THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
KNOXVILLE, TENNESSEE 37916
E11-1107-03-008-83

Cost of Producing and Marketing Rooted Cuttings of Three Woody Ornamental Species in Tennessee, 1980

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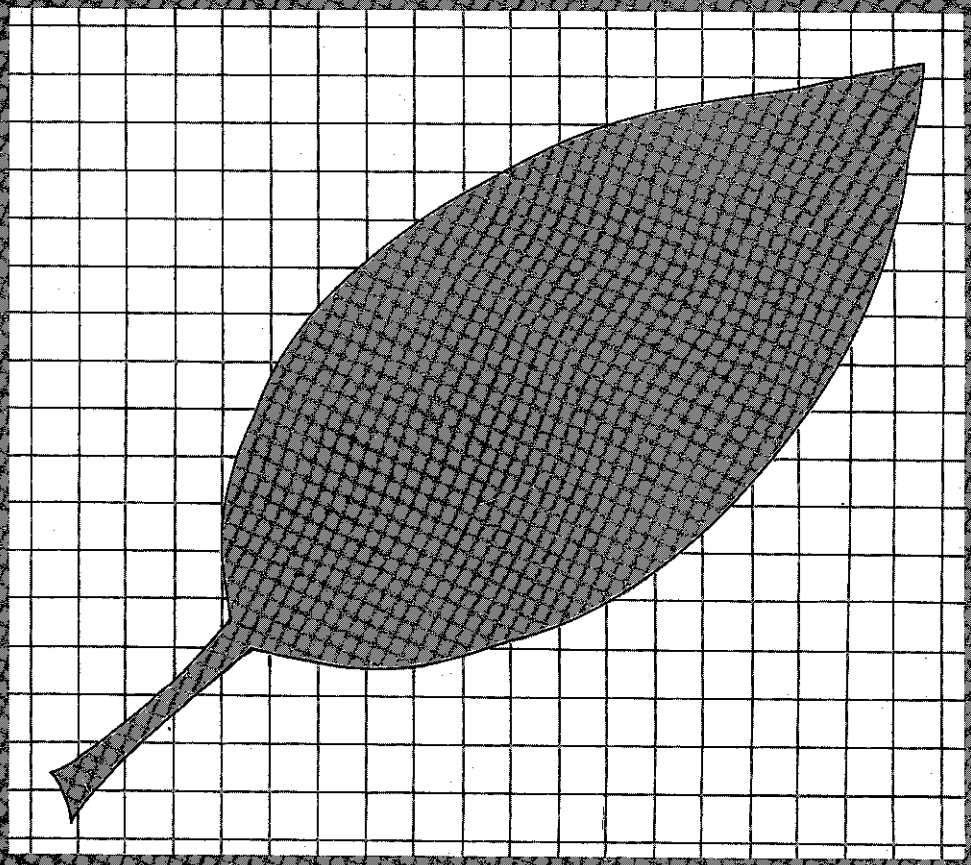

Bulletin 624
April 1983

The University of Tennessee
Agricultural Experiment Station
Knoxville, Tennessee
D. M. Gossett, Dean

ABSTRACT

The objective of this study was to develop an accurate means of computing total production and marketing costs incurred in propagating a woody ornamental cutting in Tennessee. A form developed by Oregon State University Agricultural Extension Service personnel was modified and used by propagators in Tennessee to determine their propagation costs. Production and marketing costs were determined for three species of woody ornamental rooted cuttings produced in three production systems.

Production and marketing costs per salable rooted cutting varied between species and among the production systems. Labor expense was the major cost in the total production and marketing cost per cutting. Both cash and non-cash costs were considered when computing production and marketing cost. Non-cash cost was a significant portion of the total production and marketing cost per salable rooted cutting.

KEY WORDS: Andorra junipers, Hetz hollies, dwarf winged euonymus

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by
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INTRODUCTION

Plant propagators in Tennessee and other nursery producing states have limited information about production and marketing costs and the methods of cost determination for woody ornamental rooted cuttings (liners). Without accurate production cost data, growers are less likely to determine realistic and competitive selling prices for their products. Up-to-date production cost data also aid growers in making important managerial decisions that can result in reduced costs and increased profits.

Production and marketing costs vary among growers and between plant species. Variations are due to differences in production practices, cost of production materials, size and efficiency of operations, marketing strategies, and overhead costs. Growers often price plants based on competitors selling price. Since production and marketing costs vary among growers and between species, the probability of two growers having the same cost for the same plant species is low.

The selling price for each plant should cover not only the production and marketing cost but also the desired return on investment (profit). Net profit is the money remaining after all production and marketing costs are paid. In other words, total sales revenue minus total production and marketing costs equals net profit. Without accurate cost data, growers are less likely to identify the profitability of various plant species and the best production methods and thus have less control over net profits.

Total production and marketing costs consist of two components, variable and fixed costs. Variable or direct costs (media, insecticides, fertilizer) vary in relation to the number of plants produced. For example, the greater the number of plants produced the greater will be the amount of fertilizer used. Fixed costs, known also as indirect or overhead costs

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(depreciation on buildings and equipment, maintenance, insurance, utilities) do not vary in relation to the number of plants produced. For example, depreciation on buildings will remain the same even if the number of plants produced is decreased.

Major obstacles to the determination of production and marketing costs have been the identification of specific cost components and the record keeping required. To overcome this obstacle, a form was developed for computing plant propagation and marketing costs using estimates [5].The form enables growers to determine cost with minimum record keeping, identifies all cost components from the beginning to the end of the production cycle, and computes a total production and marketing cost for each salable liner.

The general objective of this report was to develop economic information applicable to plant propagators in Tennessee and other nursery producing states on the production of woody ornamental liners. The specific objectives were to:

1. Develop an accurate means of determining total production and marketing costs incurred in propagating a woody ornamental liner in Tennessee.
2. Determine the total production and marketing costs for liners of three woody ornamental plant species commonly produced by Tennessee growers. These were: *Juniperus horizontalis* 'Plumosa Compacta Youngstown' (Youngstown Andorra Juniper), *Ilex crenata* 'Hetzii' (Hetz Japanese holly) and *Euonymus alatus* 'Compactus' (dwarf winged euonymus).

REVIEW OF PREVIOUS WORK

Published data on the costs of producing and marketing specific species or cultural groups of plants are limited. Early works were concerned primarily with the broad aspects of nursery production economics such as the usefulness of cost data and bookkeeping systems. More recent studies have provided valuable information on costs of production, cost-price relationships, and production systems. However, data on the costs of plant propagation of specific ornamental plants are almost non-existent.

Padgett and Frazier [10] determined average cost of production for liners, 1-gallon, and 3-gallon container plants for small, medium, and large container nurseries in Georgia, but individual plant species were not considered.

Yager [14] computed production cost of liners at the Cartwright Nursery in Tennessee but it was assumed that all liner costs were the same regardless of species.

Hahn *et al.* [9] reported for container-grown stock the specific cost divisions of the production cycle. Results showed the cost divisions with the

greatest impact on reducing total production costs for large producers were overhead, canning, liners and the length of the production cycle. However, the effect of plant species was not considered.

Badenhop, *et al.* [1, 2, 3, 4] and Coutu [6] developed cost of production budgets and cost-price relationships for five woody ornamental species at nurseries within USDA plant hardiness zones 7, 8, and 9 (Figure 1). Differences in production techniques were found to be a major source of variation in cost of production between climatic zones and among individual growers. Results indicated that production cost advantages existed for producers in the Southeastern part of the United States.

Phillips [11, 12] developed a method to estimate the cost of producing woody ornamental landscape plants. Records required for completing the Internal Revenue Service Schedule F, Form 1040, were used in conjunction with cost of production budgets.

Crafton, *et al.* [7] developed cost of production budgets and decribed production techniques for five woody ornamental container crops in Climatic Zone 8 in the South. Two budgets representing two different production techniques (usual method and alternate method) were determined for each crop. The results showed that labor cost and total cost of production varied according to plant species and type of production technique used.

METHODS

A primary objective of this study was to develop a practical and accurate method for computing the production and marketing costs of propagating a woody ornamental liner in Tennessee (Figure 2). A cost form (Appendix A) was developed to record expenditures made by propagators. The form was designed to reflect expenses normally incurred by plant propagators in Tennessee but is easily adaptable to other input costs and growing areas.

Skilled labor (operator, supervisor, foreman) cost in this study was set at $4.50 per hour. Unskilled labor (laborers) cost was set at $4.00 per hour. The total wage rate included the basic wage, social security tax (FICA), workmen's compensation insurance, and federal unemployment compensation.

The mileage rate used for calculating travel costs was $0.25 per mile and was based on 1980 AAA Auto Club estimates. This rate covered gasoline, oil, maintenance and repair, insurance, depreciation, and other miscellaneous costs.

