A Case Study on the Economic Feasibility of Producing Maple Liners in a Traditional Tobacco Greenhouse

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Abstract

The goal of this case study was to investigate the economic feasibility of a new enterprise for Southside Virginia farmers to help alleviate problems stemming from a loss of income and excess production capacity of a tobacco greenhouse. Maple liner production in a tobacco greenhouse was determined to not be economically feasible by this study. The control scenario, as well as the sensitivity analysis revealed that maple liner production would yield a loss when produced in a tobacco greenhouse. The breakeven number of plants to be sold was 43% of the cuttings planted, and could exceed 50% under some conditions of the sensitivity analysis. While the maple liner production schedule was determined to be culturally suitable as a supplemental greenhouse activity, the tobacco greenhouse engineering design was deemed inadequate for maple liner production. Modifications were needed to the ventilation and irrigation systems. This economic study was based on a field trial conducted in Halifax County, Virginia.

Acknowledgements

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1 Introduction To The Case

Flue-cured tobacco is commonly referred to as the "golden leaf" for both its brilliant golden color when cured and for the lucrative profits it generates. Its production has been a staple crop of rural Southside Virginia's[1] economy for more than two centuries. In Virginia, tobacco production, which ranks sixth among all commodities produced in Virginia, accounted for more than $132 million in cash receipts on 27,900 acres in the year 2000. Flue-cured production, however, is centralized in the Southside Virginia area, which produced over 78% of Virginia's total flue-cured production. Farms in Southside are highly dependent on tobacco income, which accounted for nearly 90% of total value of their agricultural production in 1996.[2]

The past several years have brought forth increased scrutiny of tobacco by government, society, and academia. Each segment has altered its outlook and behavior regarding tobacco issues: tobacco product promotion has been forbidden by legislation; tobacco use has been banned in most public facilities; academic research is now searching for alternatives to tobacco production. The demise of tobacco production has affected the livelihoods of hundreds of producers, and altered a tradition older than the United States. The economic importance of tobacco stretches far beyond the farm. Tobacco sales stimulate activity in manufacturing, retail and wholesale trade, financial services, advertising, etc. Wise and Reaves is estimated the total economic output in Southside Virginia in 1995 at $756 million. This figure includes more than $250 million in total value-added contribution, associated with over 6,800 jobs, in Southside Virginia. This output contributed to 11% of the total industry output, and 7% of the total value added to the Southside economy. Additionally, an economic model was developed demonstrating the economic contribution of tobacco throughout the agricultural and non-agricultural sectors of Southside Virginia. The linear model estimated that a 10% decrease in the

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[1] In this study, Southside Virginia is defined as the six-county region of Pittsylvania, Halifax, Mecklenburg, Brunswick, Lunenburg, and Charlotte. These six contiguous counties are the top six flue-cured-producing counties in the Commonwealth.

[2] Gale, H. Frederick, Jr., Linda Foreman, and Thomas Capehart, Tobacco and the Economy: Farms, Jobs, and Communities. Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 789.

flue-cured production quota would result in a $76 million dollar decrease in economic output. Considering the linear nature of this model, it can be assumed that a 40% cut in the production quota would have 4 times the effect, resulting in a more than $300 million decrease in economic output.[3] These figures reinforce the importance of flue-cured tobacco production in Southside Virginia.

Larry McPeters[4] reports 86 greenhouses in Halifax County. Other Virginia Cooperative Extension agents in the Southside region report a total of 285 greenhouses. Therefore, supplemental or alternative use of these greenhouses could have tremendous upside potential for the incomes of producers in the Southside area. While the total number of greenhouses that remain in full production is unknown, extension agent Larry McPeters of Halifax County estimates approximately 80% of the greenhouses are in use. It is also important to note that many greenhouses that are actively used are not currently being used to capacity.

Table 1.1 Number Of Greenhouses By County

County	**Number of Greenhouses**
Halifax County	86
Pittsylvania County	70
Lunenburg County	26
Charlotte County	26
Brunswick County	21
Mecklenburg County	56

This case study specifically focuses on the propagation of two cultivars of ornamental Maple trees - 'Red Sunset' and 'October Glory' - in a traditional tobacco greenhouse. Production of new crops in tobacco greenhouses may help to alleviate two problems;

[3] Wise, W., and Reaves, D.W.: "Tobacco's Important Role in the Southside Virginia," Rural Economic Analysis Program, Blacksburg, Virginia. 1996.

[4] Larry McPeters has served as the Virginia Cooperative Extension Agent in Halifax County for more than 20 years, and is current with farming, economic, and social trends of the region.

excess production capacity of the greenhouse and decreased farm income. Preliminary research indicates that woody liner[5] production provides an profitable opportunity for producers in the region.

This case study does not deeply investigate the demand for maple liners in Virginia. Beyond a brief analysis into an expected price, the market was not researched. The market data for the nursery industry is both fragmented and proprietary, and it is difficult to collect meaningful data from secondary sources. Interested producers need further market research.

1.1 Significance Of Halifax County

Southside Virginia, and particularly Halifax County, has experienced less than desirable economic conditions over the past decade. These problems arise from the aforementioned tobacco situation, as well as the closing of several key employers in the textile and wood-products industries. Many of the jobs lost in Halifax County are being exported to developing nations. This has resulted in a loss of earned income to the citizens of Southside Virginia.[6]

Most tobacco producers now use tobacco transplants produced in a tobacco greenhouse. The tobacco greenhouse produces higher quality transplants and is a labor-saving asset for these producers. The greenhouse is a permanent year-round structure, but is used only three months of the year for tobacco transplant production. This fixed resource remains idle for 9-10 months of the year; therefore, there is excess production capacity within these underutilized greenhouses. The fixed costs of ownership are considerable, as the costs of a newly erected greenhouse can exceed $50,000. It is desirable to spread

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[5] The term liner is coined from lining out nursery stock in a field row. The term evolved to mean a small plant rooted from seed, cutting, plug, grafting, or tissue culture. These seedlings and rooted cuttings are usually transplanted into small one-gallon liner pots, where they continue to grow to a suitable size that can be transplanted into the field (Hartman, *et al.*). The term woody liner refers specifically to woody ornamental plants that have been rooted from cuttings or seedlings. The woody liners hereafter referred to will be a finished product in a one gallon liner container, approximately 18 months old.

[6] Earned Income is all income earned from working – even if it is not taxable. Earned income includes: wages, union strike benefits, long-term disability benefits (prior to retirement), net earnings from self-employment, etc.
http://www.irs.gov/formspubs/display/0,,i1%3D50%26genericId%3D12626,00.html 03/13/02

the fixed costs of ownership over a 12-month period multi-production cycle, rather than one three-month single-production cycle.

Scott Sink *et al.* researched potential alternative enterprises in Halifax County for the forthcoming United States Department of Agriculture (USDA) publication *Developing Sustainable Agricultural Enterprises for Rural Communities*. Twenty potential enterprises were identified and discussed by a focus group of Halifax County economic development leaders. These enterprises were analyzed using the Kepnor-Traegner Decision Matrix, which allowed each enterprise to be analyzed subjectively and objectively.[7] From the research, three potential enterprises were chosen for further research. The propagation of woody ornamental liners was one of the enterprises identified.

Halifax County was chosen for four primary reasons:

- The twenty-year working relationship the county has with the other research partners;
- The county's number-two ranking as a flue-cured-producing county and its central location in Southside Virginia; and
- The negative economic conditions within the agricultural sector and across the community.[7]
- The abundance of greenhouse space in Halifax County

1.2 History and Current Situation of the Tobacco Industry

The tobacco market is unique; collaborative work between federal and producer regulation ensures quality and price support. Congress passed the Tobacco Inspection Act in 1935, designed to establish official tobacco grade standards. This act designated tobacco auction warehouses as a marketplace where tobacco growers would receive mandatory inspection of each lot of tobacco to determine its grade and type.[8] The Flue-Cured Tobacco Cooperative Stabilization Corporation, formed in 1946, controls the price

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[7] Scott Sink, Charlie Coale, Gene Haugh, Dixie Reaves, Dan Schofer, Larry McPeters. *Developing Sustainable Agricultural Enterprises To Provide Small Farmers in Rural Communities Sustainable Job and Income Opportunities*. Forthcoming USDA publication.

[8] http://www.ustobaccofarmer.com/whowwearepage.html 02/14/02

level of tobacco through a quota system and the grading system that maintains a price floor. Producer members of the cooperative are entitled to a loan deficiency payment[9] program for quota tobacco. "The overall effect of the price support loan program is to provide the farmer with a stabilized and orderly marketing system, which eliminates drastic fluctuations in market prices and ensures a consistent supply of quality tobacco for all customers worldwide."[10]

The economic growth of the tobacco industry has diminished as the industry has been plagued by legislation and litigation over the past 50 years.[11] The public's perception of tobacco use has drastically changed, and much of the public no longer condones the use of tobacco products. The Master Settlement Agreement[12] (Agreement) between tobacco manufacturers and state Attorneys General led to a major increase in the costs to consumers who still choose to smoke or chew as companies passed the costs of litigation and the Agreement on to the consumers in the price of their products, reducing demand for tobacco substantially. The decline in demand is evident by the decrease in the per capita consumption of cigarettes. The following list shows results of the overall change in the tobacco industry.

- Per capita consumption of cigarettes peaked in 1963 at 4,365, one year prior to the United States (U.S.) Surgeon General's warning.[13]
- Per capita consumption has since declined by over 40% to 2,261 in 1998.[9]
- The overall supply of tobacco has increased as manufacturers are importing cheaper tobacco from Africa, China, and South America.[14]

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[9] "The loan deficiency payment (LDP) program is embedded in the nonrecourse marketing assistance loan program that exists for 16 crops. This program provides producers with financial tools to alleviate possible short-term cash flow needs without selling their crop, thus allowing farmers to store production, and market their crops when conditions are more favorable. Producers are eligible for LDPs, and the LDP rate is the difference between the loan rate and the posted county prices (PCP). County loan rates are based on the national loan rate, a 12-month average PCP, production data, and the distance to terminal markets. The PCP is a price formulated to mimic crop marketing conditions in the county and is based on terminal market prices, adjustments reflecting market and transportation factors." From - "The Loan Deficiency Payment Phenomenon." FAPRI Bulletin, December 1998. Iowa State University http://www.fapri.iastate.edu/bulletin/dec98/theLoanDeficiencyPaymentPhenomenonFinal.htm

[10] http://www.ustobaccofarmer.com/whowwearepage.html 02/14/02

[11] Borio, Gene. "Tobacco Timeline." www.tobacco.org/History/Tobacco_History.html#aa4 ©1993-2000

[12] The legal agreement requires the tobacco companies to pay more than $200 billion during the next 25 years. This Agreement resolved numerous lawsuits over health care costs associated with tobacco.

