ECONOMIC EVALUATION OF ORGANIC RABBITEYE BLUEBERRY PRODUCTION IN SOUTH GEORGIA

by

KRISTY JEAN PLATTNER

(Under the Direction of Esendugue Greg Fonsah)

ABSTRACT

The research provides agronomic and economic production information on organic blueberry. The profitability of organic rabbiteye blueberry production in Georgia was investigated to determine which of four distinct production technologies were most economically efficient. Enterprise budgets were utilized to determine cost, revenues and net returns of pine bark, pine straw, ground cover and non-mulched organic mulch production methods over a seven year period. Enterprise budget data was utilized to develop second-degree stochastic dominance analysis aimed at determining risk-rated economic efficient preferred system. The analysis ranked each method by most to least preferred alternative after comparing net returns, yields and revenues. The results depict that under low risk aversion, pine bark was the most preferred production system for net returns. A sensitivity analysis was generated to determine net returns behavior vis-à-vis percentage change in price and yield.

INDEX WORDS: Organic Agriculture, Blueberry, Enterprise Budget, Stochastic Dominance, Sensitivity Analysis

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DEDICATION

I would like to dedicate this thesis to my family. To my parents, Valarie and George, for all their support and love and self-sacrifice to see their children's dreams materialize. Without them I would not be the person I am today and will become tomorrow. Words cannot express the gratitude I have for them. I would like to thank my brother, Michael, for keeping me inside reading. I could ask for a better brother but I doubt he would be as much fun. To the memory of my G-pop Ray-Ray, for making me think before I speak. Grandma Mean Jean who demonstrated what a strong woman should be. Doug Lyle, I wish he could be here today, I always wonder what he would be doing. I'd like to thank my friends in the College of Agriculture for all the smiles and friendship. Thanks to Jo Anne Norris and Kim Brown who consistently answered my questions and always with a smile. Carter Dunn for being there for me and going through it all at the same time, life is a lot better when you have a partner in crime! And lastly, to Jim Muckler for the countless smiles, the road trips, the journeys and the unconditional love. May we continue to grow together because each day is better then the last.

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CHAPTER 1

INTRODUCTION

1.1. Background

North America and Europe comprise 96% of global revenues in organic food and drink. In 2004, the organic food and drink market was valued at $27.8 billion. Sales in 2005 passed $30 billion with largest market growth occurring in North America which expanded by over $1.5 billion a year (Sahota, 2007). The increase in consumer demand for organics has prompted an increase in organic production. Consumers perceive that organic products are better for the environment, safer and healthier than their conventional counterparts (Lohr, 2005). Organic producers in the United States spent more than $1 billion importing organic products to the United States resulting in an 8:1 import-to-export ratio. Much of the imported products were organic grains and seed to produce organic meats. Organic fruits and vegetables generated over $5 billion in sales in 2005 (Lipson, 2007).

The increase in consumer demand for organic fresh fruits and vegetables includes organic blueberries. Limited research has been conducted on the profitability of organic blueberry production in Georgia. Many enterprise budgets have been developed for conventional blueberry production in the state, demonstrating the profitability of the operation (Fonsah et al., 2005; Fonsah et al., 2006; Fonsah et al., 2007; Fonsah et al., 2008). This study will take the budget format employed by Fonsah et al. (2008) to determine the cost and revenues associated with organic rabbiteye blueberry production in South Georgia.

Four organic production methods were observed for seven years. The differing methods are based on organic mulch types which are: pine bark, pine straw, ground cover and non-mulched (control). Each production type received the same fertilizer, pesticide and harvesting regime, the main differences between the methods were yield and weed removal time. Second-degree stochastic dominance will be implemented to determine which production method is most preferred under two levels of risk aversion. Seven years of budgets will be created for each production method as well as fixed cost and irrigation budgets. These budgets will give a general cost and revenue estimate for producing organic blueberries under various production methods in South Georgia growing conditions. The information provided will aid in producers, extension agents and future producers when determining the benefits of producing organic blueberries.

1.2. The Problem Statement

Organic blueberry production is a relatively new method for growing and harvesting berries. The costs and potential profits are unknown for organic blueberry production methods. Weed control is a major problem. In this research paper several organic production methods between 2 farms in South Georgia are assessed for costs and profit potential. The data collected will provide insight and information about the potential profitability of organic blueberries.