Tennessee propagators sometimes use other grower's stock plants as a source for unrooted cutting material.[1]This arrangement allows the propagator to benefit from stock plants without the responsibility for

[1]Stock plants are used only as a source of cutting material.

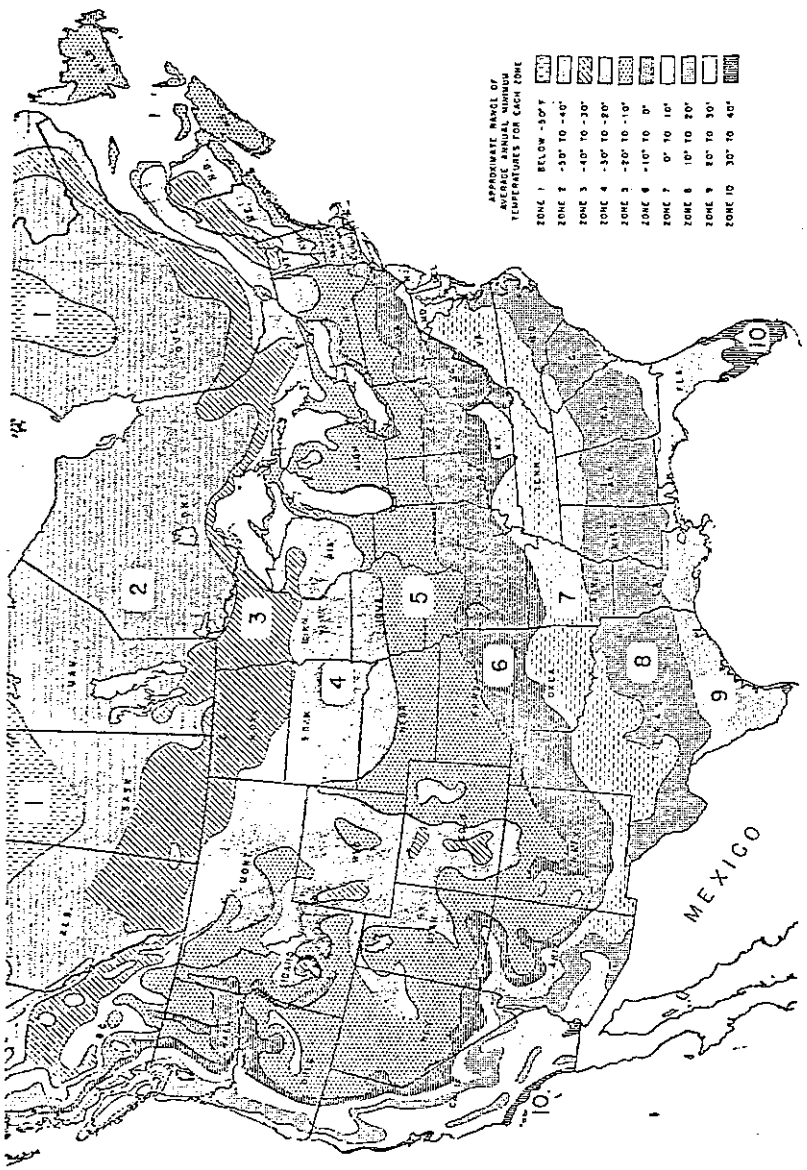

FIGURE 1. Zones of plant hardiness in the United States (from Plant Hardiness Zone Map, U.S. Dept. of Ag. Misc. Pub. 814, 1960).

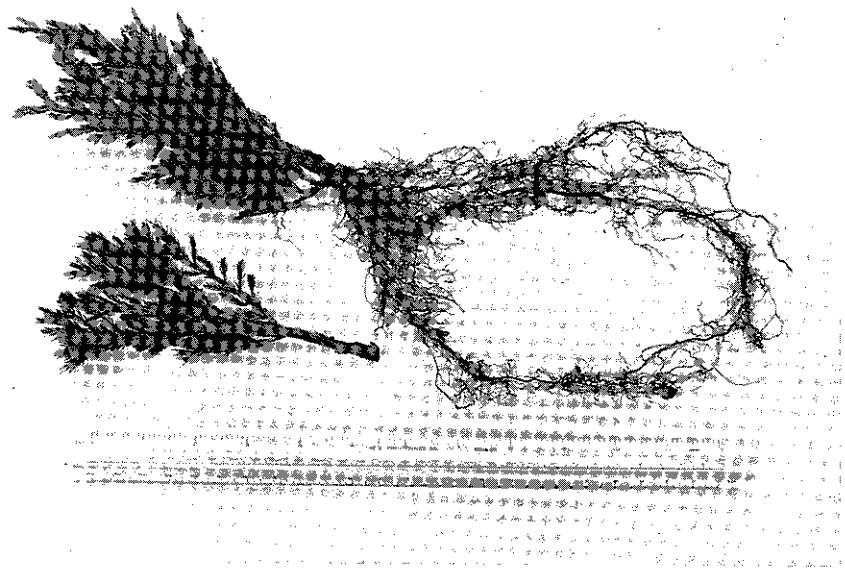

FIGURE 2. Unrooted and rooted Youngstown Andorra Juniper cuttings.

maintenance costs such as fertilization and weeding. As compensation for this service, the supplier of the unrooted material receives a percentage of the propagators rooted crop (trade-back) or a discount on liner or other nursery stock purchased at a later date. The normal trade-back practice is for the supplier to receive up to 10% of the rooted cuttings in return for providing the unrooted cuttings.

Propagators normally do not consider trade-back plants a cost item when computing production costs. However, this investment should be recovered because the propagator invested capital into the trade-back cuttings during their development. Production costs must therefore be increased on the remaining (after trade-back) marketable crop to account for the trade-back expense. Provisions for determining trade-back cost were included in this study.

Opportunity cost is the return a resource (capital) can earn when put to its best alternative use [8]. By investing capital into the nursery business, the owner has elected to forego the opportunity to use money in other enterprises. A 12% annual interest rate was used to compute opportunity cost for capital expenditure.

Depreciation cost was calculated using the straight-line method.[2] As a

[2]Original cost less salvage value divided by useful life in years.

piece of equipment or a building is used, its economic value is gradually transformed into a product such as rooted cuttings [8]. Depreciation cost sets aside the expended economic worth so that it may be used to replace the resource at the end of its useful life.

Cash and non-cash costs were used in computing production and marketing cost. Cash costs were those costs which required the grower to spend money, commonly called out-of-pocket expenses. Wages and material equipment expenditures are examples of such costs. Non-cash costs do not involve the actual transfer of funds. These costs were difficult for most producers to determine since money was not physically spent. Examples of non-cash costs are deprectiation and interest. Many growers fail to consider non-cash costs when computing production and marketing cost and may under-estimate the total capital required to produce plants.

Production and marketing costs for this study were developed using data supplied by Tennessee propagators for three commonly grown plant species.

PRODUCTION SYSTEMS

Three distinct production systems were evaluated. Each production system used similar production cycles which were standardized for this report. Two basic types of propagation facilities were used: (1) individual outdoor beds and (2) plastic covered quonset houses containing two growing beds (Figures 3, 4, and 5).

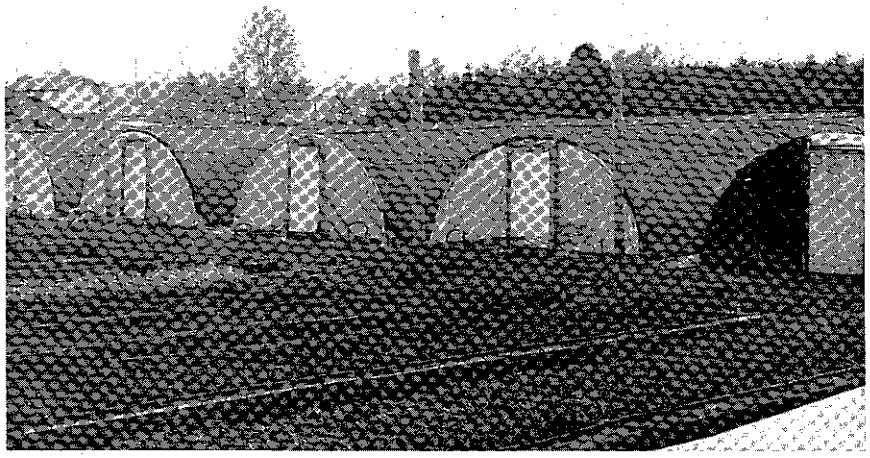

FIGURE 3. Types of propagation structures used by growers; outdoor beds and quonset houses.