[13] ERS/USDA Briefing Room – Tobacco Background http://www.ers.usda.gov/briefing/tobacco/background.htm 5/22/02

- Three consecutive years of quota cuts has limited production in 2000 to approximately half the 1997 pounds produced. [15]
- The future of the tobacco price stabilization program is in jeopardy. Current legislation in Congress proposes a buyout of current quota allotments.[16]
- The mandate to retrofit barns to produce reduced-nitrosamine tobacco has also led to increased costs to producers.[11]
- Southside Virginia is not expected to remain a competitive (with eastern North Carolina, South Carolina, and Georgia) flue-cured producing region with the increased costs and reduced demand, and without the tobacco program[17]

1.3 Objectives Of This Case Study

The objectives of this case study were legitimized through a field trial of maple liner production in Halifax County, which investigated the characteristics of maple liner production within a traditional tobacco greenhouse. An economic analysis subsequently analyzed the economic feasibility of production.

1.3.1 Objectives Of The Field Study

In an effort to go beyond secondary research and hypothetical scenarios that sometimes fail to uncover unforeseeable variables that have a dramatic effect on production, a field trial was performed to test the agronomic feasibility of propagating and growing maple liners in tobacco greenhouse structures without substantially changing or investing in the structures. The field trial provides a real example of maple liner production in a tobacco greenhouse. Specific objectives of the field trial were:

- Determine modifications needed to produce woody liners

The following questions for the field study were the basis of the hypotheses tested in this case study:

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[14] Brown, Blake. *Implications of Elimination of the US Flue-Cured Tobacco Program.* North Carolina State Universtiy Cooperative Extension. Setpember 1997. p.2

[15] Sink, Scott. *Developing Sustainable Agricultural Enterprises for Rural Communities: The Case of Packaged Agr-itourism in Southside Virginia.* June 2001.

[16] http://www2.ncsu.edu:8010/unity/lockers/users/a/abbrown/tobacco_econ/Summary.PDF

[17] Brown, Blake. *Implications of Elimination of the US Flue-Cured Tobacco Program.* North Carolina State Universtiy Cooperative Extension. Setpember 1997. p.4
http://www2.ncsu.edu:8010/unity/lockers/users/a/abbrown/tobacco_econ/policy/SenateTobTest.pdf

1. Is it physiologically possible to produce maple liners as a supplemental greenhouse activity?
2. Does the tobacco greenhouse require modification to the traditional ebb-and-flow irrigation system?
3. Does the tobacco greenhouse have sufficient cooling measures during the summer?

1.3.2 Objectives Of The Economic Analysis

The overall objective of this case study was to determine the economic feasibility of growing maple liners in traditional tobacco greenhouses. Specific objectives for the study of maple liners are to:

- Determine break-even levels of production and project cash flows for this enterprise;
- Develop an enterprise budget that can be used by producers for an investment decision;

The following questions considered by this economic analysis economic analysis are again the basis of the hypotheses tested:

1. Is it economically feasible to produce maple liners in a traditional tobacco greenhouse?
2. What is the break-even level of production for maple liners when produced at full capacity of the tobacco greenhouse?
3. How sensitive is the break-even level of production for maple liners to price fluctuations (cost and revenue)?

2 Maple Liner Field Trial

The field trail served to review and test cultural requirements and challenges of producing maples. The data recorded from this field trial served as a basis for the ensuing economic analysis. Planning for field trial began in July and data was collected into October.

2.1 Methods Of The Field Trial

A greenhouse north of Halifax, Virginia was chosen for this initial study based on its design, its proximity to the major stakeholders in this investigation and the availability of an on-site manager to maintain some of the operations of this study.

2.1.1 Facilities and Engineering

The greenhouse measures 35ft wide X 300ft long, has adjustable side curtains, and 1, 36in reverse mounted end-fan capable of moving 10,000 cu. ft of air per minute, 12 inch roof mounted internal fans every 15 ft, and a roof mounted LP furnace at the south end (See Figure 5.2). The need to limit high greenhouse temperatures in July and August was predicted. A 60% woven shade cloth was secured over 150 linear feet of the south end of the greenhouse, extending horizontally to the rails above the side curtains and shading the whole of the experiment area. Because the greenhouse was not equipped with adequate ventilation, the active cooling measures could not be tested[18].

The augmentation of the traditional tobacco float irrigation system was also predicted as a requirement for maple liner production. A Netafim mist irrigation system was designed for ornamental liner propagation. This system consisted of a Phytotronics™ six zone controller, ¾ in flexible main pipe, hanging mist nozzles and electronic solenoids. It was installed such that the float irrigation system was retained as a comparative control of the need for this augmentation.

The greenhouse production area consisted of 3 beds 15 ft by 50 ft dimensions on each side of a 2 ft wide walkway (See Figure 5.1). The beds were framed by 2" X 6" boards and lined with 6mil impermeable black plastic (to produce float irrigation beds), or landscape fabric (for mist irrigated beds). Overhead mist irrigation was installed over 3 beds and retained float irrigation on 3 beds.

The flats used in the greenhouse study were Dyna-flat™, which are a heavy-duty plastic flat. The flats are 4 inches x 14 inches x 20 inches, and each requires 1.95 square feet of

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[18] Active cooling is recommended as one air change per minute
Boodley, James W. *The Commercial Greenhouse*. (New York: Delmar Learning, 1996), 89.

floor space. Each flat can accommodate 50 cuttings for rooting. Therefore, there are 50 cuttings per 1.95 square feet of floor space. Following the assumption of 80% usable floor space, one tobacco greenhouse can support planting 107,650 cuttings.

2.1.2 Significance of Maples

Maples (*Acer rubrum*) were chosen as a test species because a) the cultural practices permit a production schedule that complements tobacco transplant production (See Figure 2.1) and b) rooting maple cuttings served as a model for the production of other ornamental plants in tobacco greenhouses. Input variables and fixed costs will be similar in nature for most woody ornamental species produced in a tobacco greenhouse. The economics and costs structure would obviously change if other trees produced had a shorter or longer production schedule.[19] Propagation materials for the two cultivars chosen for this trial, 'Red Sunset' and 'October Glory,' were also readily available from a cooperating nursery owner.

The Reference Manual of Woody Plant Propagation recommends maples be propagated during the months of June, July, and August, with June and July noted as ideal. Following propagation, the maples commonly take 21 to 28 days to root.[20] The rooted cutting subsequently grows into a 4-5 foot saleable whip.[21] The entire growth period commonly takes 14-16 months. The following graphical representation reveals the propagation and production schedule, as well as how it coincides with tobacco plug production.

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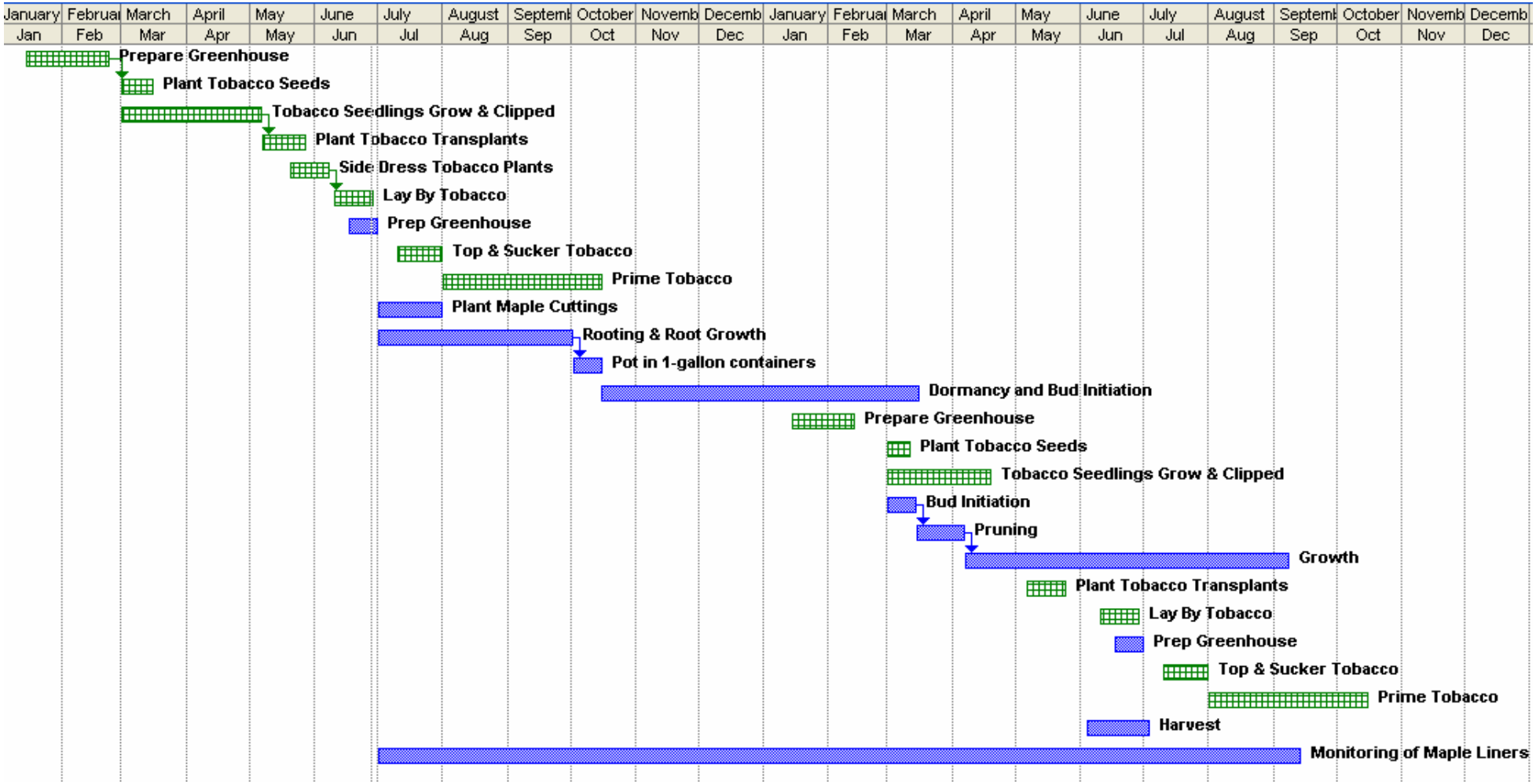
[19] Coartney, James S., Luckham, W. Richard, and Smeal, Paul L. "The Economics of Shade Tree Production." Virginia Cooperative Extension Publication 430-592. 1990.
[20] Dirr, Michael A. and Charles W Hueser, Jr. The Reference Manual of Woody Plant Propagation. Varsity Press, Inc. 1987. pp. 86
[21] A saleable whip is defined as a 4-5 feet tall whip, with a straight ½ to ¾ inch caliber trunk.