1.3. Objectives

Organic blueberry production represents a market where producers can capture a higher price premium than conventional blueberries, but until the cost of production is known, it would be difficult to determine the financial viability and lucrativeness of the crop. Exact figures on blueberry production profitability are difficult to determine due to high variability in production

costs and price volatility, yields per acre and uncertainty about future market prices (Williamson and Lyrene, 1995; Fonsah et al., 2006). Agricultural practices differ from grower to grower, farm to farm, region to region, and county to county. Due to this vast variability, the principal objective of this study is to determine profitability margin of 'Brightwell' organic rabbiteye blueberry under four differing production technologies and Georgia weather conditions.

The specific objectives of the research are as follows:

(1) Provide both agronomic and economic production information to individuals seeking to transition or begin organic blueberry production in the Southeastern United States.

(2) To develop several risk-rated enterprise budgets for each method of production to determine cost, revenues and net returns of the four mulching techniques.

(3) To determine the most economically viable production method in terms of economic efficiency and financial viability.

(4) Utilize second-degree stochastic dominance statistical analysis method to determine the most efficient organic blueberry production system; and

(5) Policy implementation.

An enterprise budget is the estimates of receipts (income), costs, and profits associated with production of blueberries. The enterprise budget will illustrate the potential loss and profit margins for four different organic mulch types during the blueberry establishment phase. Since weed control is the highest concern in organic production the ability of the different mulches to reduce weed growth will play a crucial role in the profitability of the operation. The relative risk-return efficiencies of the four production methods in terms of yields, revenues and net returns generated in the budgets will be analyzed using second-degree stochastic dominance.

1.4. Usefulness of Study

The information presented will aid extension agents, current and future farmers with a basic guideline for organic production. Production methods will be reviewed to determine under South Georgia growing conditions which method provides the best results with the least cost. Seven years of budgets will be constructed for each of the four mulching systems, along with two fixed cost budgets and a drip irrigation cost budget. The information generated in the budgets will be analyzed using second-degree stochastic dominance in the program *Simetar* (Richardson et al., 2008). The analysis will determine which production method is the most efficient under risk. This can be utilized by growers in similar conditions throughout the southeastern United States.

1.5. Organization

The remainder of this thesis is comprised of five chapters. Chapter 2 will overview the United States economy and agricultural sector focusing on domestic blueberry production and Georgia's role in blueberry production. Chapter 3 examines horticultural literature on blueberry history and production methods and blueberry demand both domestic and abroad. Methodology will be discussed including risk-rated enterprise budgets for each production method and stochastic dominance econometric analysis overview in chapter 4. Empirical results and econometric analysis are reviewed in chapter 5. Chapter 6 will be the conclusion and summary with suggestions for future research.

CHAPTER 2

HIGHLIGHTS OF THE U.S. ECONOMY AND BLUEBERRY AGRICULTURE SECTOR

2.1 Background of United States of America

The United States of America (USA) is the fourth largest country in the world with an area of 3,794,066 square miles. Total population from the 2000 census was 281,421,906 with a 2008 estimate of 305,461,000 via the U.S. Census Bureau. The terrain varies from the Atlantic to the Pacific oceans but contains a large central plain drained by the fourth largest river in the world, the Mississippi River. The Appalachian mountain range runs along the eastern coast while the Rocky mountain range is located in the western region. Throughout the country various weather patterns are experienced as well as distinctive fauna and flora (CIA Factbook, 2008).

Within the USA, there are ten major farm production regions (refer to figure 2.1.). The Pacific coast region produces wheat, fruit, potatoes and dairy. California harvests over 300 crops for the Pacific region. The Mountain States colder climate and high elevations make it favorable for wheat, oats, sugar beets, potatoes, fruits, vegetables and greenhouse crops. Texas and Oklahoma comprise the Southern Plains region and produce citrus, rice, cotton and vegetables. A majority of the countries wheat is produced in the Northern Plains along with grains, hay, forage crops, and cattle. Kansas, Nebraska and the Dakotas comprise the Northern Plain States. Soybeans, sugarcane, cotton and rice are grown in the Delta States. Corn is the major crop produced in the Corn Belt with feed grains, soybeans and wheat. The Lake States and

Northeastern States produce milk, fruit and vegetables. Appalachia has peanuts, dairy, cattle and is a major tobacco producer. The Southeast consists of Georgia, Florida, Alabama and South Carolina which provide fruits, vegetables, peanuts, cotton, winter vegetables and citrus (FAO, 1996).

Figure 2.1. United States Agriculture Regions Source: Food and Agriculture Organization, 1996 Country Report: United States of America (FAO, 1996).