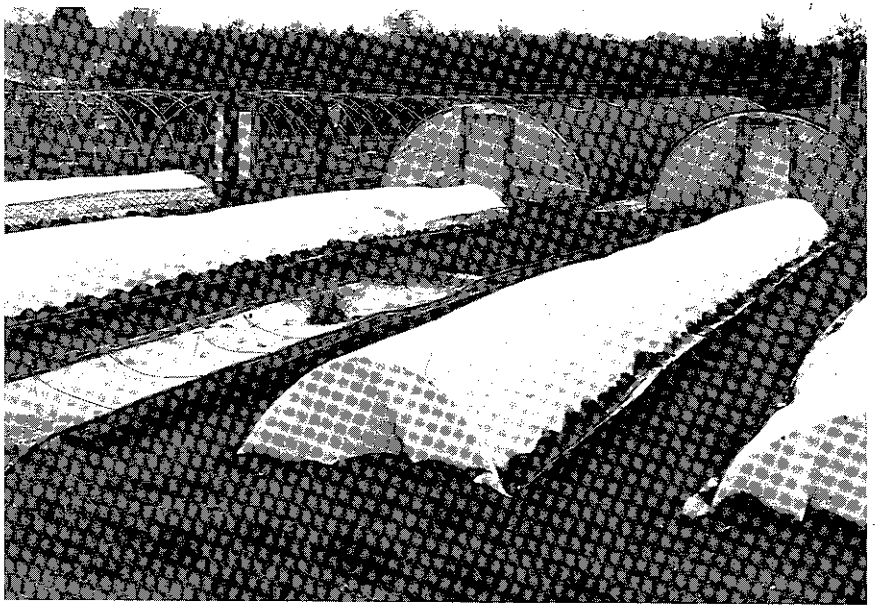

FIGURE 4. Outdoor beds covered for winter protection.

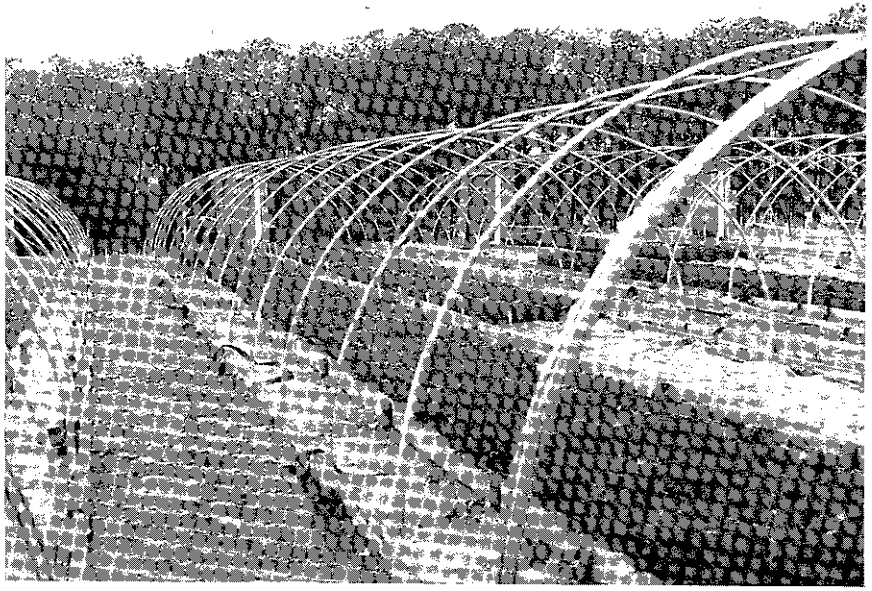

FIGURE 5. Quonset house containing two beds.

Production System One used 4 ft. × 50 ft. (1.2 m. × 15.2 m.) outdoor propagation beds for all production. Concrete reinforcement wire was used to support the plastic covering. The structures were kept closed until rooting began. Cuttings were misted for 6 to 8 weeks or until rooting was well underway and then handwatered until harvest. After cuttings were well established the plastic covering was removed.

Production System Two used 12 ft. × 98 ft. (3.7 m. × 29.9 m.) plastic covered quonset houses which contained two 5 ft. × 96 ft. (1.5 m. × 29.2 m.) propagating beds. Cuttings were misted for 6 to 8 weeks or until rooted. During spring and summer, houses were sprayed with white wash or covered with shade cloth to reduce light intensity and temperature. Normal maintenance practices were used until harvest.

Production System Three used both the 12 ft. × 98 ft. (3.7 m. × 29.9 m.) plastic covered quonset houses which contained two 4 ft. × 96 ft. (1.2 m. × 29.3 m.) growing beds and 4 ft. × 48 ft. (1.2 m. × 14.6 m.) outdoor propagation beds. Culture techniques were similar to those used in Systems One and Two.

Standardized Production Cycle for Youngstown Andorra Juniper, 1980

November-December	Take and prepare cuttings for propagation, stick cuttings, cover bed/house for winter protection, mist 6 to 8 weeks or until cuttings are well rooted.
April	Remove winter protection, perform required cultural practices (weed, water, fertilize).
July	Prune cuttings and continue performing required cultural practices.
February-March	Harvest, grade, pack and ship cuttings (18 months average in propagation bed).

Standardized Production Cycle for Hetz Japanese Holly, 1980

September	Take and prepare cuttings for propagation, stick cuttings, mist 6 to 8 weeks or until cuttings are rooted.
December	Cover bed/house for winter protection.
March	Remove winter protection.
April	Perform required cultural practices (weed, water, fertilize).
July	Prune cuttings and continue performing required cultural practices.
September	Prune cuttings and continue performing required cultural practices.
November	Cover bed/house for winter protection.
February	Remove winter protection.
March	Harvest, grade, pack and ship cuttings (18 months average in propagation bed).

Standardized Production Cycle for Dwarf Winged Euonymus, 1980[a]

July	Take and prepare cuttings for propagation, stick cuttings, mist 6 to 8 weeks or until cuttings are rooted.
August	Perform required cultural practices (weed, water, fertilize).
October	Discontinue fertilization.
March	Harvest, grade, pack and ship cuttings.

PRODUCTION CYCLE CHARACTERISTICS

Data for the 1980 rooted cutting crop were used in this study. The length of production cycle, number of cuttings stuck, and survival rate of cuttings for each grower are given in Table 1.

Table 1. Production cycle characteristics of three species of woody ornamental rooted cuttings for three production systems, 1980

Plant species	Unit	Production System One	Two	Three
Youngstown Andorra juniper				
survival percentage	percent	70	80	85
cuttings stuck	number	33,000	82,000	13,700
length of production cycle	months	18	18	18
Hetz Japanese holly				
survival percentage	percent	65	90	85
cuttings stuck	number	23,100	24,100	15,800
length of production cycle	months	18	18	20
Dwarf winged euonymus				
survival percentage	percent	60	90	85
cuttings stuck	number	69,000	36,000	59,800
length of production cycle	months	7	7	24

The survival percentage of cuttings was dependent on mortality and culling losses which were estimated for each production system using records from previous crops. System One had the lowest survival percentage on all species. Systems Two and Three had survival percentages ranging from 80 to 90% for the three species. Survival percentage depended on several factors: (1) the species rooted, (2) adequate misting of cuttings during root development,(3) maintenance (weeding, watering, pruning, fertilizing) of rooted cuttings through development into a marketable plant, and (4) grading standards used in selecting salable cuttings.

[a]The production cycle averaged 7 months in length for Production Systems One and Two. A 24-month production system was used in Production System Three.

The size of each cutting crop stuck was obtained from production records kept by growers. Growers considered past sales records and the availability of the species in the marketplace to decide which species to grow and how many cuttings of a species to produce.

All three production systems used similar production cycles for Youngstown Andorra juniper and Hetz Japanese holly. However, for dwarf winged euonymus, Production Systems One and Two had a 7-month production cycle while System Three had a 24-month production cycle.

Production data used in determining the production and marketing costs for each production system are given in Table 2. The primary difference in production cost data between systems was overhead expense, in particular, initial investment in buildings and equipment.

Computed Production and Marketing Cost

The computed production and marketing cost per marketable cutting for each species and production system is given in Table 3. System Two had the lowest production and marketing cost for all three species while System Three had the highest. A comparison of production and marketing cost per rooted cutting with the wholesale selling price demonstrates the importance of knowing all costs (Table 2).

Cash and Non-Cash Costs

Cash and non-cash costs are given in Table 4. Cash cost ranged from 6.7 to 26.2 cents per salable cutting or 61 to 79% of the total production and marketing costs. Non-cash cost ranged from 3.3 to 16.8 cents per salable cutting or 21 to 39% of the total production and marketing costs. Non-cash costs were a significant component of the total production and marketing costs. If a producer does not take non-cash cost into account, an under-estimation of investment may occur.