Figure 2.1 Production Schedule



2.1.3 Plant Material and Methods

Two cultivars of *Acer rubrum*, 'October Glory' and 'Red Sunset' were chosen for this field study because they are in relatively high demand, were readily available for propagation material, of suitable propagation schedule to the season of study, and easily salable as 1-gallon size liners. A commercial nursery provided stock material for cuttings as well as considerable expertise in vegetative propagation of ornamental trees. This nursery would also purchase liners produced from this material provided they were of commercial quality.

Cuttings of 'October Glory" and "Red Sunset" maple were taken on August 5, 2001 and August 22, 2001. These consisted of ¼ in diameter shoots, 7-8 in long, with 4-6 nodes taken from the top most actively growing portion of trees 8-12 inches in diameter at breast height (dbh). Additional cuttings were taken from adventitious basal shoots that sprouted from damaged trees. Cuttings were immediately placed in bins under ice and transported 150 miles to the greenhouse. Cuttings were prepared for propagation by stripping leaves from the lower 2 nodes, and making a diagonal cut just below the bottom-most node. Cuttings were rinsed in 1:20 diluted bleach for 10 seconds, rinsed twice with tap water and dipped in 1000 ppm IAA : 500 ppm NAA, (Dip-In-Grow^{TM}) for 10 seconds. They were inserted 2 inches deep in rooting medium in propagation flats on 3-inch centers and watered in. The first cuttings of the two cultivars were arrayed in the propagation beds with 900 of each cultivar divided between two treatments (float and mist irrigation) and in 3 beds of each treatment (See Figure 5.1). In the second planting planted 600 cuttings, 300 of each cultivar were arrayed in the propagation beds under the mist treatment only.

Weekly monitoring of the plants was used to collect data on rooting success and growth. Lifting randomly selected marked cuttings from each bed and measuring the diameter of root system quantified rooting success and characteristics. Measurements were taken once per week to determine rooting dynamics. These numbers were statistically analyzed for variance in rooting success and characteristics. Ambient greenhouse air and soil

temperatures were recorded initially using a standard liquid thermometer, and later recorded with a data logger.

The cuttings remained in propagation trays until October 20, 2001 when they were potted into one-gallon containers. It is advantageous to use containers that prevent circling of the roots[22]. Rootmaker™ containers were used to pot the rooted cuttings. On this date, rooting success was recorded, and all plants not rooted were declared dead. Root length was also recorded at this time.

Because most woody liners need to be exposed to cold weather in order to initiate budding the following spring they can be moved from inside the greenhouse during the winter months, prior to tobacco plug seeding in late February. Therefore, the propagation schedule for maple liner production can coincide with tobacco transplant production.

2.2 Field Trial Results

All cuttings under the float irrigation treatment died. The cuttings under the mist irrigation treatment rooted more successfully, though. From both plantings, 29.5% of those cuttings planted under mist irrigation successfully rooted. Commercial operations typically root 75-95% of planted maple cuttings[23].

Rooting success and root length was analyzed for effects of cultivar and time of propagation. Cuttings taken on August 22, 2001 rooted significantly better than those taken on August 5, 2001, though survivors from the earlier propagation had longer roots. This is not surprising, as earlier planted cuttings had longer time to develop. Red Sunset had longer roots and better rooting success, but not significantly so. The higher temperatures of early August negatively impacted the rooting success of the planted

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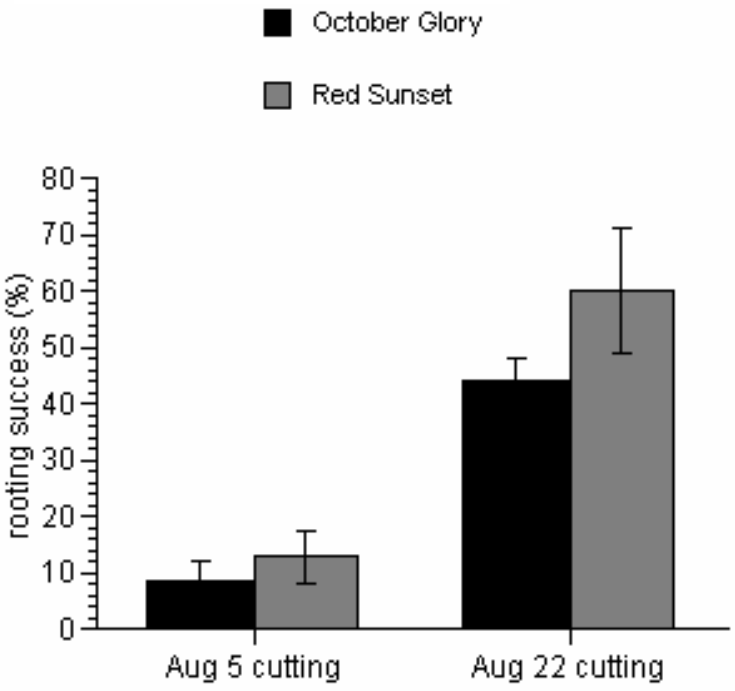
[22] Pot-bound plants do not ever recover from the spiraled root system when transplanted into the ground; thus they are not salable as liners. Dr. Carl Whitcomb has developed a system called Rootmaker™ that "air-prunes" roots, and prevents bundling of the roots in the container[22]. Another system, called Spinout™, uses a chemical compound to prevent root bundling.

[23] Dirr, Michael A. and Charles W Hueser, Jr. The Reference Manual of Woody Plant Propagation. Varsity Press, Inc. 1987. p. 86

cuttings. This indicates that it would be beneficial to plant the cuttings earlier in the summer if summer temperatures could be moderated.

Figure 2.2 Root Growth Data

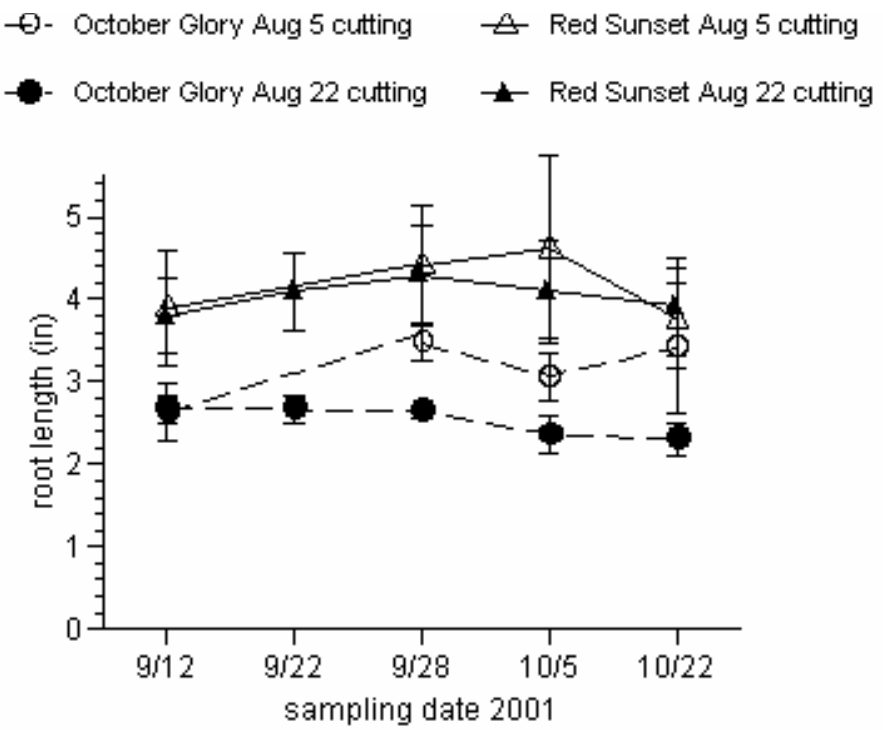
a) Percent Rooting Success



ANOVA Results for Rooting Sucess

	F	p
cultivar	2.39	0.14
cutting date	33.32	<0.0001
cultivar X date	0.14	0.7161

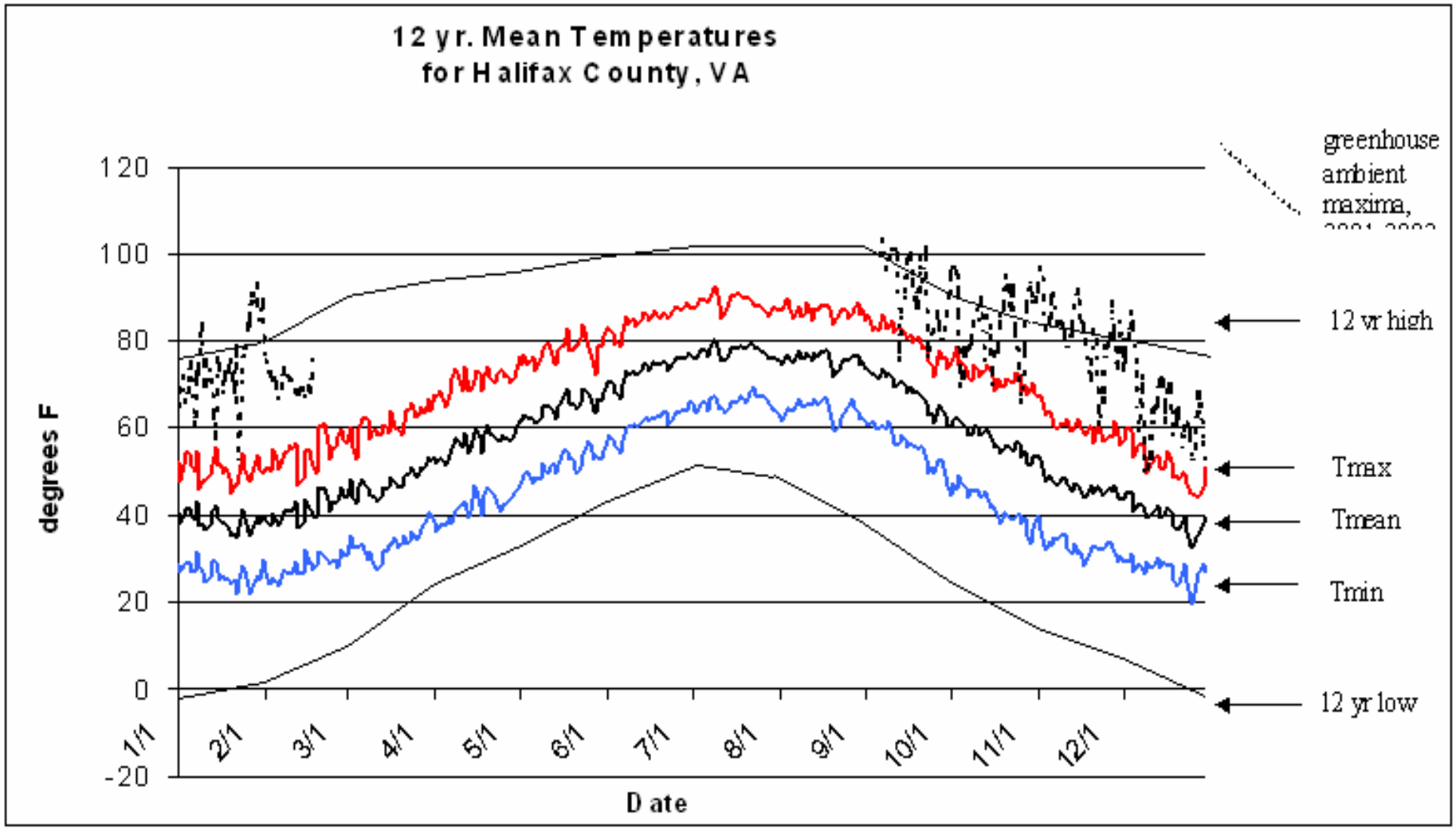
b) *Root growth over time of surviving Acer Rubrum 'October Glory' and 'Red Sunset' cuttings*