2.2. Economic Growth

The USA has the largest national economy in the world. In 2006, gross domestic product (GDP) was 13,194.7 billion dollars (IMF). Exports grew by 12.7 % in 2006 compared to 2005 exports of a $1.4 trillion dollars. The highest ever exports in dollar terms was experienced in 2006 comprising 11.1 % of the GDP. Imports increased to $2.2 trillion up 10.5% from 2005 (U.S. Department of Commerce, 2007). The GDP can be separated into sectors with agriculture contributing 1.2%, industry over 19%, and services comprising 79%. In 2007 the U.S. GDP grew 2% despite inflation and increased unemployment (CIA Factbook, 2008).

2.3. Agricultural Sector

Value of the agriculture sector production in 2005 was $275.4 billion. The 1.2% of agriculture's contribution to the national GDP translates into $118,980 million of the overall GDP of $13,194.7 billion. Agriculture exports were over $82 million for 2007 while imports totaled over $70 million (ERS/USDA, 2008). The leading agricultural exports in 2006 were feed grains, oilseeds, wheat, fruit juices and wine, and feeds and fodders. Top agricultural imports were fruit juices, malt beverages, fruits and nuts, wine and vegetables (fresh and frozen) in 2006 (USDA/ERS, 2007).

2.4. U.S. Blueberry Industry – Historical Perspectives

Blueberries are native to North American and are one of the two major native fruits (Sciarappa, 2006) and have only been domesticated within the last century (Rieger, 2006). Harvesting from the wild probably occurred for thousands of years among Native Americans (Rieger, 2006). As far back as 1887, blueberry selections from the wild were made. In northwestern Florida a logging contractor made a selection in 1892 and planted them in rows where they continued to yield fruit for over 35 years. By 1930 about 2,000 acres of rabbiteye blueberries were being grown in Florida, all of which were made from wild selections or plants dug from the wild. In the mid-1920s the University of Georgia began research at the Coastal Plain Experiment Station in Tifton, Georgia on the best wild selections, which initiated a breeding program to select the best characteristics from wild selections to produce superior cultivars (Trehane, 2004).

Blueberry plants can be productive for over fifteen years, but like most plants they are susceptible to disease, excessive weed growth, freeze, drought, and extreme heat. As a general rule, blueberries prefer acidic soils with a 4.4-5.4 pH range. Plants grown on virgin soils have been more productive than plants grown in previously cultivated fields (Williamson and Lyrene, 1995).

Each blueberry species and cultivar require a minimum amount of hours at or below 45°F which plants must be exposed to so that 90% of the buds will open and develop "normally" following a two-week exposure to warm weather. This cold weather is known as "chilling requirement" and dictates when in the season the plants will bloom and fruit. Plants with low-chilling requirements such as 200-300 hours will normally bloom in mid to late February. The low-chilling plants should not be planted in high chilling regions, since they will often break bud too early and suffer freeze damage to the blossoms. If adequate chilling time is not observed, then bloom and leaf-development can be late and erratic, resulting in a reduction of yields (Krewer and NeSmith, 2006). Different growth, yield, and chilling requirements are experienced by the different blueberry species which are discussed in the next section.

2.4.1. Blueberry Species

Four species are economically important to several regions of the United States. These species are: Lowbush (wild), Northern Highbush, Southern Highbush, and Rabbiteye blueberries.

The Lowbush is predominately a wild plant. Cultivation and maintenance is basically the management of native wild stands done in Canada, Maine, Nova Scotia, and other northern regions. This crop has high chilling requirements, and almost all the fruit is processed (Rieger, 2006).

The northern highbush are grown in Michigan, New Jersey, Oregon, and other northern states (Austin, 1994) and are native to the east coast (Krewer and NeSmith, 2006). This is the most important cultivated blueberry in the United States (Rieger, 2006). A minimum of 800 chill hours are required for optimal yield. In the south, the soil must have a minimum of 3% organic content, thus growth is limited to sites naturally high in organic matter or soils amended with pine bark (Krewer and NeSmith, 2006; Fonsah et al., 2007).

Southern Highbush is a hybrid between northern highbush and other blueberry species. They combine the characteristics of the northern highbush plant to render it adaptable to the deep south region and climate (Rieger, 2006). Chill requirements are low ranging from 200-700 hours, which enables the plants to fruit as early as April to early-May. Grown mostly in Florida, southern Georgia and eastern North Carolina, southern highbush berries can receive several dollars per pound or more because of the early-season ripening, while late season blueberries may receive a dollar or less per pound (Rieger, 2006). Like the other blueberry cultivars, the Southern Highbush blueberry plants are not only more susceptible to pest and freeze damage but they require proper site selection and high soil organic matter of 3% or greater for a successful crop (Krewer and NeSmith, 2006; Fonsah et al., 2007; Fonsah et al., 2008).