Labor Cost

Labor expense was a large portion of the total production and marketing costs. Labor cost as a percentage of total costs is shown in Table 5. Labor cost percentage ranged from 30 to 53% of the total production and marketing costs for the three species. The computed values support the findings of other researchers [9, 13]. System Three had the least variation in labor cost percentage, ranging from 30 to 32% of total cost. Table 6 shows that System One used 11.5 man-hours of labor per thousand rooted dwarf winged euonymus cuttings (7-month production cycle) as compared to 9.4 and 8.6 man-hours, respectively, for the Andorra juniper and Hetz holly (18-month production cycles). Plant propagation practices used in

Table 2. Production data used for computation of production and marketing costs of three species of woody ornamental rooted cuttings for three production systems, 1980

Item	Unit	Production System One	Two	Three
Factor costs				
Land per acre	dollars	3,000	1,500	1,500
Taxes per acre	dollars	15	2	5
Labor per hour				
Skilled	dollars	4.50	4.50	4.50
Unskilled	dollars	4.00	4.00	4.00
Management				
Labor, percent of total labor cost	percent	20	20	20
Operation, percent of total cash costs	percent	15	15	15
Capital interest rate (annual)	percent	12	12	12
Overhead (annual)	dollars	15,300	25,000	24,000
Total cuttings produced	million	.5	1	.5
Initial investment				
Buildings	dollars	30,000	80,000	80,000
Propagation structure				
Bed	dollars	209	---	150
Greenhouse	dollars	---	500	400
Irrigation system				
Bed	dollars	125	---	117
Greenhouse	dollars	---	294	303
Equipment	dollars	3,500	22,600	59,500
Wholesale price per plant/size of plant at harvest				
Youngstown Andorra juniper	dollars/inches	.32/6	.32/6	.30/6
Hetz Japanese holly	dollars/inches	.30/6	.30/6	.30/6
Dwarf winged euonymus	dollars/inches	.30/6	.30/6	.55/6-9 .80/9-12

the three production systems require much hand labor. Maintenance practices (weeding, watering, pruning, fertilizing) are done primarily by hand. Little mechanization was involved in production of the three species studied. The labor time used for each crop was influenced by: cultural requirements of the species, (2) efficiency of workers and/or supervisors and (3) length of the production cycle.

Andorra juniper and Hetz holly were pruned a minimum of one time during the 18-month production cycle in all three systems. However, dwarf winged euonymus was not pruned since it produces only one flush of growth during each growing season. Thus, pruning labor for dwarf winged euonymus was less.

Table 3. Production and marketing costs per marketable rooted cutting for three species of woody ornamental plants for three production systems, 1980

Plant species	Production System			Average for species
	One	Two[a]	Three	
	cents per rooted cutting			
Youngstown Andorra juniper	27	18	34	26
Hetz Japanese holly	30	20	43	31
Dwarf winged euonymus	20	10	40	23
Average for system	26	16	39	

[a]Actual production cost may be slightly higher for Youngstown Andorra juniper and Hetz Japanese holly due to discounts on other types of plant material in place of trade-back arrangement.

For Andorra juniper, System Two required only 7.1 man-hours per thousand rooted cuttings compared to 9.4 and 10.0 man-hours, respectively, for Systems One and Three. These data show the comparative labor efficiency advantage of System Two, especially when the size of the crop is considered. System Two produced 82,000 Andorra juniper cuttings while Systems One and Three produced 33,000 and 13,700, respectively.

System Two used 11.7 man-hours of labor to produce a thousand Hetz holly cuttings versus 7.2 man-hours to produce a thousand dwarf winged euonymus cuttings. The difference in man-hour requirement between the two species was due partially to the length of the production cycle (18-month for Hetz holly and 7-month for dwarf winged euonymus).

System One required 1.9 beds to propagate Hetz holly cuttings but 9.6 beds were required to produce dwarf winged euonymus. Thus, more man-hours were necessary to prepare, stick, harvest and maintain the dwarf winged euonymus cuttings. Data show that .0115 man-hours of labor were

Table 4. Cash and non-cash amount and percentage of total production and marketing cost for three species of woody ornamental rooted cuttings for three production systems, 1980

Plant species	Production system					
	One		Two		Three	
	Cents per plant	Percent of total cost	Cents per plant	Percent of total cost	Cents per plant	Percent of total cost
Youngstown Andorra juniper						
Cash	17.8	66	12.2	68	22.1	65
Non-cash	9.2	34	5.8	32	11.9	35
Total	27.0	100	18.0	100	34.0	100
Hetz Japanese holly						
Cash	19.2	64	14.0	70	26.2	61
Non-cash	10.8	36	6.0	30	16.8	39
Total	30.0	100	20.0	100	43.0	100
Dwarf winged euonymus						
Cash	15.8	79	6.7	67	24.8	62
Non-cash	4.2	21	3.3	33	15.2	38
Total	20.0	100	10.0	100	40.0	100

Table 5. Labor cost as a percentage of total production and marketing costs for three species of woody ornamental rooted cuttings for three production systems, 1980

Plant species	Production System		
	One	Two	Three
	percent		
Youngstown Andorra juniper	36	39	32
Hetz Japanese holly	33	46	31
Dwarf winged euonymus	53	47	30

used per dwarf winged euonymus cutting while .0086 man-hours of labor were required to produce a Hetz holly cutting (Table 6).

Table 6. Man-hours required to produce one thousand woody ornamental rooted cuttings of three species for three production systems, 1980

	Production System		
	One	Two	Three
	Man-hours per thousand rooted cuttings		
Youngstown Andorra Juniper	9.4	7.1	10.0
Hetz Japanese holly	8.6	11.7	11.8
Dwarf winged euonymus	11.5	7.2	12.7

Analysis of Production and Marketing Costs

An analysis of the cost categories used in determining total production and marketing costs of each species for each system is given in Table 7. A more detailed itemization of the cost categories shown in Table 7 is given in Tables 8, 9 and 10.

Cost of cutting (before sticking). The cutting (before sticking) cost category was subdivided into: (1) cuttings taken from plants other than stock plants, (2) cuttings taken from stock plants and (3) cuttings purchased. None of the growers surveyed purchased cuttings from a commercial supplier for any of the species studied. Stock plants of other producers were used as a source of cuttings under System One for the three species. Stock plants of other growers were also the source of cuttings under System Two, except for the dwarf winged euonymus. A stock block of dwarf winged euonymus was maintained as a cutting source under System Two. Stock blocks were maintained as a source of cuttings for all three species under System Three.

Travel time for laborers to collect cuttings and maintenance of vehicles was less under System Three because of maintained stock blocks. A supply of unrooted cutting material was guaranteed under System Three because

Table 7. Amount and percentage of production and marketing costs by cost categories for three species of woody ornamental rooted cuttings for three production systems, 1980

Cost categories	Production system					
	One		Two		Three	
	Cents per plant	Percent of total cost	Cents per plant	Percent of total cost	Cents per plant	Percent of total cost
Youngstown Andorra juniper						
Cutting (before sticking)	1.5	5.6	1.1	6.3	3.7	10.9
Rooting and growing cuttings	13.2	48.9	10.0	55.6	17.8	52.2
Overhead	6.6	24.6	4.7	25.9	8.5	25.1
Operating capital interest	3.2	11.8	2.2	12.2	4.0	11.8
Trade-back[a]	2.5	9.1	---	---	---	---
Total	27.0	100.0	18.0	100.0	34.0	100.0
Hetz Japanese holly						
Cutting (before sticking)	1.2	4.1	4.0	20.0	2.3	5.4
Rooting and growing cuttings	15.4	51.3	9.3	46.6	25.7	59.7
Overhead	7.2	24.1	4.2	20.8	9.7	22.6
Operating capital interest	3.5	11.5	2.5	12.6	5.3	12.3
Trade-back[b]	2.7	9.0	---	---	---	---
Total	30.0	100.0	20.0	100.0	43.0	100.0
Dwarf winged euonymus						
Cutting (before sticking)	2.9	14.5	2.8	28.3	0.7	1.8
Rooting and growing cuttings	12.1	60.5	5.1	50.5	23.8	59.4
Overhead	2.9	14.7	1.6	16.5	9.6	24.0
Operating capital interest	1.1	5.5	0.5	4.7	5.9	14.8
Trade-back[a]	1.0	4.8	---	---	---	---
Total	20.0	100.0	10.0	100.0	40.0	100.0

Table 8. Analysis of the production and marketing costs of rooted cuttings by cost categories, Youngstown Andorra juniper, 1980

Cost categories	Production system One	Two	Three
	percent		
Cutting (before sticking)			
Cuttings taken from plants other than stock plants	74.9	76.6	---
Cuttings from stock plants	---	---	94.6
Overhead	25.1	23.4	5.4
Total	100.0	100.0	100.0
Rooting and growing cuttings			
Facilities, equipment and supplies	37.5	48.0	64.6
Media	5.5	9.4	7.0
Preparing and sticking	13.6	10.2	9.7
Culture	13.6	10.1	1.9
Harvesting	17.8	10.5	11.5
Waste disposal and cleanup	1.2	0.5	0.2
Utilities	10.8	11.3	5.1
Total	100.0	100.0	100.0
Overhead			
Advertising and promotion	14.9	20.1	6.8
Dues, liscenses, fees	11.7	4.8	6.7
Accounting, bookkeeping and secretarial services	29.5	43.6	48.2
Miscellaneous travel expense	25.8	10.9	16.9
Labor management	5.8	8.7	9.6
Operation management	12.3	11.9	11.8
Total	100.0	100.0	100.0