Temperature data recorded from the liquid thermometer indicated that ambient air temperatures in the greenhouse were as high as 115°F and soil temperatures reached 94°F. Suitable propagation temperatures for these cultivars are reported as 75-85°F ambient temperature and 70°F soil temperature. The engineering design of the greenhouse does not allow for adequate cooling of the greenhouse. The greenhouse is much like a "solar-oven." The solar load generates heat, which is trapped under the plastic roof. This causes the ambient temperatures within the greenhouse to increase well beyond the ambient outside temperature. The temperatures observed in Halifax County during the summer of 2001 are not an anomaly. Ambient temperatures routinely reach and/or exceed 90°F during the afternoon of summer days. As shown in Figure 2.3, the temperature of the greenhouse routinely was higher than the daytime maximum, and often exceeded the record high for that day.

The peaks in temperature and lack of mist irrigation in a tobacco greenhouse create a production risk, as soil temperatures above 90^{o}F impede root growth on the maple cuttings. It is reasonable to assume that soil temperature will exceed this threshold with daytime ambient temperatures in the greenhouse reaching the aforementioned levels. This production risk in turn creates an economic risk to the producer. The economic risk is witnessed through mortality and poor quality plants.

Figure 2.3 Environmental temperature data for Halifax County, Virginia



3 Economic Analysis

The field trial of propagating maples in a Halifax County tobacco greenhouse laid the foundation for the economic analysis. Labor coefficients, materials, usage rates, etc. recorded from the field trial are all reference points for the economic analysis. The economic analysis scales up the numbers recorded from the field trial to full production of the greenhouse. From the economic analysis, investment recommendations can be made.

3.1 Methods Of The Economic Analysis

Since the variable and fixed input costs associated with maple liner production are not unique to the container nursery industry, the enterprise budgets developed for maple liner production serve as a model for other species. The values used in the enterprise budgets developed were derived from catalog prices, label recommendations, and observations from the field trial.

3.1.1 Variable versus Fixed Costs

Before identifying the variables that are necessary for production, it is first necessary to understand the economic significance of variable and fixed costs. Variable costs change with the level of output. They are a function of the amount produced, and they occur only if the producer produces a product. Examples of such costs common to many farming operations are seed, fertilizers, pesticides, fuel, hourly labor, feed, etc. Fixed costs, on the other hand, occur whether or not the producer decides to produce and regardless of the level of production (within a range). Producers can benefit from economies of scale as fixed costs are spread evenly across more units of production; reducing the unit costs of production. Examples of fixed costs are salaried labor, depreciation, interest, insurance, rent, etc. The distinction between variable and fixed costs is important in decision-making. A general principle in economics is that a manager should consider only variable costs when making short-run production decisions, as the fixed costs will remain regardless of the level of production.[24]

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[24] Boehlje Michael D. and Vernon R. Eidman. Farm Management. John Wiley & Sons. New York. 1984. pp 87-89.

3.1.2 Economic Analysis Inputs

The variable inputs required for production of maple liners will make up the variable costs for the enterprise. These inputs can be seen in the following table, Table 3-1. Some of these variable costs will be incurred only once, while others will be linked with more than one period of production.

Table 3.1 Variable Costs

Flats	Containers	Tree Supports
Herbicide	Insecticide	Fertilizer
Rooting Hormone	Perlite	Substrate
Labor	Water	Electricity

The fixed or ownership costs that are incurred by this enterprise would be spread out among tobacco transplant production and maple liner production. The tax rate in Halifax County for real estate is $0.40 per $100 value of the asset. [25] The Capital Recovery Method is used to compute depreciation and interest[26].

Table 3.2 Fixed Costs

Property Taxes	Insurance
Depreciation	Interest

The source of revenue from producing maple liners is from sales to wholesale nurseries. These nurseries purchase liner stock to produce a more mature plant. These sales will occur during the fall months.

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[25] A greenhouse is considered real estate in Halifax County. Phone conversation with Halifax County Commissioner of Revenue, Danny Jackson. 02/25/02

[26] According to Boehlje and Eidman, the Capital Recovery Method is superior to conventional methods of computing depreciation and interest - straight-line depreciation and interest on the average investment. The capital recovery method is more complex, and it is computed by using a capital recovery factor – the amount of money at the end of the year to pay interest on the unrecovered capital at the designated interest rate and specified number of years. The major advantage is that the capital recovery method more accurately estimates the costs involved in ownership.
Boehlje, Michael D. and Eidman, Vernon R. Farm Management. New York: John Wiley & Sons. 1984. pp 142-144.

3.2 Assumptions

In order to perform an economic analysis, several explicit assumptions must be made. These assumptions are important to understand how the decisions for the economic analysis and the outcomes were derived. The first list of assumptions regards the tobacco greenhouse itself and the ownership costs of the tobacco greenhouse.

- A tobacco greenhouse is assumed to be 150 feet x 35 feet x 11 feet, giving a total of 5,250 square feet of floor space (See Figure 5.4).
- For the computation of interest and depreciation expense, it is assumed that a new greenhouse is purchased. This greenhouse costs $30,000, and has a useful life of 10 years.[27] The interest rate is assumed fixed at 8%[28].
- The fixed costs are divided between the horticulture and tobacco crops by percentage time of greenhouse use. The tobacco will incur 1/3 of the fixed costs, and the horticulture crops will incur 2/3 of the fixed costs.
- Machinery costs for the production of the maple liners are assumed to be negligible.
- The mortality used for the economic analysis was calculated from the field trial in Halifax County. It was assumed that all rooted cuttings, as of October 20, 2001 would mature to a saleable whip. All production costs are incurred regardless of mortality and/or inferior quality (rendering the liner not salable)

Because there are no clear market numbers for the number of liners that are bought and sold in Virginia each year, it is important to make assumptions about the market.

- A review of catalogs of liner producers around the Eastern United States, a market price for maple liners would be $7.00 per one-gallon liner.

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[27] The General Depreciation System, as described by the Internal Revenue Service Publication 225, Farmer's Tax Guide, allows for a greenhouse structure to be depreciated for 10 years. This figure is the basis for the useful life estimate.

[28] The 8.00% interest rate was derived from the Prime Rate plus 3.00%. The Prime Rate on December 1, 2001 was 5.00% according to the Federal Reserve Bank (www.frb.org).

- The customers of these liners are wholesale nurseries in the state of Virginia. The customers purchase woody ornamental liners to producer larger plants either in the field or in larger containers.
- An orderly marketing plan would be developed by the producer to meet local demand at a market price of $7.00 per one-gallon maple liner.

3.3 Economic Analysis Scenario Results

Sensitivity analysis identifies how different agronomic and economic changes affect output. The following scenarios analyzed the economic sensitivity:

- Scenario I analyzed the conditions of the field trial performed in the Halifax County greenhouse field trial.
- Scenario II analyzed an across the board 10% increase in the total costs.
- Scenario III analyzed a decrease in the price per liner, and how it affected the bottom line of the operation.
- Scenario IV analyzes an across the board 10% decrease in the total costs.

3.3.1 Scenario I: Control – (Halifax County Field Trial)

This scenario used data collected during the field trial, and was scaled up to full production levels at 107,650 cuttings. The field trial experienced 70% mortality, thus the number of saleable plants would be 30% of all cuttings planted. Costs and revenue based on these results were used to develop as a baseline enterprise budget (Table 3.1).

The economic analysis for this control scenario combined all costs and revenues to determine the economic feasibility of maple-liner production in traditional tobacco greenhouses. The full production cycle costs and revenues can be seen visually through an enterprise budget.

The results of the control scenario are summarized in the Table 3.1. The analysis revealed a net income loss. The control scenario did however have a positive contribution margin, which indicated that all of the variable costs were covered by the generated revenue. However, in order to breakeven the percentage of salable plants must improve by 13% from that which was observed in Halifax County.

Table 3.3 Control Scenario Summary

	Control Scenario
Revenue	$226,065
Contribution Margin	$14,066
Net Income	($72,549)
Breakeven Number Sold	46,328
Breakeven Percentage Sold	43%
Unit Costs Of Production	$9.25

Table 3.4 Control Scenario Budget

Control Scenario					
107,650 Maple Cuttings Planted					
Num. Planted	107,650		**Price or**		
Percent Salable Plants	30%	**# Units**	**Costs/Unit**		**Total**
1 gallon Maple Liners		32,295	$7.00		$226,065
Variable Operating Expenses	units				
Containers	containers	107,650	$ 0.41		$ 43,598
Substrate	yd^3	267.49	$ 25.00		$ 6,687
Perlite	yd^3	133.75	$ 1.75		$ 234
Tree Supports	stakes	107,650	$ 0.05		$ 5,383
Fertilizers	pounds	3,499	$ 1.20		$ 4,198
Hormone	oz	43.06	$ 2.13		$ 92
Herbicide					$ 300
Delivery/Transportation Costs		32,295	$1.00		$ 32,295
Water	gallons	5,103,531	$2.67/1000 gal		$ 13,626
Labor					$ 80,300
Electricity					$ 500
Crop Insurance		294,246	1.5% of total expenses		$ 4,414
Miscellaneous		188,714	10%		$ 18,871
Repair					$ 1,500
Total Variable Expenses					**$211,999**
Fixed Costs					
Marketing					$11,303
Management Salary		$10,000	5%		$21,303
Property Taxes		.40/$100	$30,000		$120
Insurance (On Structure)					$250
Interest On Operating Line					$ 20,350
Depreciation and Interest					
- Greenhouse					$2,981
- Flats					$3,610
- Tree Stock					$26,743
Total Fixed Costs					**$86,660**
Total Operating Expenses					**$298,659**
Income Before Taxes					($72,594)
Income Tax Rate					0.00
Income Taxes					$0
Net Income					($72,594)

3.3.2 Scenario II – Increased Costs

Scenario II was designed to reveal the impact of an across-the-board increase in the total variable costs of production used in Scenario I. This scenario analyzed a 5% and a 10% increase to the total variable cost category. The revenue and fixed costs remain constant in this scenario from the control. Costs and revenues are listed in an enterprise budget (See Table 3.6).