2.4.2. Rabbiteye Blueberries

Rabbiteye (*Vaccinium ashei = virgatum*) blueberries are adapted to the southeastern United States, have moderate chilling requirements, grow vigorously, and produce satisfactory yields. Compared to highbush species, rabbiteyes are not as sensitive to soil type, are more heat and drought resistant, are hearty growers, and suffer from less pest damage (Austin, 1994).

The fruit looks identical to the northern highbush blueberry fruit except rabbiteyes only require 400 to 500 chilling hours per winter, so they can produce fruit in a warmer climate where the northern highbush will not perform well. The plant received its name because as the berry begins to ripen, a pink spot appears on the calyx which looks like the pink of a rabbit eye (Trehane, 2004).

The rabbiteye can achieve heights of 10-ft or more in the wild but should be kept to a height of 6 to 8 feet in cultivated fields for easier harvesting. They perform best in moist, but, well-drained, acidic soil that has an organic matter content of at least 2% (Krewer and NeSmith, 2006). Root systems are relatively deep which capture moisture deeper in the soil profile aiding in the species drought resistance trait. Rabbiteye leaves retain water more efficiently than northern Highbush, thus loses less moisture to transpiration and adding to drought resistant characteristics (Trehane, 2004). Rabbiteyes production life-span extends past thirty years. For instance some plants that were established in 1958 still produce berries in Georgia (Krewer and NeSmith, 2006).

2.5. Georgia Blueberry Industry

2.5.1. Conventional Blueberry

In Georgia, conventional blueberry production has increased exponentially since the mid-1970's (Scherm and Krewer, 2003; Fonsah et al., 2007; Fonsah et al., 2008) to reach the statewide farm gate value of $75 million from 10, 278 harvested acres in 2006 (Boatright and McKissick, 2007). In 2007, the value of blueberries produced dropped to $44.8 million, a 41% loss due to freeze induced crop damage (Boatright and McKissick, 2008).

Based on the value of utilized production in 2006, Georgia ranked third among the U.S. blueberry growing states after Michigan and New Jersey (New Jersey Agricultural Statistics Service, 2007). According to the 2007 rankings Georgia has dropped to 8th for value of utilized production but remains 3rd in total acres harvested (New Jersey Agricultural Statistics Service, 2008).

Blueberries contribute 18.6% of the total fruits and nuts produced in the state just behind peaches with 18.7% while pecans comprise 53.2% in 2007 (Boatright and McKissick, 2008). Blueberries surpassed peaches in commodity value in 2004. Blueberry production valued over $48 million while peach production was valued over $36 million (Boatright and McKissick, 2005). From 2004 to 2006 blueberries remained Georgia's 2nd most important fruit and nut crop behind pecans and above peaches (Boatright and McKissick, 2005). Blueberry acreage has been increasing since 2000 from 5,607 to 10,664 acres in 2007, while peach acreage has decreased since 2000 from 15,795 to 11,063 in 2007 (Boatright and McKissick, 2008).

In Georgia, rabbiteye blueberries are the most productive and the easiest to grow as they are less sensitive to soil types, incur less pest damage, are heat and drought resistant and are vigorous growers when compared to other blueberry species (Krewer and NeSmith, 2006). Typical yields for mature, well-managed fields are 5,000 to 7,000 pounds per acre with some fluctuations yearly (Krewer and NeSmith, 2006; Fonsah et al., 2007; Fonsah et al., 2008). Most cultivars grown in Georgia were developed by Dr. Tom Brightwell, Dr. Max Austin or Dr. D. Scott NeSmith at the University of Georgia (Hubbard et al. 1992) with new varieties coming out annually from several universities in the southeast.

Plants are usually spaced 6'×12' and 5'×12' which are respectively 605 plants per acre and 726 plants per acre (Hubbard et al. 1992). Spacing of 4'×12' is not uncommon and constitutes 907 plants per acre. These are spacings in which mechanical harvesters can operate.

Georgia's total blueberry industry is 71% irrigated with the main method of irrigation being drip. Those growers who did not irrigate, had an 80% reply that drought was one of there three major problems in blueberry production. Other problems mentioned by producers were freeze damage and weed control. Insect and disease problems were not a large production problem to Georgia producers with insecticide and fungicide usage being roughly 20%. Herbicides were used at a higher rate by 63% of blueberry producers (Hubbard et al. 1992).

By 2002, 81% of growers reported using irrigation with an increase of 31% in southwest Georgia. A large portion of drip irrigation was replaced by overhead irrigation by 2002. Insecticides and fungicides are used on an "as needed" basis but have increased substantially in use since 1991. The main production problems encountered by growers in 2002 were pest existence and damage, plant growth and weather conditions. Freeze damage remained the worst obstacle to production since 1991 (Florkowski, 2004).

