A Production System and Costs for Propagating Dogwood Cultivars from Softwood Cuttings[1]

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Abstract

Propagation of flowering dogwood (*Cornus florida L.*) cultivars from softwood cuttings offers a successful alternative method to producing cultivars by field budding of dogwood seedlings. The total cost to produce an acceptable rooted cutting is $0.34. A 9-month propagation period, mid-July to mid-April, is required. Variable costs comprised 79% of total costs, with labor being the most important variable cost item. Rooting dogwood cultivars is economically practical and in the future more growers will be producing dogwoods by this propagation method.

Index words: rooting, *Cornus florida* cultivars, propagation cycle, production costs

Introduction

Two systems for producing flowering dogwoods (*Cornus florida L.*) recently described by Badenhop and Einert (1) started with propagation by seed. Although this method is generally successful, it is dependent on a source of well-ripened seeds from desirable stock trees. The supply of seed is subject to climatic conditions and may fluctuate greatly from year to year. Budding of seedlings is required to reproduce specific cultivars.

Propagation by rooted stem cuttings rather than by seed is an alternative propagating method. It could possibly be an easier and more efficient method of reproducing dogwood and would also permit cloning (3, 4, 7). Research concerned with propagation by stem cuttings of this species as practiced by nurserymen is limited; therefore, this study was undertaken with the following objectives: 1) to synthesize a monthly sequence of steps required to produce a quality rooted cutting, 2) to determine labor and equipment requirements to produce liners for 0.4 hectare (1 acre) of field production (about 4,833 cuttings if spaced 1.4 x 0.6 m (54 x 24 in)), and 3) to estimate the variable and fixed costs of producing a rooted cutting. Work reported herein with softwood cuttings of current year's growth was confined to those cultivars most commonly produced including *Cornus florida rubra* and *Cornus florida* cultivars 'Cherokee Chief,' 'Cherokee Princess,' 'Cloud Nine' and 'First Lady.'

Materials and Methods

Information on operational steps necessary to propagate salable dogwood plants by softwood cuttings was synthesized from data collected in 1984 from 8 nurserymen in the McMinnville, TN, area using an in-depth interview. Detailed information was obtained on the production cycle, labor and equipment requirements, and cost factors essential to the budgeting process.

Labor and equipment inputs were developed in terms of physical qualities and the timing of the activity. One of the most difficult items to estimate is the labor needed to perform individual tasks during crop production. Time and motion analysis and nursery crop records supplied by growers were used in making estimates of labor performance rates. Efficient workers exceed the rates used while others fall considerably below. An additional 20% was added to all direct labor requirements for overhead labor. This was assumed to account for time used for general maintenance of the propagation facility, repairs, time losses between jobs, and other activities which could not be allocated to a specific crop (2).

Variable costs are primarily explicit costs that vary directly with output. Costs for containers, fertilizer, insecticides, and operating costs of machinery and equipment increase as output per unit of time of a given system of producing rooted dogwood cuttings increase. These cost estimates include a constant unit input price times the input quantities associated with specified techniques and levels of output. In this study, all input costs were based on prices in July 1984, and the successful rooting of 4,833 cuttings. Interest was charged on one-half the variable cost items since it is not necessary to have all the funds immediately available at the beginning of the production period.

Fixed costs, on the other hand, are incurred regardless of output and are assumed to be constant for a given size operation. Some fixed costs are implicit costs relating to interest on fixed assets and returns to managerial and salaried supervisory labor. Other fixed costs are more explicit charges such as taxes, insurance, annual maintenance, advertising and promotional expenses and license and bonding fees. Another fixed cost is that of depreciation as a method of recovering the cost of a fixed asset over the useful life of the asset. Many fixed assets such as machinery, buildings and misting and irrigation systems have a useful life of more than 1 year but decline in value due to wear, degree of mainte-

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nance and obsolescence. Interest charges on capital assets were based on the current value of nondepreciable inputs (land) and on one-half the value of the depreciable items (buildings and equipment). The owner recovers his investment on depreciable items through depreciation allowances. Standard procedures were used to allocate the fixed costs (2, 9).

Results and Discussion

The production cycle synthesized from information provided by nurserymen is described in Table 1. It began with the preparation of the polyhouse for propagation in early July. Propagation medium was prepared by layering coarse sand and finely ground pine bark on ground beds in the propagation house and rototilling into the local clay soil to produce a thoroughly mixed medium of 60% bark, 20% clay, and 20% sand. (Some growers preferred a peat and sand mixture which is good for rooting but not as good as the soil mixture for continuing growth of the plant.) The medium was then fumigated under a clear polyethylene cover using methyl-bromide. Peat pots, 6.4 x 10.2 cm (2.5 x 4 in), in trays were filled with the medium, the medium was pressed firmly into each pot since cuttings root better in a firm medium than in a loose one (8), the beds were leveled and compacted, and the trays were placed on top of the beds. When this was completed, the propagation house was covered with 2 layers of 6 mil polyethylene film and 1 layer of shade cloth.