As shown in Table 3.3 the net income was reduced as a result of the variable costs increase. Also, the contribution margin was reduced to a negative figure as a result of a 10% variable costs increase, which indicated that not all of the variable costs were covered. As expected with a costs increase, the breakeven number of plants sold also rose from the control scenario.

Table 3.5 Variable Costs Increase Results Summary

	5% Variable Costs Increase	**10% Variable Costs Increase**
Revenue	$226,065	$226,065
Contribution Margin	$5,361	($5,148)
Net Income	($82,153)	($93,542)
Breakeven Number Sold	48,857	51,338
Breakeven Percentage Sold	45%	48%
Unit Costs Of Production	$9.54	$9.90

Table 3.6 Increased Variable Costs Budget

Scenario I - Increased Production Costs 107,650 Maple Cuttings Planted						
Num. Planted **Percent Salable Plants**	107,650 30%	**# Units**	**Price or Costs/Unit**	**Total**	**5% Variable Costs Increase**	**10% Variable Costs Increase**
1 gallon Maple Liners		32,295	$7.00	$226,065	$226,065	$226,065
Variable Operating Expenses	units					
Containers	containers	107,650	$ 0.41	$ 43,598	45,778	47,958
Substrate	yd^3	267.49	$ 25.00	$ 6,687	7,022	7,356
Perlite	yd^3	133.75	$ 1.75	$ 234	246	257
Tree Supports	stakes	107,650	$ 0.05	$ 5,383	5,652	5,921
Fertilizers	pounds	3,499	$ 1.20	$ 4,198	4,408	4,618
Hormone	oz	43.06	$ 2.13	$ 92	96	101
Herbicide				$ 300	315	330
Delivery/Transportation Costs		32,295	$1.00	$ 32,295	33,910	35,525
Water	gallons	5,103,531	$2.67/1000 gal	$ 13,626	14,308	14,989
Labor				$ 80,300	84,315	88,330
Electricity				$ 500	525	550
Crop Insurance		273,896	1.5% of total expenses	$ 4,108	4,314	4,519
Miscellaneous		188,714	10%	$ 18,871	19,815	20,759
Repair				$ 1,500	1,575	1,650
Total Variable Expenses				**$211,694**	**$220,704**	**$231,213**
Fixed Costs					$5,361	($5,148)
Marketing				$11,303	$11,303	$11,303
Management Salary		$10,000	5%	$21,303	$21,303	$21,303
Property Taxes		.40/$100	$30,000	$120	$120	$120
Insurance (On Structure)				$250	$250	$250
Interest On Operating Line					$21,204	$22,084
Depreciation and Interest						
- Greenhouse				$2,981	$2,981	$2,981
- Flats				$3,610	$3,610	$3,610
- Tree Stock				$26,743	$26,743	$26,743
Total Fixed Costs				**$66,310**	**$87,514**	**$88,394**
Total Operating Expenses				**$278,004**	**$308,218**	**$319,607**
Income Before Taxes				($51,939)	($82,153)	($93,542)
Income Taxes				$0	$0	$0
Net Income				($51,939)	($82,153)	($93,542)

3.3.3 Scenario III – Decreased Revenues

Scenario III was designed to reveal the impact of an across-the-board decrease in the total revenue from decrease in the expected market price in Scenario I. This scenario analyzed a 5% and a 10% decrease in total revenues. The costs categories remained unchanged from the control scenario. From this scenario, an enterprise budget will be created once again (See Table 3.8).

The results are of this scenario are shown in Table 3.7. The decreased revenues had a greater impact than did the increased costs. The increased costs scenario only considered an increase in variable costs, which did not result in an overall increase in costs. This accounted for the difference in the two scenarios. The contribution margin was reduced to a negative figure as a result of a 10% decrease. This indicated the importance of market development and sustainability.

Table 3.7 Decreased Revenue Scenario Results

	5% Revenue Decrease	**10% Revenue Decrease**
Revenue	$214,762	$203,459
Contribution Margin	$3,068	($8,235)
Net Income	($83,567)	($94,871)
Breakeven Number Sold	50,185	54,250
Breakeven Percentage Sold	47%	50%
Unit Sale Price	$6.71	$6.36

Table 3.8 Decreased Revenue Scenario Results

Scenario II - Decreased Revenue 107,650 Maple Cuttings Planted						
Num. Planted	107,650		**Price or**		**5% Revenue**	**10% Revenue**
Percent Salable Plants	30%	**# Units**	**Costs/Unit**	**Total**	**Decrease**	**Decrease**
1 gallon Maple Liners		32,295	$7.00	**$226,065**	**$214,762**	**$203,459**
					6.65	$6.30
Variable Operating Expens	units					
Containers	containers	107,650	$ 0.41	$ 43,598	$ 43,598	$ 43,598
Substrate	yd³	267.49	$ 25.00	$ 6,687	$ 6,687	$ 6,687
Perlite	yd³	133.75	$ 1.75	$ 234	$ 234	$ 234
Tree Supports	stakes	107,650	$ 0.05	$ 5,383	$ 5,383	$ 5,383
Fertilizers	pounds	3,499	$ 1.20	$ 4,198	$ 4,198	$ 4,198
Hormone	oz	43.06	$ 2.13	$ 92	$ 92	$ 92
Herbicide				$ 300	$ 300	$ 300
Delivery/Transportation Costs		32,295	$1.00	$ 32,295	$ 32,295	$ 32,295
Water	gallons	5,103,531	$2.67/1000 gal	$ 13,626	$ 13,626	$ 13,626
Labor				$ 80,300	$ 80,300	$ 80,300
Electricity				$ 500	$ 500	$ 500
Crop Insurance		273,896	1.5% of total expenses	$ 4,108	$ 4,108	$ 4,108
Miscellaneous		188,714	10%	$ 18,871	$ 18,871	$ 18,871
Repair				$ 1,500	$ 1,500	$ 1,500
Total Variable Expenses				**$211,694**	**$211,694**	**$211,694**
					$3,068	($8,235)
Fixed Costs						
Marketing				$11,303	$11,303	$11,303
Management Salary		$10,000	$0	$21,303	$21,303	$21,303
Property Taxes		.40/$100	$30,000	$120	$120	$120
Insurance (On Structure)				$250	$250	$250
Interest On Operating Line					$20,325	$20,325
Depreciation and Interest						
- Greenhouse				$2,981	$2,981	$2,981
- Flats				$3,610	$3,610	$3,610
- Tree Stock				$26,743	$26,743	$26,743
Total Fixed Costs				**$66,310**	**$86,635**	**$86,635**
Total Operating Expenses				**$278,004**	**$298,329**	**$298,329**
Income Before Taxes				($51,939)	($83,567)	($94,871)
Income Tax Rate				0.00	0.00	0.00
Income Taxes				$0	$0	$0
Net Income				($51,939)	($83,567)	($94,871)

3.3.4 Scenario IV – Decreased Variable Costs

Scenario IV is designed to reveal the impact of an across-the-board decrease in the total variable costs of production used in Scenario I. This scenario has a 10% decrease to the total variable costs category. This sensitivity analysis revealed the importance of controlling costs, as well as the impact that these decreases have on the net income. Once again, the fixed costs are constant. An enterprise budget was created again (See Table 3.10).

The results of the decreased variable costs scenario are summarized in Table 3.9. Decrease in the variable costs, as would be expected, led to an improvement in the profitability. The net income loss decreased by over $10,000, and the contribution margin increased. Also, the breakeven percentage sold decreased as well, which narrowed the gap from the field trial. The deceased costs illustrated the importance of costs control.

Table 3.9 Decreased Variable Costs Scenario Results

	5% Variable Costs Decrease	**10% Variable Costs Decrease**
Revenue	$226,065	$226,065
Contribution Margin	$24,445	$34,824
Net Income	($61,353)	($50,112)
Breakeven Number Sold	44,370	42,044
Breakeven Percentage Sold	41%	39%
Unit Costs Of Production	$8.90	$8.55

Table 3.10 Decreased Costs Scenario Budget

Scenario IV - Decreased Costs 107,650 Maple Cuttings Planted							
Num. Planted **Percent Salable Plants**	107,650 30%	**# Units**	**Price or Costs/Unit**		**Total**	**5% Variable Costs Decrease**	**10% Variable Costs Decrease**
1 gallon Maple Liners		32,295	$7.00		$226,065	$226,065	$226,065
Variable Operating Expenses	units						
Containers	containers	107,650	$ 0.41		$ 43,598	$ 41,418	$ 39,238
Substrate	yd^3	267.49	$ 25.00		$ 6,687	$ 6,353	$ 6,019
Perlite	yd^3	133.75	$ 1.75		$ 234	$ 222	$ 211
Tree Supports	stakes	107,650	$ 0.05		$ 5,383	$ 5,113	$ 4,844
Fertilizers	pounds	3,499	$ 1.20		$ 4,198	$ 3,988	$ 3,779
Hormone	oz	43.06	$ 2.13		$ 92	$ 87	$ 83
Herbicide					$ 300	$ 285	$ 270
Delivery/Transportation Costs		32,295	$1.00		$ 32,295	$ 30,680	$ 29,066
Water	gallons	5,103,531	$2.67/1000 gal		$ 13,626	$ 12,945	$ 12,264
Labor					$ 80,300	$ 76,285	$ 72,270
Electricity					$ 500	$ 475	$ 450
Crop Insurance		294,246	1.5% of total expenses		$ 4,414	$ 4,414	$ 4,414
Miscellaneous		188,714	10%		$ 18,871	$ 17,928	$ 16,984
Repair					$ 1,500	$ 1,425	$ 1,350
Total Variable Expenses					**$211,999**	**$201,620**	**$191,241**
Fixed Costs							
Marketing					$ 11,303	$ 11,303	$ 11,303
Management Salary		$10,000	$0		$ 21,303	$ 21,303	$ 21,303
Property Taxes		.40/$100	$30,000		$ 120	$ 120	$ 120
Insurance (On Structure)					$ 250	$ 250	$ 250
Interest On Operating Line					$ 20,350	$ 19,488	$ 18,626
Depreciation and Interest							
- Greenhouse					$ 2,981	$ 2,981	$ 2,981
- Flats					$ 3,610	$ 3,610	$ 3,610
- Tree Stock					$ 26,743	$ 26,743	$ 26,743
Total Fixed Costs					**$86,660**	**$85,798**	**$84,936**
Total Operating Expenses					**$298,659**	**$287,418**	**$276,177**
Income Before Taxes					($72,594)	($61,353)	($50,112)
Income Taxes					$0		
Net Income					($72,594)	($61,353)	($50,112)

3.3.5 Scenario V – Production Scale and Mortality Matrix

Scenario V analyzed two important issues; mortality and economies of scale. Mortality was a major cost that can have a major impact on the economic feasibility of maple-liner production in a traditional tobacco greenhouse.

