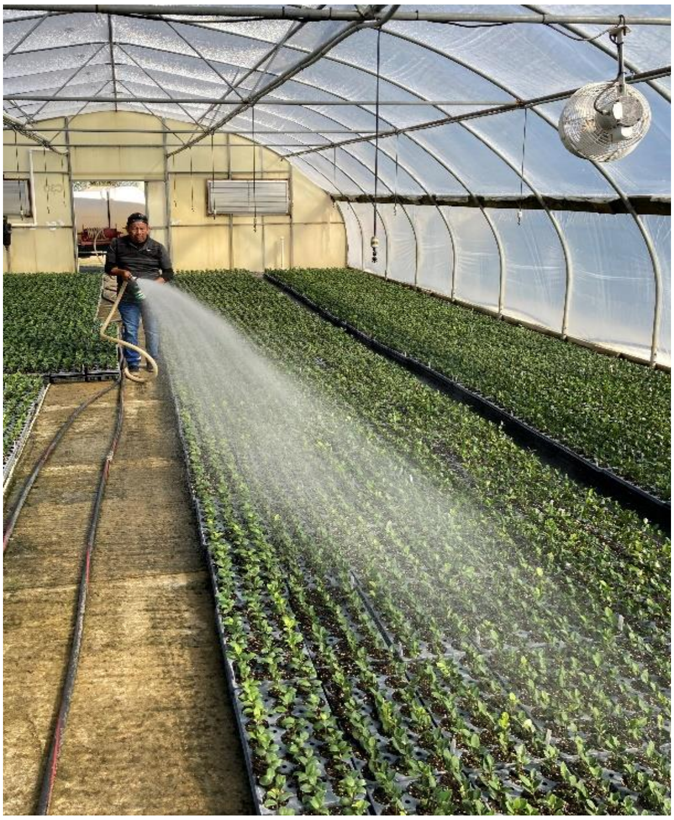


Figure 20. Drench application of water-soluble fertilizer to rooted cuttings to encourage healthy root development.

Figure 21. (left) Applying water to rooted cutting in order to provide leachate for analysis, and (right) measuring electrical conductivity and pH data of leachate to determine fertility level.

OVERWINTERING

Once cuttings are well rooted and mist applications have been discontinued, the temperature in the greenhouse is gradually reduced over several weeks. This allows the plants to acclimate to dormant season temperatures without cold injury. Acclimated plants are able to withstand near freezing temperatures without injury. A minimum temperature at 2°C (35°F) in the greenhouse will provide adequate protection to well acclimated rooted cuttings (Fig. 22). Upon acclimation, the rooted cuttings are transferred to an overwintering house. White overwintering plastic provides 50% shade during the dormant season. The white plastic is removed and replaced with 50% shade cloth after the frost-free date.

Figure 22. (left) Covering greenhouses with 50% opacity plastic for winter protection, and (right) outdoor mounted, direct fire, forced air heat for high efficency heating.

WEED MANAGEMENT

Preventative sanitation practices greatly reduce not only disease organisms but also weed seeds. Prior to filling each propagation house all debris is removed with a backpack blower. Next the house is sprayed with a disinfectant. Finally, a herbicide application is applied for weed prevention. Marengo® (a.i. indaziflam) or Sureguard® (a.i. flumioxazin) can be tank mixed with Roundup Pro® (a.i. glyphosate) and applied to the floor of an empty greenhouse (Fig. 23). Always review labels for instructions, precautions, and restrictions for all pesticides before application. The house is allowed to ventilate and dry for 24 hours before filling. The floor of each house is covered by a woven nylon ground fabric to prevent weeds as well. In addition, to sanitizing each house prior to filling with cuttings, either new or steam sterilized cell inserts are used (Fig. 24). Untreated used propagation trays are a potential source of both weed seeds and plant disease organisms.

Currently, Ronstar® G (ai. oxadiazon) by Bayer is the only preemergent herbicide labeled for use in propagation. It may not be used in an enclosed greenhouse. Therefore, it is applied after the overwintering plastic film is removed in the spring. Regular scouting for weeds, followed by timely hand weeding is necessary to manage weeds effectively.

Figure 23. Interior view of clean and sanitized propagation house.

Figure 24. New 18-cell and 21-cell tray inserts.

DISBUDDING

As cuttings are collected, all flower buds are removed to direct stored carbohydrates towards root development instead of flowering and seed formation. This also prevents botrytis blight on open flowers in the mist bed. Another round of disbudding is performed after cuttings have rooted and before the first flush of growth in the spring.

Figure 25. (left) Disbudding flower buds on rooted cuttings, (right) removed flower buds.

PRUNING

After the first flush of growth in the spring, liners are power sheared to promote branching. Blocks of liners are arranged in the house to accommodate a rolling gas-powered pruning machine. The overhead irrigation design allows for unobstructed access for the pruning machine and workers. All debris is blown and collected in a bag attachment on the pruning machine (Fig 26).

Figure 26. Gas powered sickle bar pruning machine with blower and bag attachment for uniform pruning and debris collection.

FINISHED LINERS

By early summer the following year, fully rooted branched liners are ready to shift up to either one-gal or three-gal containers (Figs. 27 and 28).

Figure 27. (left) Finished liners ready to pot into one-gal or three-gal containers, and (right) finished liners loaded onto trailers for transport to potting facility.

Figure 28. Well branched healthy camellia root systems.