Twelve and seven-tenths to 17.8 cm (5 to 7 in) tip cuttings were taken in mid-July from cultivar stock blocks on the nursery. The best cutting was about 15.2 cm (6 in) with at least 3 pairs of leaves cropped to half a leaf (3). Best cuttings were produced from stock blocks that had been heavily pruned and fertilized (3). The soft cuttings were placed immediately in a container filled with water to prevent wilting (desiccation) and then moved to the preparation site. Cuttings were then stripped of all leaves except the last 3 or 2 pair at the top of the cutting. Wounding was not necessary for rooting, but most growers have adopted it as a standard practice. Cuttings were then wounded and quick dipped in a 2% (20,000 ppm) indolebutyric (IBA) rooting hormone solution. Cuttings were taken to the polyhouse after dipping where they were stuck to a 4 cm (1.6 in) depth in individual peat pots. It is important to take only that quantity of cuttings from the stock blocks which can be prepared and stuck during a given day.

Cuttings rooted in 6 to 8 weeks. During that time, cuttings were automatically misted for 5 seconds at 10-minute intervals everyday from 8:00 a.m. to 5:00 p.m. Misting was discontinued after the plants were rooted and then they were watered only as needed. Any cutting having 1 or more roots was considered to have rooted.

Fertilizer (9-45-15) was applied once after the cuttings were rooted. A fungicide (Benlate) was applied every 30 days as a preventative, and insecticide (Sevin) was applied as needed, normally 2 times during the production

Table 1. Production cycle including labor and equipment requirements for propagating 4,833 dogwood liners from softwood cuttings for 0.4 hectare (1 acre) of field production, Tennessee, 1984.

Month	Operation description[z]	Equipment	Hours per 5,400 cuttings	
			Machine	Man
July	Fill ground beds with 60% pine bark, 20% soil, 20% sand, mix thoroughly	Rotary tiller	0.25	2.00
	Fumigate medium with methyl-bromide	Hand	——	2.00
	Fill 5,400 peat pots with medium; set in flats on top of remaining medium	Hand	——	24.00
	Take 5,400 tip cuttings from cultivar stock block, trim, quick-dip in 2% IBA, stick into peat pots	Pickup, ½ ton	2.00	60.00
	Cover greenhouse with 2 layers of 6 mil. polyethylene film and 1 layer shade cloth	Hand	——	7.00
July-August	Mist cuttings 5 seconds every 10 minutes, 8:00 a.m. to 5:00 p.m.; continue misting 6-8 weeks or until cuttings have rooted	Mist system	3.70	1.00
	Apply fungicide (Benlate)—1 time (x)	Sprayer, backpack	0.10	0.25
August-April	Apply fertilizer (9-45-15)—1x after cuttings have rooted	Hand	——	0.25
	Apply fungicide (Benlate) every 30 days—8x	Sprayer, backpack	1.50	2.00
	Apply insecticide (Sevin)—2x	Sprayer, backpack	0.40	0.50
	Check, observe, water as needed after cuttings have rooted	Irrigation system	10.00	21.00
	Remove shade cloth in early December	Hand	——	1.00
	Keep greenhouse heat to 34 °F (1 °C) from December 1 to mid-March	Heater	267.00	1.00
	Rooted cuttings ready for harvest, April 15; 90% survival rate of cuttings stuck			

[z]Trade names which appear are intended only as an example, not an endorsement.

period. The shade cloth was removed from the polyhouse in early December.

Young rooted cuttings must be given winter protection because the roots must not be allowed to freeze. Thus, supplemental heat was provided to keep polyhouse heat $\geq$ 1 °C (34 °F) from early December to mid-March. Rooted cuttings were ready to harvest by mid-April after the danger of frost was past and the cuttings had leafed out. Growers reported that 90% of the cuttings taken rooted and survived through the winter. There was very little difference between cultivars in the percent which were rooted successfully, although reds were slightly more difficult to root than the pinks or whites.

Estimated variable costs are outlined in Table 2. These costs were subdivided into the following categories: materials, machinery and equipment, labor, and interest on operating capital. Total variable costs to produce 4,833 liners amounted to about $1,310 or $0.27 per liner. Twenty-eight percent of these costs were for materials, 17% for machinery and equipment, 50% for labor and 5% for interest on operating capital. One hundred forty-six man hours of labor were required to produce the 4,833 liners. Of these man-hours, 122 were for labor required to propagate the cuttings and 24 were overhead labor hours associated with the propagation. The computed values are consistent with the findings of other researchers (2, 5).

Fixed or overhead costs are difficult to estimate for propagation operations. Fixed costs vary with costs associated with capital investment, spacing interval of the cuttings stuck for rooting, survival rate of the plants, and length of the production cycle. Estimated fixed costs were based on information provided by growers interviewed in this study and amounted to $342 which was 21% of the total production costs for the

Table 2. Estimated variable costs of propagating 4,833 dogwood liners from softwood cuttings for 0.4 hectare (1 acre) of field production, Tennessee, 1984.