The matrix in Table 3.11 is a useful tool to better understand at what level maple-liner production is economically feasible. This matrix is computed with the same costs as in the control scenario. The change in revenue comes from differences in the number planted and the percent of salable plants. The breakeven number decreases as the level of production increases, due to the efficiencies gain from economies of scale. Table 3.11 indicates that efficiencies gained from economies of scale are not able to overcome production at or below 35% salable plants. At 45,000 cuttings planted, though, fixed costs are less than $2.00 per plant, and continue to decrease as production increases. Breakeven production then occurs between 35% and 45% salable plants. However, breakeven does not occur until after 85% salable plants when only 10,000 plants are planted, once again showing the significance of economies of scale.

It is important to note the impact mortality had on the economic feasibility of producing woody liners in a tobacco greenhouse. If a producer produced over 25,000 plants, the profits would be realized by selling 60% of the cuttings planted. By producing 60% of the planted cuttings to commercial quality, the producer would be nearing the industry standard level of production. The industry commonly sells 65% to 80% of their planted cuttings.[29]

[29] Dirr, Michael A. and Charles W Hueser, Jr. The Reference Manual of Woody Plant Propagation. Varsity Press, Inc. 1987. pp. 29

Table 3.11 Net Income Matrix

Number Planted	Percentage of Salable Plants														
	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
10,000	($40,016)	($36,516)	($33,016)	($29,516)	($26,016)	($22,516)	($19,016)	($15,516)	($12,016)	($8,516)	($5,016)	($1,516)	$1,984	$5,484	$8,984
15,000	($41,598)	($36,348)	($31,098)	($25,848)	($20,598)	($15,348)	($10,098)	($4,848)	$402	$5,652	$10,902	$16,152	$21,402	$22,654	$27,117
20,000	($43,187)	($36,187)	($29,187)	($22,187)	($15,187)	($8,187)	($1,187)	$5,813	$12,813	$19,813	$22,791	$28,741	$34,691	$40,641	$46,591
25,000	($44,777)	($36,027)	($27,277)	($18,527)	($9,777)	($1,027)	$7,723	$16,473	$25,223	$28,877	$36,315	$43,752	$51,190	$49,661	$55,961
30,000	($46,359)	($35,859)	($25,359)	($14,859)	($4,359)	$6,141	$16,641	$23,070	$31,995	$40,920	$49,845	$49,781	$57,341	$64,901	$72,461
35,000	($47,949)	($35,699)	($23,449)	($11,199)	$1,051	$13,301	$25,551	$32,131	$42,544	$52,956	$53,677	$62,497	$71,317	$80,137	$88,957
40,000	($49,538)	($35,538)	($21,538)	($7,538)	$6,462	$20,462	$29,293	$41,193	$53,093	$55,052	$65,132	$75,212	$85,292	$95,372	$101,059
45,000	($51,120)	($35,370)	($19,620)	($3,870)	$11,880	$23,485	$36,873	$50,260	$53,913	$65,253	$76,593	$87,933	$95,137	$106,004	$116,872
50,000	($52,710)	($35,210)	($17,710)	($210)	$17,290	$29,572	$44,447	$50,249	$62,849	$75,449	$88,049	$96,455	$108,530	$120,605	$132,680
55,000	($54,299)	($35,049)	($15,799)	$3,451	$22,701	$35,658	$52,020	$57,924	$71,784	$85,644	$95,358	$108,641	$121,923	$135,206	$148,488
60,000	($55,882)	($34,882)	($13,882)	$7,118	$23,901	$41,751	$50,485	$65,605	$80,725	$91,852	$106,342	$120,832	$135,322	$149,812	$164,302
65,000	($57,471)	($34,721)	($11,971)	$10,779	$28,500	$47,837	$56,901	$73,281	$89,661	$101,622	$117,320	$133,017	$148,715	$164,412	$180,110
70,000	($59,061)	($34,561)	($10,061)	$14,439	$33,098	$53,923	$63,316	$80,956	$94,488	$111,393	$128,298	$145,203	$162,108	$179,013	$195,918
75,000	($60,643)	($34,393)	($8,143)	$18,107	$37,704	$50,837	$69,737	$88,637	$103,057	$121,169	$139,282	$157,394	$175,507	$193,619	$196,389
80,000	($62,232)	($34,232)	($6,232)	$21,768	$42,303	$55,993	$76,153	$92,300	$111,620	$130,940	$150,260	$169,580	$188,900	$193,131	$211,051
85,000	($63,822)	($34,072)	($4,322)	$25,428	$46,901	$61,148	$82,568	$99,655	$120,183	$140,710	$161,238	$181,765	$187,634	$206,674	$225,714
90,000	($65,404)	($33,904)	($2,404)	$24,732	$51,507	$66,309	$88,989	$107,016	$128,751	$150,486	$172,221	$193,956	$200,061	$220,221	$240,381
95,000	($66,994)	($33,744)	($494)	$27,843	$47,525	$71,465	$95,405	$114,372	$137,314	$160,257	$183,199	$191,204	$212,484	$233,764	$255,044
100,000	($68,583)	($33,583)	$1,417	$30,954	$51,420	$76,620	$97,578	$121,728	$145,878	$170,028	$194,178	$202,507	$224,907	$247,307	$269,707
105,000	($70,165)	($33,415)	$3,335	$34,072	$55,321	$81,781	$103,731	$129,089	$154,446	$179,804	$190,294	$213,814	$237,334	$260,854	$284,374
107,650	($71,011)	($33,334)	$4,344	$35,718	$57,383	$84,511	$106,987	$132,985	$158,982	$184,979	$195,689	$219,802	$243,916	$268,030	$292,143

4 Interpretation Of Study Findings And Overcoming Potential Economic Problems

Diversification into a new enterprise gives producers the chance to improve their farm profitability and reduce risk exposure of their farming operations. Additionally, fixed costs are spread among more units, capitalizing on the efficiencies of economies of scale. Labor, equipment, capital, land, etc. can all be better utilized, too. Therefore, the quest for new profit generating enterprises will likely never cease for a progressive farmer.

4.1.1 Economic Feasibility of Woody Liners

The primary objective of this case study was to analyze the economic feasibility of producing maple liners in a tobacco greenhouse. This objective was met by answering specific questions listed in Section 1.3.2.

1. Is it economically feasible to produce maple liners in a traditional tobacco greenhouse?

   From the economic analysis conducted, maple liner production was shown not to be economically feasible in a traditional tobacco greenhouse with the limited modifications employed in the field trails. The net income calculated from the control scenario was a loss of ($72,594).

2. What is the break-even level of production for maple liners when produced at full capacity in the tobacco greenhouse?

   In order to breakeven, 43% of the cuttings planted, must be sold.

3. How sensitive is the break-even level of production for maple liners to price fluctuations (cost and revenue)?

   The sensitivity analysis showed that the breakeven level of production was sensitive to revenue and costs fluctuations. The analysis revealed that net income could reduce by over $20,000 with more adverse market and costs conditions. Additionally, breakeven increased to as much as 50% salable plants.

The control scenario is the most likely scenario to be replicated in production because it represented the field trial performance. The matrix, however, revealed that liner mortality is the biggest factor to success. By increasing the number of plants sold, the economic feasibility answer changes dramatically. At this level of production, the net income improved dramatically as the percentage sold increased to over $100,000.

4.2 Maple Liner Production Economics In Southside Virginia

Although the maple liner production schedule fits into a tobacco greenhouse production schedule, the greenhouse was not economically feasible option for production of maple liners. The engineering requirements and other considerations impede on successful propagation of maple liners in a tobacco greenhouse.

4.2.1 Culturally Suitable

The optimal propagation period for *Acer rubrum* cuttings is during the summer months (July through mid-August). At this time, the tobacco greenhouse is idle from tobacco transplant production. As shown in Figure 2.1, the production of maple liners does coincide with tobacco transplant production. Therefore, greenhouse availability permits production of maple liners in a tobacco greenhouse.

4.2.2 Engineering Requirements

From the Halifax County field trial, it was concluded that engineering modifications were needed to even attempt to produce maple-liners in a tobacco greenhouse. The current configuration is not conducive to year round production. The modifications needed include: a) an improved ventilation system, monitoring systems for temperature control b) a misting system.

a) The greenhouse is insufficiently ventilated, as well as fitted with an inadequate irrigation system. The ventilation is not adequate for cooling the greenhouse, and allows spikes in temperatures during the daytime hours. A data logger was not installed in the greenhouse during the summer of 2002, however, observations over 100 Fahrenheit (^{o}F) were observed during September. Looking at historical ambient temperature data for Halifax County, this previous

year was not unlike the past 10 years. Temperature routinely reaches the upper 90 ^{o}F range during July and August, and periodically into the first of September, as shown with Figure 2.3.

b) The ebb-and-flow irrigation system is simple, but outdated, as new technologies have entered the market at relatively cheap prices. The ebb-and-flow system was deemed inadequate for maple-liner production because without a high relative humidity 100% of the cuttings planted in this system died. Improvement in the rooting success observed under the misting system indicated that this modification is needed to successfully root maple cuttings.

4.2.3 Other Considerations

To assume that with a few changes, maple liner production would be profitable in a tobacco greenhouse may be tempting, but a potential investor must understand the high production and market risk associated with maple liner production. Weather, insects, disease, and other potential problems can all hinder profitability. Additionally, a nursery operation is a very labor and capital-intensive operation, which requires intensive management.

A tobacco producer also must consider other production risk as well. Labor and cash flows can create a major obstacle to the producer. Although labor is not typically required year-round for a nursery operation, the labor can conflict with tobacco production. Peaks in the demand for labor could detract from tobacco production, as much of the propagation is done during while tobacco producers are busy topping, suckering, and priming their crop.

The start-up capital needed would exceed $200,000 to begin the operation, which could be amortized over a multi-year period (see Figure 5.1). For this level of production, purchasing the tree stock for obtaining cuttings would be a large expense. This study assumed the purchase of tree stock for $50, and planting over 100,000 cuttings would require over 3,500 trees. The start-up capital plus what is required for operational expenses could easily exceed $500,000 at this level of production.

The operating cash outflow for a tobacco producer to begin maple-liner production in their tobacco greenhouse large. For the level of production described in this case study, more than $200,000 must be paid out over an 18-month period before any potential revenues are realized (see Figure 3.2). This is a great risk, and cash flow must be managed carefully. A large line of credit would be needed for an efficient operation.