Table 9. Analysis of the production and marketing costs of rooted cuttings by cost categories, Hetz Japanese holly, 1980

Cost categories	Production system One	Two	Three
	percent		
Cutting (before sticking)			
Cuttings taken from plants other than stock plants	75.7	76.6	---
Cuttings from stock plants	---	---	88.2
Overhead	24.3	21.8	11.8
Total	100.0	100.0	100.0
Rooting and growing cuttings			
Facilities, equipment and supplies	40.6	50.9	69.0
Media	5.3	10.0	6.2
Preparing and sticking	10.6	7.1	6.6
Culture	9.6	11.3	4.4
Harvesting	22.6	9.3	9.5
Waste disposal and cleanup	1.2	0.5	0.3
Utilities	10.1	10.9	4.0
Total	100.0	100.0	100.0
Overhead			
Advertising and promotion	14.9	20.1	6.8
Dues, liscenses, fees	11.7	4.8	6.7
Accounting, bookkeeping and secretarial services	29.5	43.6	48.2
Miscellaneous travel expense	25.8	10.9	16.9
Labor management	5.8	8.7	9.6
Operation management	12.3	11.9	11.8
Total	100.0	100.0	100.0

the stock plants were owned. However, stock block ownership was accompanied by installation and maintenance costs. Stock block expenses were avoided under Systems One and Two by using other growers' stock plants.

Data in Table 7 show that the number of cuttings taken from stock plants under System Three influenced the cost of cutting (before sticking) percentage and actual cost. The cost of cutting (before sticking) was reduced under System Three from 3.7 to 0.7 cents by increasing the number of cuttings taken from the stock block from 13,700 to 59,800. In order to justify the ownership of stock blocks, the data suggest it may be necessary to have a minimum number of cuttings taken during each production period. The minimum number would depend on the direct (variable) and indirect (fixed) expenses incurred while installing and maintaining the stock block. Because expenses differ between plant species and among growers, the minimum number of cuttings would not be the same for each grower or stock block.

Cost of rooting and growing cuttings. The cost of rooting and growing cuttings was the major expense in the total cost of a rooted cutting. The rooting and growing cost category among species ranged from 46.6 to 60.5% of the cost of production and marketing or 9.3 to 12.1 cents per rooted cutting. The rooting and growing cost category included expenses for nursery structures, equipment, materials and utilities. Also included were labor costs incurred in the propagation, sticking, culture and harvesting of cuttings and cleanup of propagation beds after harvest. Shipping cost was not considered as a part of the production and marketing costs in this study. The expense of shipping cuttings was borne by the consumer as a handling or direct charge in this study. Information on the shipping destinations for the crops studied is given in Appendix B.

Table 10. Analysis of the production and marketing costs of rooted cuttings by cost categories, dwarf winged euonymus, 1980

Cost categories	Production system		
	One	Two	Three
	percent		
Cutting (before sticking)			
Cuttings taken from plants other than stock plants	76.4	---	---
Cuttings from stock plants	---	91.4	84.6
Overhead	23.6	8.6	15.4
Total	100.0	100.0	100.0
Rooting and growing cuttings			
Facilities, equipment and supplies	24.3	31.1	69.5
Media	12.2	15.1	5.7
Preparing and sticking	19.3	13.4	6.1
Culture	5.5	15.0	5.4
Harvesting	30.8	16.8	8.8
Waste disposal and cleanup	2.7	0.7	0.2
Utilities	5.2	7.9	4.3
Total	100.0	100.0	100.0
Overhead			
Advertising and promotion	14.9	20.1	6.8
Dues, licenses, fees	11.7	4.8	6.7
Accounting, bookkeeping and secretarial services	29.5	43.6	48.2
Miscellaneous travel expense	25.8	10.9	16.9
Labor management	5.8	8.7	9.6
Operation management	12.3	11.9	11.8
Total	100.0	100.0	100.0

Spacing intervals for the cuttings influenced the total cost per rooted cutting. Spacing intervals for each species are given in Table 11. Under System Two a closer spacing (1.5 in. or 3.8 cm.) was used than under System Three and thus more cuttings were placed in a given production area. For example, using a 1.5 in. (3.8 cm.) spacing between cuttings under System Two nearly 24,600 juniper cuttings were produced in a 4 ft. × 96 ft. (1.2 m. × 29.3 m.) area. Under System Three, using 1.75 in. (4.4 cm.) spacing, only 18,000 juniper cuttings were produced in the same area. The additional 6,500 cuttings stuck under System Two would be allocated a portion of the direct (variable) and indirect (fixed costs) of the propagation bed, thereby reducing the amount allocated to each rooted cutting in each bed. An optimum spacing would maximize the number of cuttings in a given growing area and minimize cutting loss due to overcrowding, insects and disease.

Overhead. Overhead costs reflected the management decisions of each production system. The data show that at the higher levels of production, the cost per cutting was less. In this study one million rooted cuttings were produced under System Two while about one-half million were produc-

Table 11. Spacing interval, rooting bed dimensions and approximate cutting capacity of beds used by three production systems for three species of woody ornamental cuttings, 1980

Plant species	Unit	Production system		
		One	Two	Three
Youngstown Andorra juniper				
Spacing interval	inches (centimeters)	1.5 (3.8)	1.5 (3.8)	1.75 (4.4)
Rooting bed dimensions	feet (meters)	4 × 50 (1.2 ×15.2)	5 × 96 (1.5 × 29.3)	4 × 96 (1.2 × 29.3)
Cutting capacity	number	12,800	30,700	18,100
Hetz Japanese holly				
Spacing interval	inches (centimeters)	1.5 (3.8)	1.5 (3.8)	2.0 (5.1)
Rooting bed dimensions	feet (meters)	4 × 50 (1.2 ×15.2)	5 × 96 (1.5 ×29.3)	4 × 48 (1.2 × 14.6)
Cutting capacity	number	12,800	30,700	6,900
Dwarf winged euonymus				
Spacing interval	inches (centimeters)	2.0 (5.1)	1.5 (3.8)	2.0 (5.1)
Rooting bed dimensions	feet (meters)	4 × 50 (1.2 × 15.2)	5 × 96 (1.5 × 29.3)	4 × 48 (1.2 × 14.6)
Cutting capacity	number	$7,200	30,700	6,900

ed under Systems One and Three. Therefore, overhead (fixed) costs were distributed over more cuttings grown under System Two which reduced the total cost for each rooted cutting. Cuttings grown under System Three had the highest cost per salable cutting for each of the selected species. The total annual overhead costs identified in System Three ($24,000) were almost the same as those identified under System Two ($25,000). Because only one-half as many cuttings were produced under System Three as under System Two, the overhead cost distributed to each marketable cuttings was considerably less under System Two.

Overhead costs charged to the individual plant increased as the production cycle lengthened. Under System Three a 24-month production cycle was used for producing dwarf winged euonymus and overhead costs were $5,700. If a 7-month production cycle had been used, overhead costs would have decreased to approximately $1,700. The additional 17 months increased overhead costs by $4,000 or over $235 per month. The data suggest that the production cycle be shortened as much as possible. However, the propagator must consider the size and quality of the finished plant.

Operating capital interest. Operating capital interest was directly affected by the cash costs incurred in obtaining the cutting (before sticking), rooting and growing cuttings, and overhead costs categories. Decreased cash expenditures would result in a lower operating capital interest charge for each grower. For example, under System One total cash costs were $3,700 for the production of Andorra juniper resulting in an operating capital expense of over $650. By reducing total cash expenses 20%, operating capital interest would have been lowered to about $530.

Operating capital interest expense could have been reduced if the production cycle was shortened. For example, if a 7-month production cycle had been used for dwarf winged euonymus in System Three instead of a 24-month production cycle, interest charges would have lowered from over $3,500 to about $1,000.

Trade-back cost. A trade-back arrangement to procure a supply of unrooted cuttings was used under System One. Data in Table 7 show the effect of trade-back on the final production and marketing costs. Ten percent of both the rooted Andorra juniper and Hetz holly crop were traded-back while 5% of the rooted dwarf winged euonymus crop was traded-back to the original suppliers of the unrooted cutting materials. This added 1.0 to 2.7 cents to the production and marketing cost per rooted salable cutting grown under System One.