Item	Description	Unit	Quantity	Cost per unit	Total
				—dollars—	
Materials[z]	Peat pots	each (6.4 cm² x 10.2 cm)	5,400	.03	162.00
	Plastic trays[y]	each (48.3 cm² x 7.0 cm)	100	.65	32.50
	Plastic for polyhouse[x] 6 mil., clear	sq. ft. (.093 sq. m)	8,000 (12% for crop)	.06	28.80
	Plastic for fumigation[x] 6 mil., clear	sq. ft. (.093 sq. m)	3,200 (12% for crop)	.06	23.04
	Shade cloth[x]	sq. ft. (.093 sq. m)	3,770 (12% for crop)	.14	12.67
	Soil mixture, pine bark, sand, soil	cu. yd. (.765 cu. m)	6.0	14.00	84.00
	Rooting hormone, 2% IBA	pt. (.473 L)	1.0	12.00	12.00
	Fertilizer, 9-45-15	lb. (.45 kg)	5.0	.60	3.00
	Benlate (fungicide)	lb. (.45 kg)	.3	12.55	3.76
	Sevin (insecticide)	lb. (.45 kg)	.06	2.50	0.15
	Methyl-bromide (fumigant)	lb. (.45 kg)	5.0	1.40	7.00
Subtotal					368.92
Machinery and equipment	Rotary tiller	hr.	.25	.97	.24
	Pickup, 1/2 ton	hr.	2.0	9.18	18.36
	Misting system	hr.	3.7	.25	.92
	Irrigation system	hr.	10.0	.75	7.50
	Sprayer, backpack	hr.	2.0	.30	.60
	Overwintering, minimum heat	rooted cutting	4,833	.04	193.32
Subtotal					220.94
Labor	Hired labor	hr.	122.0	4.50	549.00
	Related hired labor hours[w]	hr.	24.0	4.50	109.80
Subtotal					658.80
Interest on operating capital, 4.5 months @ 13%	——	——	——	——	60.87
TOTAL VARIABLE COSTS					1,309.53

[z]Trade names which appear are intended only as an example, not an endorsement.

[y]The plastic trays are used for 2 years. The depreciation cost of the trays is calculated by dividing the initial value by the useful life of the trays.

[x]Dogwood liners use 12% of the bed space in the polyhouse. Consequently, only 12% of the polyethylene film and shade cloth covering the polyhouse are charged to the dogwood liners. Since the polyethylene film covering is used 2 years and the shade cloth 5 years, the costs assessed to each were charged accordingly.

[w]Related hired labor activities include time used for general maintenance of the propagation facility, repairs, purchasing supplies, time losses between jobs, and other activities which could not be allocated to a specific crop. These hours were estimated at 20% of production labor hours.

9-month propagation period (Table 3). These costs were grouped into 4 categories: land, buildings, machinery and equipment, and general overhead. Land accounted for 8%, buildings for 10%, machinery and equipment for 18%, and general overhead for 64% of total fixed costs. These results are similar to those found in other studies and amounted to $0.07 per rooted cutting (6). The sum of the variable and fixed costs was $0.34 per rooted cutting.

Significance to the Nursery Industry

Results of this study indicate that propagation of dogwood cultivars from softwood cuttings is a feasible alternative method to producing cultivars by field budding of dogwood seedlings. Ninety percent of the softwood cuttings were rooted; the cost prorated per rooted cutting was $0.34. Growers interviewed believed rooting dogwood cultivars is economically practical and that more growers in the future will be producing part of their supply of dogwoods for sale by this propagation method.

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Table 3. Estimated fixed costs of propagating 4,833 dogwood liners from softwood cuttings for 0.4 hectare (1 acre) of field production, Tennessee, 1984.

Item	Description	Estimated fixed cost
		— —dollars— —
Land	Taxes[z]	2.32
	Interest[y]	26.75
Subtotal		32.74
Buildings	Depreciation[x]	13.83
	Interest[y]	14.20
	Insurance and taxes[w]	4.71
Subtotal		32.74
Machinery and equipment	Depreciation	32.54
	Interest	20.77
	Insurance and taxes	6.81
Subtotal		60.12
General overhead	Utilities (telephone, electricity)	7.95
	General repairs and maintenance	13.84
	Advertising and printing	2.95
	Licenses and bonds	1.26
	Insurance, personnel	6.05
	Travel and other professional fees	2.90
	Administrative and management (clerical, operator, supervisory labor and office supplies)	161.24
	Miscellaneous	2.53
	Interest, at 13% per annum for 4.5 months	21.74
Subtotal		220.46
TOTAL FIXED COSTS		342.39

[z]Taxes were estimated at the rate of 2% per year of assessed value; value is full market value.

[y]Interest on land was at the rate of 13% per year of full market value. For buildings and equipment, interest was estimated by taking 13% of the average value of buildings and equipment based on initial cost and salvage value.

[x]Depreciation was estimated by dividing initial cost adjusted for salvage value by years of useful life.

[w]Insurance and taxes were an estimated cost based on 2% of the initial cost of the buildings and equipment.