4.3 Recommendations

Woody liner production for shade trees may have economic potential in Southside Virginia; however, a tobacco greenhouse may not be the most efficient median of production. Based on agronomics with no substantial structure or engineering changes, the economic analysis revealed it was not economically feasible to produce maple liners in a tobacco greenhouse. Every scenario revealed a negative net income. The contribution margin was positive (with the exception of a 10% variable costs increase and 10% revenue decrease), but the revenues generated could not pay the fixed costs of operating. The breakeven percentage sold was within 20% of that observed in the field trials; indicating that different management and growing practices could potentially make this a profitable enterprise. The net income matrix revealed the impact mortality had on the operation. As mortality approached commercial levels, the operation would become profitable. A summary of the economic analysis is shown in Table 4.1. The table shows the economic changes documented from each scenario.

Table 4.1 Economic Analysis Summary

Economic Factors	Control	5% VC Increase	10% VC Increase	5% Revenue Decrease	10% Revenue Decrease	5% VC Increase	10% VC Decrease
Revenue	$226,065	$226,065	$226,065	$214,762	$203,459	$226,065	$226,065
Contribution Margin	$14,066	$5,361	($5,148)	$3,068	($8,235)	$24,445	$34,824
Net Income	($72,549)	($82,153)	($93,542)	($83,567)	($94,871)	($61,353)	($50,112)
B/E Number Sold	46,328	48,857	51,338	50,185	54,250	44,370	42,044
B/E Percentage Sold	43%	45%	48%	47%	50%	41%	39%
Unit Costs of Production	$9.25	$9.54	$9.90	$6.71	$6.36	$8.90	$8.55

The tobacco greenhouse does very well at producing tobacco transplants. It is not designed for other production practices, though. Without serious modifications, the greenhouse will not support maple liner production. Modifications that could be considered are listed in Table 4.1. Further research is needed to document the economic and production feasibility of these modifications.

Table 4.2 Potential Engineering Modifications

Raised Sidewalls	Shade Cloth / White Wash	Fog
Exhaust Fans	Evaporative Pads	Removal of Plastic Top

While this case study did not reveal a positive economic scenario for woody liner production in a tobacco greenhouse, it should not detract from the potential for diversification into the horticulture industry. The horticulture industry is growing in Virginia and will continue to present opportunities for entrepreneurs. The use of the tobacco greenhouse does not appear to be the most efficient median for expansion into this industry however. There is much research and exploration needed to discover how a horticultural enterprise would interact with a tobacco greenhouse and its production schedule in order for it to be a successful median for growth.

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6 Appendix

6.1 Field Trials in Halifax County

Research Facilities & Engineering:

The manufacturer's specs rate the exhaust fan for 11,195 cubic feet per minute (cfm) at zero static pressure. This fan is inadequate for the recommended one air change per minute (Boodley, 89). The greenhouse volume is calculated with the following equation:

$$V, \text{Ft}^3 = (L \times W \times H) + \left(\frac{p \cdot r^2 \cdot \Theta}{360} - \frac{b^2}{\tan \frac{\Theta}{2}} \right)$$

Where V=Volume (Ft^3),

L=Length (Ft),

W=Width (Ft),

r^2=Length of arc (Ft),

b=1/2 width of arc (Ft)