Under System Two, a 10% discount was given to the suppliers of unrooted Andorra juniper and Hetz holly material on any nursery stock purchased. The effect of the discount on total production and marketing cost per plant is not known but would depend on the discounted price of the nursery material purchased by the suppliers of the unrooted material. Growers should consider the effects of discounts on the production and marketing cost and make the required adjustments in total cost.

Limitations

The computed costs in this report are valid only for the data used herein and should be used cautiously for other nursery production systems or plant species. Each grower must evaluate production practices, cost of production materials, size of operation, marketing strategies, and overhead costs during a specific production period. Adjustments in the various costs used to compute total production and marketing costs must be periodically made to adequately cover cost increases due to inflation.

While each production system is different it is believed that the results shown here are typical of those in the industry. These results support findings of other workers [1, 6].

SUMMARY

The objective of this study was to develop an accurate means of determining total production and marketing cost incurred in propagating a woody ornamental cutting in Tennessee. Production and marketing costs were computed for *Juniperus horizontalis* 'Plumosa Compacta Youngstown' (Youngstown Andorra Juniper), *Ilex crenata* 'Hetzii' (Hetz Japanese holly) and *Euonymus alatus* 'Compactus' (dwarf winged euonymus) for three production systems. A form was developed which identified production and marketing practices used by propagators in Tennessee. The form considered five cost categories: (1) cuttings (before sticking), (2) rooting and growing cuttings, (3) overhead, (4) operating capital interest, and (5) trade-back.

The production and marketing costs range of a salable rooted cutting was as follows: Andorra juniper--18 to 34 cents, Hetz holly--20 to 43 cents, dwarf winged euonymus--10 to 40 cents. Production and marketing costs were affected by (1) number of cuttings produced, (2) spacing interval between cuttings in the rooting bed, (3) survival percentage of cuttings and (4) overhead costs for the operation.

Cash and noncash costs as percentages of total cost were determined. Cash cost as a percentage of total production and marketing costs for the three species ranged from 61 to 79%. Non-cash costs ranged from 21 to 39% of total cost.

Labor expense was the major cost in the total production and marketing costs. Labor cost ranged from 30 to 53% of total cost for the three species produced in the three production systems. Labor time required for each crop was influenced by: (1) the species rooted, (2) efficiency of workers and/or supervisors and (3) length of production cycle.

Accurate and simple cost determination techniques are needed for all phases of the nursery industry. Additional cost computation forms should be developed for both container and field production of woody ornamental plant material in Tennessee.

LITERATURE CITED

1. Badenhop, M. B. and S-103 Technical Committee. 1979. "Factors Affecting Southern Regional Production Advantages for *Juniperus chinensis* 'Pfitzeriana'." Southern Cooperative Series Bull. No. 237.
2. Badenhop, M. B. and S-103 Technical Committee. 1979. "Factors Affecting Southern Regional Production Advantages for Kurume Azaleas." Southern Cooperative Series Bull. No. 241.
3. Badenhop, M. B. and S-103 Technical Committee. 1980. "Cost of Producing and Marketing a Shade Tree: The Pin Oak." Southern Cooperative Series Bull. No. 244.
4. Badenhop, M. B. and S-103 Technical Committee. 1980. "Factors Affecting Production Costs and Returns for Flowering Dogwood." Southern Cooperative Series Bull. No. 246.
5. Bluhm, W. 1980. "Computing Costs of Plant Propagation." Ore. State Univ. Ag. Ext. Service.
6. Coutu, A. J. and S-103 Technical Committee. 1982. "Nursery Management and Production Costs: Burford Holly *(Ilex cornuta* 'Burfordi')." Southern Cooperative Series Bull. No. 278.
7. Crafton, V., T. D. Phillips and T. Blessington. 1982. "Costs of Producing Woody Ornamental Plants." Miss. State Univ. Ag. Econ. Dept. Res. Rep. No. 137.
8. Doll, J. P. and F. Orazem. 1978. *Production Economics: Theory with Applications.* Grid, Inc., Columbus, Ohio.
9. Hahn, D. E., J. L. Robertson and E. M. Smith. 1979. "An Analysis of Production Costs for Containerized Nursery Products." Ohio Ag. Res. and Devel. Center Res. Cir. No. 246:3-7.
10. Padgett, J. H. and T. L. Frazier. 1962. "The Relationship Between Costs and Pricing of Woody Ornamentals." Univ. of Ga. Ag. Exp. Sta. Bull. N.S. 100.
11. Phillips, T. D. 1979. "Development of Cost of Production Budgets for Landscape Plants in the South." *Economics of Producing and Marketing Woody Landscape Plants.* Tennessee Valley Authority Bull. Y-149:6-8.
12. Phillips, T. D. 1981. "Using Budget Data to Estimate Cost of Producing Landscape Plants." Proc. of 26th An. Southern Nurserymen's Assoc. Res. Conf. "155-162.
13. Reynolds, R. K. and W. R. Luckman. 1979. "Financial Management for Nurserymen." Amer. Nurseryman. CXLIX(3):18, 82-83.
14. Yager, E. 1978. "Cost of Liner Production at Cartwright Nurseries." Intr. Plant Prop. Soc. Combined Proc. 28:292-293.

APPENDIX A
COST COMPUTATION TECHNIQUE

Instructions on Using the "Computing Costs of Plant Propagation" Form

This form has been developed for use by plant propagators to determine propagation costs for a single species of cutting. The form consists of five main sections. Section I is for determining the cost of cuttings before they are stuck. Sections II, III and IV are for determining costs incurred while rooting and growing cuttings to salable size. Section V brings the costs determined in Sections I through IV together for a total cost per rooted (salable) cutting.

The following points should be thoroughly understood before using the form:

1. The plant propagator should use only those subsections (A, B, C, etc.) and individual costs (1, 2, 3, etc.) that apply to the production system in use. All others should be ignored.
2. The wage rate should include not only the base wage per hour, but also the cost of benefits (social security, worker's compensation, insurance, etc.) broken down as an **hourly** cost. A government study (Chamber of Commerce, 1981) revealed that the employer's share of legally required payments (social security tax, worker's compensation, unemployment compensation) in 1980 amounted to 8.9% of the basic wage. For example, if the basic employee wage were $3.50 per hour, the employer may use a wage rate of $3.82 ($3.50 + $.32) to accurately reflect the labor cost.

   Percentages for additional employee benefits, such as pensions, insurance, and sick leave are shown in Table A-1. These figures should serve as guidelines in the computation of hourly labor cost.
3. The fluctuation of prices on petroleum products may require adjustment in the $0.25 mileage rate. If adjustments must be made, the following average annual costs should be included when computing the new mileage rate: gasoline/oil, insurance, maintenance/repair (include parts and labor). The summation of thes costs divided by the average annual mileage will determine the proper mileage rates to be charged.

   For instance, if the annual average mileage for a company vehicle is 5,000 miles and the annual costs are as follows--

Gasoline/oil	$1,200
Insurance	200
Maintenance repair	200
Total	$1,600

the mileage rate is $0.32 ($1,600 ÷ by 5,000 miles).

4. The interest rate should be adjusted to the current market situation in order to reflect adequately the costs of the rate of interest. The current interest rate at banks, credit unions or other financial institutions is satisfactory. The rate should be expressed as a decimal value (for example, 12% = .12).

5. Estimates are usually sufficient to supply the information required to compute each specific cost. The plant propagator should make estimates using knowledge acquired during the last production cycle.

THE FORM SHOULD BE REVIEWED SEVERAL TIMES BEFORE ATTEMPTING TO COMPUTE THE COSTS OF PRODUCTION. This review will aid in understanding the form and its application.

COMPUTING COSTS OF PLANT PROPAGATION

This form is for use by plant propagators in determing their propagation costs.[a] It consists of five sections. Section I is for determining cost of cuttings before they are stuck. Sections II, III, and IV are for determining costs in rooting and growing cuttings to a salable size. Section V brings costs of all sections together for a total per cutting cost at salable size.