Figure 6.1 Field Trial Layout

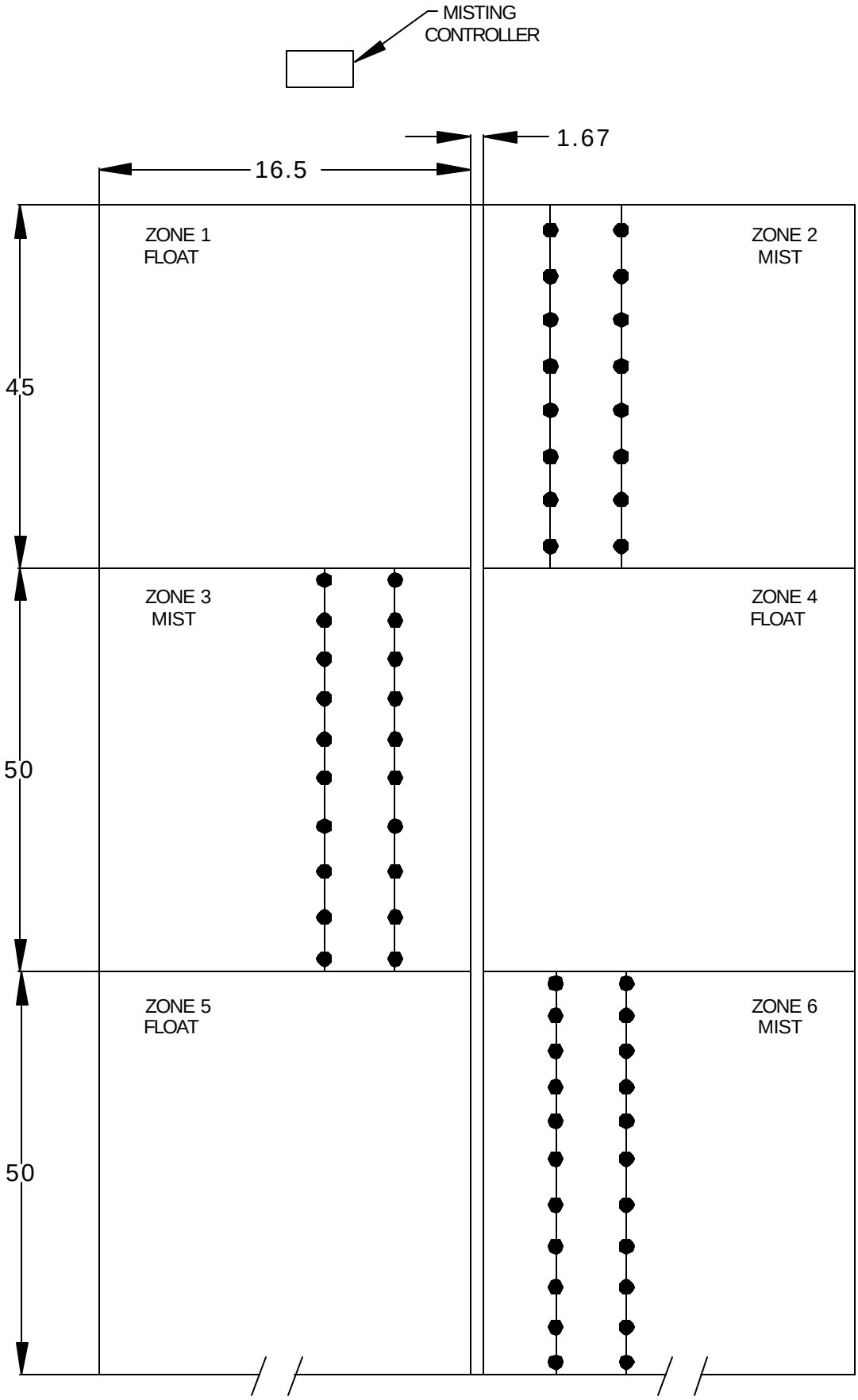


Figure 6.2 Field Trial Greenhouse Dimensions

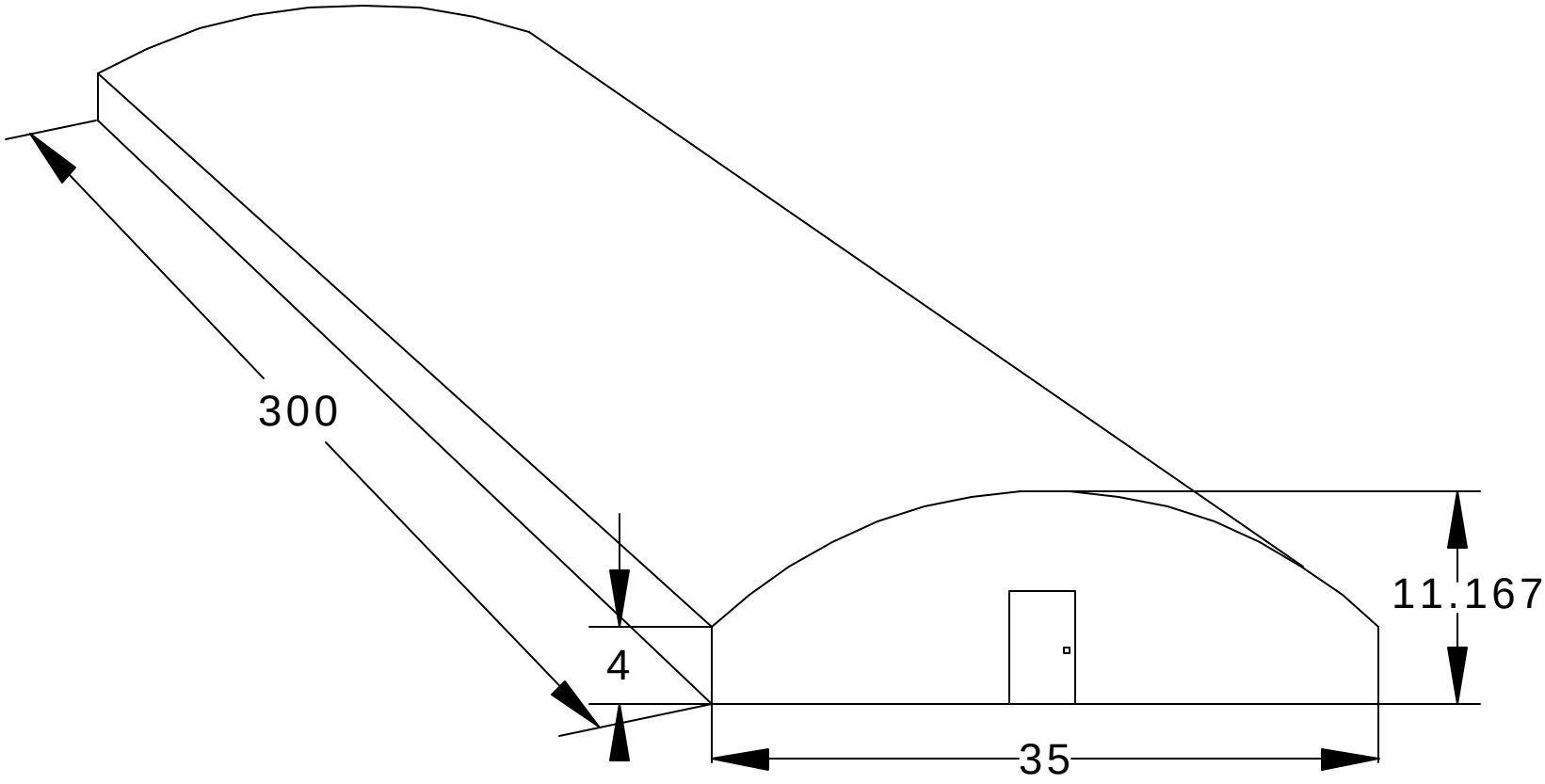


Figure 6.3 Cross-Section of Greenhouse

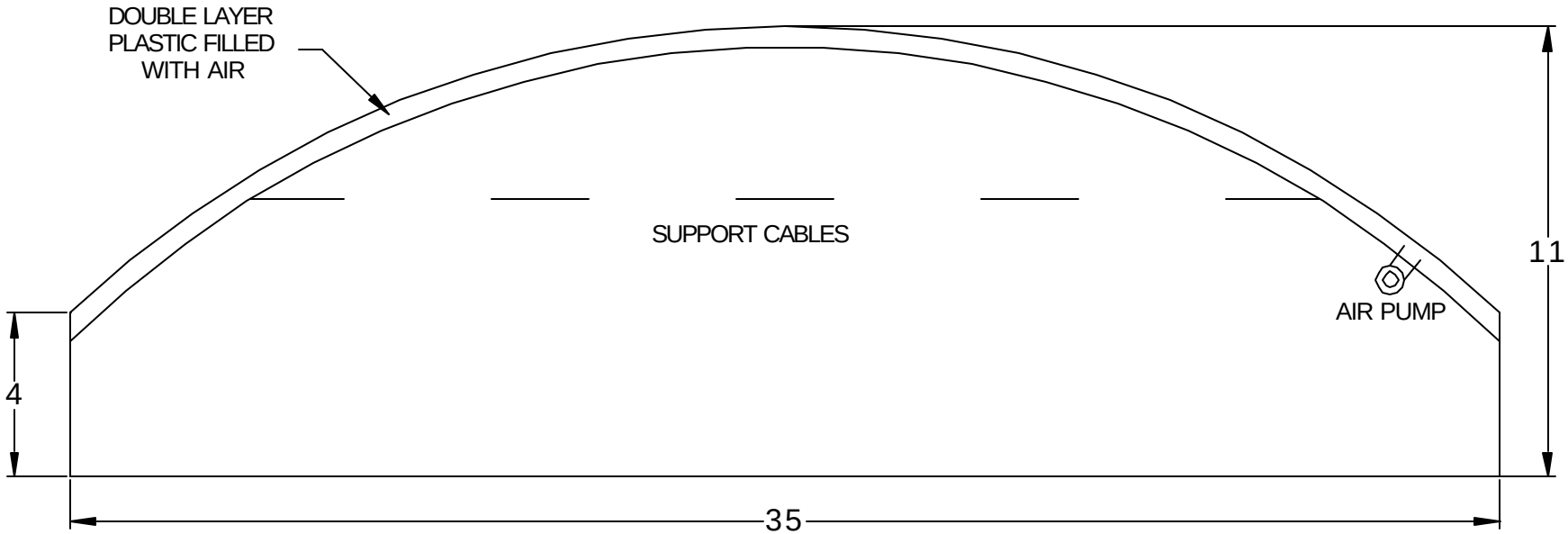
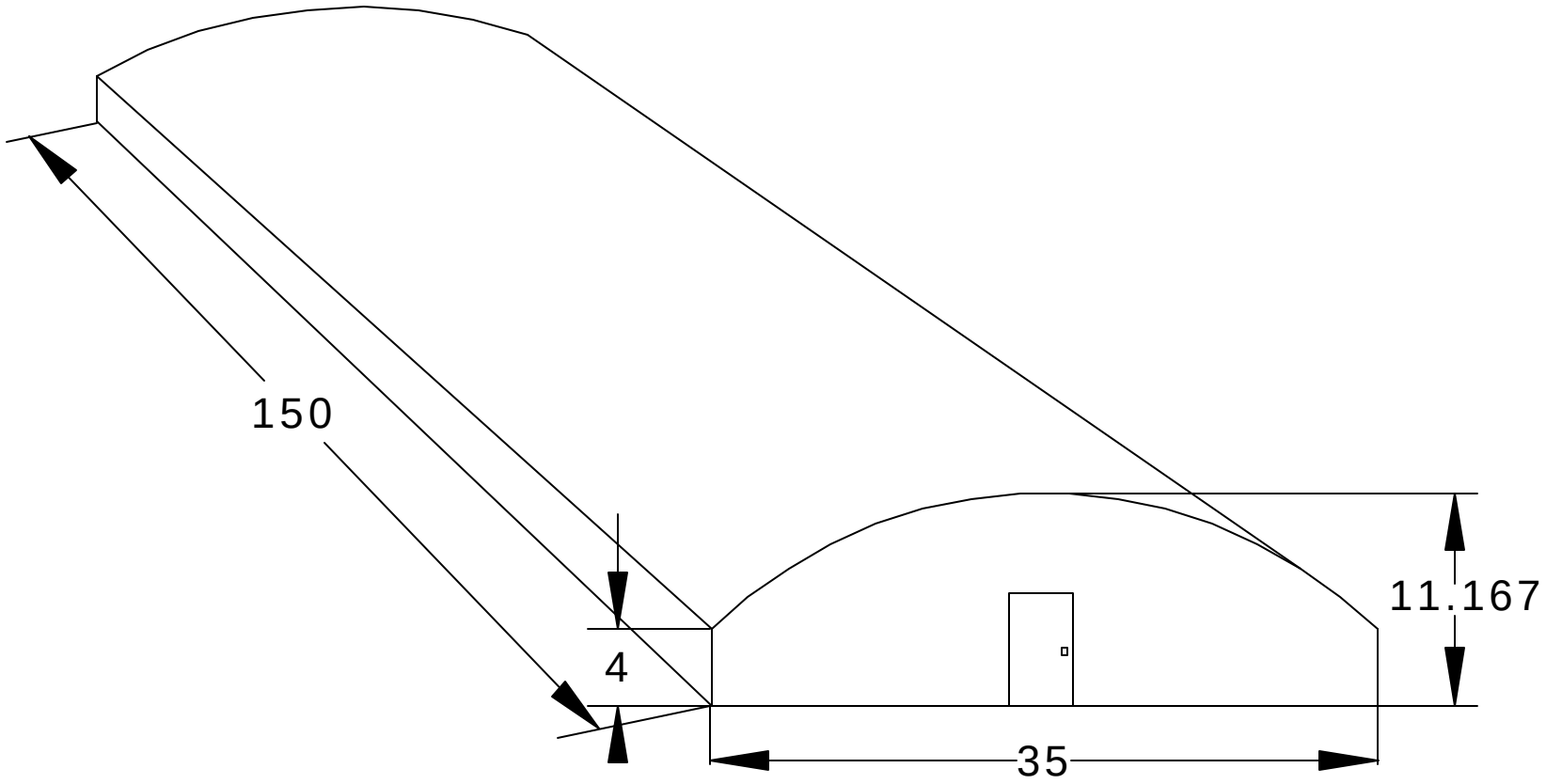


Figure 6.4 Standard Tobacco Greenhouse Used for Economic Analysis



6.2 Documentation of Budget Inputs

Table 6.1 Supply Purchase Price and Usage Rates

Expected Purchase Price			Expected Use		
Flats	$11.25	each	Liners per Flat	50	
Containers	$0.41	each	Liners per Container	1	
Fertilizers	$1.20	per pound	Fertilizer Rate	0.0325	lbs/container
Tree Supports	$0.05	each	Media per Flat	1145	yd^3/flat
Potting Media[1]	$25.00	per yd^3	Media per Container	151	yd^3/container
Perlite	$1.75	per yd^3	Media Mixture, Perlite	1	yd^3
Labor	$8.00	per hour	Media Mixture, Substrate	2	yd^3
Hormone	$2.13	oz	Water (mist) (Rooting)	1600	gal/day
Water	$2.67	per 1000 gal	Water (sprinkler)	0.125	gal/pot/day

[1] Cost includes $17.50/$yd^3$ of substrate and a delivery charge of $7.50/$yd^3$

Table 6.2 Task Time Estimates

Task Time Estimate				
Planting	**Units**	**Units per hour**		**Employees**
Mixing Media	yd^3	3		1
Fill Flats	flats	60		1
Taking Cuttings	cuttings	300		3
Sticking Cuttings	cuttings	300		3
Total Man Hours				
Rooting/Growth				
Mixing Media	yd^3	3		1
Pot	liners	45		1
Staking Liners	liners	45		1
Spreading Fertilizer	liners	200		1
Spraying	liners			1
Pruning	liners	45		1
Total Man Hours				
		Hours		**Weeks**
Monitoring (hours per week)		14		64
Total Man Hours				
Harvest				
Loading		1000	containers	2

Table 6.3 Modification/Start Up Cost Estimate

Modification Cost Estimate			
Modification	**Qty**	**Cost/unit**	**Total**
Greenhouse	1	$ 30,000	$ 30,000
Tree Stock	3589	$ 50	$ 179,450
Mist Irrigation[1]			
Mist Heads	216	$ 1.75	$ 378.00
1/2" Poly Tubing (1000' roll)	1	$ 69.00	$ 69.00
3/4" Poly Tubing (100' roll)	2	$ 18.00	$ 36.00
1" In-Line Control Valve	6	$ 18.50	$ 111.00
Hanging Sprinkler Assembly	216	$ 1.30	$ 280.80
Gemini Misting 6 zone control	1	$ 425.00	$ 425.00
Miscellaneous Connections	1	$ 55	$ 55.00
Total			$ 1,354.80
Shade Cloth[2]	150'x42' 6450 ft^2		$ 1,400.00
Fan Installation			
51 in. 1hp Exhaust Fans	2		
Framing Materials			
Electrical Needs			

Modification Time Estimate	**Hours**	**Employees**	**Hourly Rate**	
Installation of Misting System	12	2	$12.00	$288.00
Installation of Shade Cloth	3	2	$12.00	$72.00
Installation of landscaping Fabric	3	2	$12.00	$72.00
Installation of Fans	25	2	$12.00	$600.00

[1]Estimate provided by Berry Hill Irrigation of Buffalo Junction, VA on 7/11/2001
[2]Estimate provided by Hummert International for custom shade cloth with grommets

7 Vita

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Study Abroad Experience

Europe, May-June 1999
• Environmental, economic, & trade issues facing the European Union

Australia, May-June 2000
• Economic, Trade, & Land-use policies in Australia

Employment Experience

Virginia Polytechnic Institute & State University, Blacksburg, VA 2001-2002
Graduate Research Assistant
• Coordinate and conduct field trial experiments
• Plan and adhere to budget
• Perform economic feasibility analysis on maple liner production

Croptech Development Corporation, Blacksburg, VA Summer 2000
Data Collection & Field Maintenance
• Collected data for production of Biotech tobacco for scientific experiments and analysis
• Assisted farmers directly in decisions involving new management practices

Hudson Farms, Alton, VA Summer 1999
Field Crew
• Sold and delivered produce, as well as production and harvest of crops
• Managed migrant labor in field – regularly communicated in Spanish
• Operation of machinery and implement

Springhill Farm, Alton, VA 1992-2000
Assistant Manager
• Aided in purchasing and financial planning decisions
• Managed employees and activities related to farm production