	Costs		
	Cash	Non-Cash	Total
I. COST OF CUTTING (BEFORE STICKING)			
A. Cuttings taken from plants away from nursery or from other than stock plants			
1. Labor (time) getting to and from source of cuttings; hours[b] _____ × wage rate $_____ =	$_____		
2. Labor (time for taking cuttings; hours[b] _____ × wage rate $_____ =	$_____		
3. Miles traveled _____ × $.25 =	$_____		
4. Materials (tools, bags, ties, labels, markers, etc.); .00007 × number of cuttings _____ =	$_____		
5. Refer to Section V.D. (page 35) for cost determination of rooted cuttings used in trade for supply of unrooted cuttings			
A. SUBTOTAL, COST OF CUTTINGS	$_____		$_____
B. Cuttings from stock plants (maintained stock block)			
1. Market value of stock plants (this species) $_____ ÷ life of plant _____ = annual depreciation =		$_____	
2. Maintenance of stock block			
a. Fertilization Labor, hours[b] _____ × wage rate $_____ + cost of fertilizer $_____ =	$_____		
b. Irrigation			
(1) Labor, hours[b] _____ × wage rate $_____ =	$_____		
(2) Depreciation: (original cost[c] $_____ − salvage value[d] $_____) ÷ 10-year-life =		$_____	
(3) Interest: (original cost[c] $_____ + salvage value[d] $_____) 2 = $_____ × interest rate[e] _____ =		$_____	
c. Pest control			
(1) Herbicide labor, hours[b] _____ × wage rate $_____ =$_____ + material cost $_____ = total $_____			
(2) Hand weeding labor, hours[b] _____ × wage rate $_____ = total $_____			
(3) Insecticide labor, hours[b] _____ × wage rate $_____ =$_____ + material cost $_____ = total $_____			
(4) Fungicide labor, hours[b] _____ × wage rate $_____ =$_____ + material cost $_____ = total $_____			
Total of herbicides, hand weeding, insecticides, and fungicides =	$_____		
d. Miscellaneous maintenance costs	$_____		
(1) Pruning, shaping, disbudding: hours[b] _____ × wage rate $_____ =	$_____		
(2) Establishment costs (if applicable) per plant $_____ ÷ life of plant in years _____ = $_____ × number of plants in block _____ =		$_____	
(3) Other miscellaneous costs	$_____	$_____	
3. Land (Assessed value $_____ × .02)[f] = taxes per acre $_____ × acres in block _____ = tax charge =		$_____	

[a] A modified version of a form developed by the Oregon State University Agricultural Extension Service, Corvallis, Oregon.

[b] Hours × number of men × number of times.

[c] Includes materials and labor.

[d] The money the system could be sold for now.

[e] Current annual interest rate; see instructions, #4.

[b] Hours × number of men × number of times.

[f] Assessed value is estimated at 25% of full market value; taxes are estimated at a rate of 2% of assessed value per year.

	Costs		
	Cash	Non-Cash	Total
4. Labor for taking cuttings			
a. Time getting to and from stock block: hours[b] _____ × wage rate $_____ =	$_____		
b. Time for taking cuttings: hours[b] _____ × wage rate $_____ =	$_____		
5. Materials (tools, bags, labels, markers, sprayers, etc.); .00015 × number of cuttings _____ =	$_____		
B. SUBTOTAL, COST OF CUTTINGS	$_____	$_____	$_____
C. Cuttings purchased			
1. Price per cutting $_____ × number of cuttings _____ =	$_____		
2. Postage, freight and/or transportation cost	$_____		
3. Labor, if any, to pick up cuttings: hours [b] _____ × wage rate $_____ =	$_____		
4. Miles traveled, if any, to pick up cuttings: miles _____ × $.25 =	$_____		
C. SUBTOTAL, COST OF CUTTINGS	$_____		$_____
D. Overhead			
1. Labor management: 20% of hired labor costs for cuttings (A.2., B.4. and/or C.3. × .20) =	$_____		
2. Operation management: 15% of cash costs (total cash costs from A, B and/or C × .15) =	$_____		
D. SUBTOTAL, COST OF CUTTINGS	$_____		$_____
I. TOTAL COSTS (summation of subtotals A, B, C and D)	$_____	$_____	$_____

II. COST OF ROOTING AND GROWING CUTTINGS

The following cost headings could apply to either a portion of a house used for propagation, to the entire house, or to a range of houses, including the associated equipment and buildings, whichever unit is most convenient for cost computation, for the entire year.

	Costs		
	Cash	Non-Cash	Total
A. Facilities, equipment and supplies			
1. Greenhouse			
a. Depreciation[g] (10-year life)		$_____	
b. Interest[h]		$_____	
c. Annual maintenance[c]	$_____		
d. Insurance	$_____		
e. Shading			
(1) Shading compound cost	$_____		
(2) Labor for applying and removing shading compound, hours[b] _____ × wage rate $_____ =	$_____		
(3) Shade covering (such as Saran shade cloth)			
(a) Depreciation[g] (5-year-life)		$_____	
(b) Interest[h]		$_____	
(c) Labor for annual putting up and taking down, if applicable: hours[b] _____ × wage rate $_____ =	$_____		
2. Miscellaneous buildings (head house, working shed, shade house, storage buildings, etc.) and concrete/asphalt pads and docks			
a. Depreciation[g] (20-year life) Depreciation $_____ × % figure[i] (_____), which equals the percentage of this crop to your total business =		$_____	
b. Interest[h] Interest $_____ × % figure[i] (_____), which equals the percentage of this crop to your total business =		$_____	
c. Annual maintenance[c]	$_____		
d. Insurance	$_____		

[b]Hours × number of men × number of times.
[c]Includes materials and labor.
[g][Original cost (including labor) – salvage value] ÷ useful life in years.
[h][Original cost (including labor) ÷ salvage value] ÷2 × interest rate.
[i]Total number of cuttings stuck of this species ÷ total nursery production of rooted cuttings.

	Costs		
	Cash	Non-Cash	Total
3. Propagation benches and/or beds			
a. Depreciation[g] (5-year life)		$_____	
b. Interest[h]		$_____	
c. Annual maintenance[c]	$_____		
d. Insurance	$_____		
4. Heating system for greenhouse and/or winter protection (insulation)			
a. Depreciation[g] [2-year (microfoam) up to 10-year (heater) life]		$_____	
b. Interest[h]		$_____	
c. Annual maintenance[c]	$_____		
d. Insurance	$_____		
5. Heating system for benches, beds and/or flats		$_____	
a. Depreciation[g] (5-year life)		$_____	
b. Interest[h]		$_____	
c. Annual maintenance[c]	$_____		
6. Mist system			
a. Depreciation[g] (5-year life)		$_____	
b. Interest[h]		$_____	
c. Annual maintenance[c]	$_____		
7. Propagation flats			
a. Depreciation[g] (2-year life)		$_____	
b. Interest[h]		$_____	
c. Annual maintenance[c]	$_____		
d. Annual replacement cost due to destruction	$_____		
8. Miscellaneous equipment			
a. Trucks, tractors, tillers, etc.			
(1) Depreciation[g] (10-year life) Depreciation $_____ × % figure[i] (_____), which equals the percentage of this crop to your total business =		$_____	
(2) Interest[h] Interest $_____ × % figure[i] (_____), which equals the percentage of this crop to your total business =		$_____	
(3) Annual maintenance[c]	$_____		
(4) Insurance	$_____		
b. Hand trucks and carts, hand tools, sprayers, dibble or marking boards, soil sterilization and fumigation equipment, shears, cutting dip tanks or containers, knives, media mixing equipment, etc.			
(1) Depreciation[g] (2-year life) Depreciation $_____ × % figure[i] (_____), which equals the percentage of this crop to your total business =		$_____	
(2) Interest[h] Interest $_____ × % figure[i] (_____), which equals the percentage of this crop to your total business =		$_____	
(3) Annual maintenance[c]	$_____		
(4) Insurance	$_____		

Housing and equipment costs should only be charged for that portion of the year and that portion of the house allocated to that crop of cuttings. For example, a crop of cuttings occupying ½ of the house for six months, followed by two three-month crops or one six-month crop of cuttings, would be charged ¼ of these costs (½ of house for ½ of year). If, however, the house is vacant for the rest of the year after the first six-month cutting crop is out, all of these costs should be charged to that six-month crop.

A. SUBTOTAL, FACILITIES, EQUIPMENT AND SUPPLIES COST (portion allocated to crop as explained in paragraph above)	$_____	$_____	$_____

If the production cycle is not 12 months, the housing and equipment cost subtotals must be adjusted by using the following formula:

Annual facilities, equipment and supplies cost subtotal ÷ 12 ×number of months required to produce the rooted (salable) cutting

[c]Includes materials and labor.
[g][Original cost (including labor) – salvage value] ÷ useful life in years.
[h][Original cost (including labor) ÷ 2 × interest rate.
[i]Total number of cuttings stuck of this species ÷ total nursery production of rooted cuttings.

Costs in Sections B, C, D, E and F are to apply only to this crop and not to other plants or crops propagated in the same or other houses.

B. Media
1. Component (bark, peat, perlite, vermiculite, pumice, etc.)
   a. Annual replacement cost—material $_____
   b. Labor, hours[b] _____ × wage rate $_____ = $_____
2. Sterilization and/or fumigation costs
   a. Material (fumigant) $_____
   b. Labor, hours[b] _____ × wage rate $_____ = $_____
3. Fertilizer and lime, pesticides
   a. Material $_____
4. Mixing components—fertilizer, lime, pesticides
   a. Labor, hours[b] _____ × wage rate $_____ = $_____
5. Cleaning of benches, beds, flats, pots, etc.
   a. Materials (disinfectants, cleaning compounds, etc.) $_____
   b. Labor, hours[b] _____ × wage rate $_____ = $_____
   B. SUBTOTAL, MEDIA COST $_____ $_____

C. Preparing and sticking cuttings
1. Preparing cuttings, such as trimming, disbudding, cleaning, etc., labor, hours[b] _____ × wage rate $_____ = $_____
2. Cutting treatment (soak, dip, dust)
   a. Materials (rooting compound, fungicide, insecticide) $_____
   b. Labor, hours[b] _____ × wage rate $_____ = $_____
3. Sticking cuttings
   Labor for marking, labeling rows and sticking cuttings, hours[b] _____ × wage rate $_____ = $_____
   C. SUBTOTAL, PREPARING AND STICKING COST $_____ $_____

D. Culture of cuttings
1. Labor: for disease and insect control; disbudding, shaping, and pruning; removing diseased and dead cuttings; misting and watering; fertilization; weed control, etc., hours[b] _____ × wage rate $_____ = $_____
2. Labor: for monitoring and maintaining heating systems (house, benches, beds), temperature, misting system, humidity, plant growth, etc., hours[b] _____ × wage rate $_____ = $_____
3. Materials (fungicides, insecticides, fertilizers, growth regulators, chemical pinching agents, herbicides, etc.) $_____
   D. SUBTOTAL, CULTURE OF CUTTINGS COST $_____ $_____

E. Harvesting cuttings
1. Labor for digging cuttings; hours[b] _____ × wage rate $_____ = $_____
2. Labor for packing and labeling cuttings; hours[b] _____ × wage rate $_____ = $_____
3. Packaging materials
   a. Flats, bands, pots $_____
   b. Plastic film, boxes, paper, bags $_____
   c. Sphagnum, excelsior, vermiculite, etc. $_____
   d. Labels, markers, ties $_____
   E. SUBTOTAL, HARVESTING COST $_____ $_____

F. Waste disposal and cleanup
1. Labor for removal, destroying (burning, tilling, etc.) hauling away trimmings, dead and diseased plants, unsold plants, materials (paper, boxes, plastic film, bags, broken flats, etc.) hours[b] _____ × wage rate $_____ = $_____
2. Dumping fees $_____
3. Cleanup of benches, beds, flats, greenhouses, buildings, etc.
   a. Labor, hours[b] _____ × wage rate $_____ = $_____
   b. Materials (for washing, sterilization, etc.) $_____
   F. SUBTOTAL, WASTE DISPOSAL AND CLEANUP COST $_____ $_____

[b]Hours × number of men × number of times.

	Costs		
	Cash	Non-Cash	Total

G. Utilities (for total nursery operation only, excluding the home and other non-nursery usage)
1. Electricity $_____
2. Fuel (gas, oil, LPG, wood, etc.) $_____
3. Water (metered cost or depreciated cost of well water system) $_____
4. Telephone $_____
5. Sewer $_____
6. Garbage service $_____
   G. SUBTOTAL, UTILITY COST [multiply total of 1, 2, 3, 4, 5 and 6 by a % figure[i] (_____), which equals the percentage of this crop to your total business] $_____ $_____ $_____
   If the production cycle is not 12 months, the utility costs must be adjusted by using the following formula:
   Annual utility cost for this crop ÷ 12 × number of months required to produce the rooted (salable) cutting
   II. TOTAL, ROOTING AND GROWING COST (summation of subtotals A, B, C, D, E, F, and G) $_____ $_____ $_____

III. OVERHEAD COST (FOR TOTAL NURSERY OPERATION)
A. Advertising and promotion (includes catalogues) $_____
B. Dues, licenses and fees $_____
C. Accounting, bookkeeping and secretarial services (hired and/or self; if self, hours[b] _____ × wage rate $_____) $_____
D. Miscellaneous travel expense (picking up fertilizer, pesticides, other supplies; visiting accountant and/or bookkeeper; miles, meals, lodging in attending tours, association and educational meetings, etc.), mileage at $.25 per mile, other expenses at actual cost $_____
E. Labor management: 20% of total hired labor costs, includes hired labor for secretarial, accounting and bookkeeping serivces (III.C. ×.20) = $_____
F. Operation management: 15% of total cash costs of total nursery operation (total of III.A, B, C, D, E × .15)= $_____
   III. TOTAL CASH COST $_____ $_____
   III. TOTAL OVERHEAD COST [Multiply total cash cost by % figure[i] (_____), which equals the percentage of this crop to your total business] $_____
   If the production cycle is not 12 months, the total cash cost must be adjusted using the following formula:
   Annual overhead cost for this crop ÷ 12 × number of months required to produce the rooted (salable) cutting

IV. OPERATING CAPITAL INTEREST (FOR SECTIONS I, II and III) Summation of all cash costs of Sections I, II and III _____ × interest rate[j] _____ × [months required to produce the rooted (salable) cutting_____]= $_____
   IV. TOTAL OPERATING CAPITAL INTEREST (SECTIONS I, II and III) $_____

V. CALCULATING COST PER MATURE (SALABLE) ROOTED CUTTING
A. Total cuttings stuck of this species _____ × cutting survival percentage of this species[k] _____ = number of salable cuttings of this species _____
B. Sum of total costs of Sections I, II, III and IV $_____
C. Sum of total costs (line B) _____ ÷ number of salable cuttings (line A) _____ = total cost per rooted (salable) cutting = $_____
D. Cost of rooted cutting used in trade for supply of cuttings [this subsection is used only if *rooted* (salable) cuttings are traded back to the original supplier of cuttings in return for the use of his stock plants] [% of crop traded _____ × total number of rooted (salable) cuttings _____ × cost per rooted (salable) cutting _____] = $_____
E. Adjusted cost of rooted (salable) cutting (total costs, line V.B.) _____ = cost of rooted (salable) cuttings (line V.D.) _____ ÷ number of remaining rooted (salable) cuttings _____ = $_____

[b]Hours × number of men × number of times × wage rate.
[i]Total number of cuttings stuck of this species ÷ total nursery production of rooted cuttings.
[j](Current annual interest rate, see instructions #4) ÷ 12.
[k]Expressed as a decimal, includes culling losses.

TABLE A-1. Percentage of basic wage for employee benefits, by type of benefit, 1980.[a]

Type of benefit	Percent of basic wage
Pension, insurance, and other agreed-upon payments (employer's share only)	
a. Pension plan premiums and pension payments not covered by insurance type plan (net)	5.4
b. Life insurance premiums; death benefits; hospital, surgical, medical, and major medical insurance premiums, etc. (net)	5.8
c. Short-term disability	0.4
d. Salary continuation or long-term disability	0.3
e. Dental insurance premiums	0.3
f. Discounts on goods and services purchased from company by employees	0.1
g. Employee meals furnished by company	0.2
h. Miscellaneous payments (compensation payments in excess of legal requirements, separation or termination pay allowances, moving expenses, etc.)	0.1
Paid rest periods, lunch periods, wash-up time, travel time, clothes-change time, get-ready time, etc.	3.5
Payments for time not worked	
a. Paid vacations and payments in lieu of vacation	4.9
b. Payments for holidays not worked	3.4
c. Paid sick leave	1.3
d. Payments for State or National Guard duty; jury, witness and voting pay allowances; payments for time lost due to death in family or other personal reasons, etc.	0.3
Other items	
a. Profit-sharing payments	1.2
b. Contributions to employee thrift plans	0.3
c. Christmas or other special bonuses, service awards, suggestion awards, etc.	0.4
d. Employee education expenditures (tuition refunds, etc.)	0.2
e. Special wage payments ordered by courts, payments to union stewards, etc.	0.1

[a]Adapted from *Employee Benefits, 1980,* U.S. Chamber of Commerce, Washington, D.C., Bulletin 6503.

APPENDIX B
SHIPPING DESTINATIONS FOR SPECIES STUDIED

Table B-1. Aggregated shipping destination data for Youngstown Andorra juniper, Hetz Japanese holly, and dwarf winged euonymus cuttings, 1980.

Destination	Percent of sold crop		
	Andorra juniper	Hetz holly	winged euonymus
Alabama	---	18.5	---
Connecticut	---	---	2.0
Illinois	21.7	---	17.3
Indiana	3.0	2.0	---
Iowa	---	---	2.3
Kentucky	3.8	14.7	4.5
Maryland	3.4	---	---
Michigan	3.5	---	3.2
Minnesota	---	---	2.3
New Jersey	15.9	---	7.5
New York	2.1	3.4	---
North Carolina	5.9	2.2	---
Ohio	4.6	---	8.6
Oregon	---	5.1	5.8
Pennsylvania	3.5	---	5.6
South Carolina	2.5	7.2	---
Tennessee	25.2	39.6	22.5
Virginia	---	3.7	---
West Virginia	---	---	2.3
Wisconsin	---	---	7.7
Other	4.9	3.6	8.4
	100.0	100.0	100.0