The Georgia blueberry industry is highly dynamic and variable throughout the state. No one general description can encompass all the production practices carried out by various individual producers. Each producer operates at different levels and incorporates different cultivation practices. If interested in beginning a blueberry operation, one should contact the county extension agent for more personalized information (Fonsah et al., 2004).

2.5.2. Organic Blueberry

Organic blueberry production is an emerging market where price premiums often exceed conventional production. Most blueberry producers in Georgia have not transitioned to organic production because of risk and uncertainty in transitioning, high management costs, limited awareness about organics, and lack of strong marketing and infrastructure (ERS/USDA, 2007). Certified organic cropland, pasture, and operations are rare in the Southeastern states (Greene, 2004).

Blueberry maggot (*Rhagoletis mendax)*, thrips (*Catinathrips kainos* O'Neill), and mummy berry (*Monilinia vaccinii-corymbosi)* disease are potentially limiting factors in organic blueberry production in Georgia (Krewer and Walker, 2006). Rabbiteye blueberries are native to the southeast and have evolved good natural resistance to local diseases and insects (Scriarappa, 2006). Organic farming relies on ecologically based practices for weed and pest management (Greene, 2004). Rabbiteye traits of natural resistance, hardiness, and vigor lend themselves to organic production in the plants native range. Weed control is most important on young bushes in Georgia since weeds can over grow a new planting in three weeks. Weed growing season extends from March until October (Krewer et al., 2008).

A growing, but limited amount of research has examined input costs, profitability, yields and managerial requirements of organic farming (Greene, 2004); organic blueberry production in Georgia is no exception. Research is currently being conducted to determine how to minimize the limiting factors of weed and disease control in an economically efficient and viable manner in Georgia.

2.5.3. The Study Area

South Georgia is the primary producer of rabbiteye blueberries for the state. The soil characteristics, climate, and water availability are well-suited for rabbiteye production. Bacon County, in southeast Georgia, is the largest producer in the state, generating over $22 million in farm gate values (Fonsah et al., 2004; Fonsah et al., 2005; Boatright and McKissick, 2007) this value declined to just under $10 million in 2007 from significant freeze damage. Figure 2.2 demonstrates in which Georgia counties blueberries are produced and what total percentage each county contributes. Clinch county produced $11 million in blueberries for 2007 (Boatright and McKissick, 2007). Appling, Ware and Wayne counties also contributed to blueberry production in Georgia (Figure 2.2. and 2.3.). Figure 2.3 illustrates the production value of fruit and nut crops per county in Georgia. Fruit and nut production in Georgia included pecans, peaches, blueberries, apples, blackberries, grapes, strawberries and other minor fruit and nut crops.

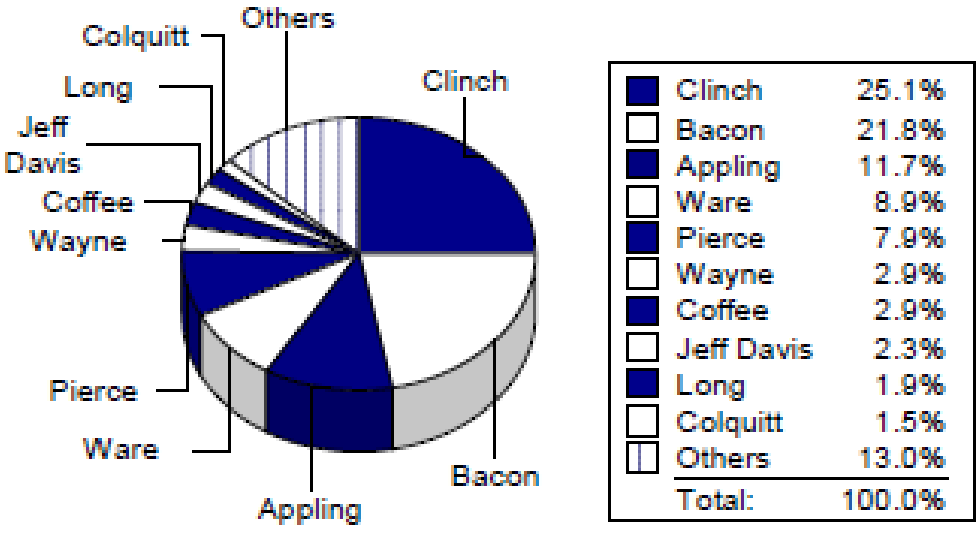

Figure 2.2. Georgia Top Blueberry Producing Counties
Source: 2007 Georgia Farm Gate Value Report, AR-08-01, 2008.

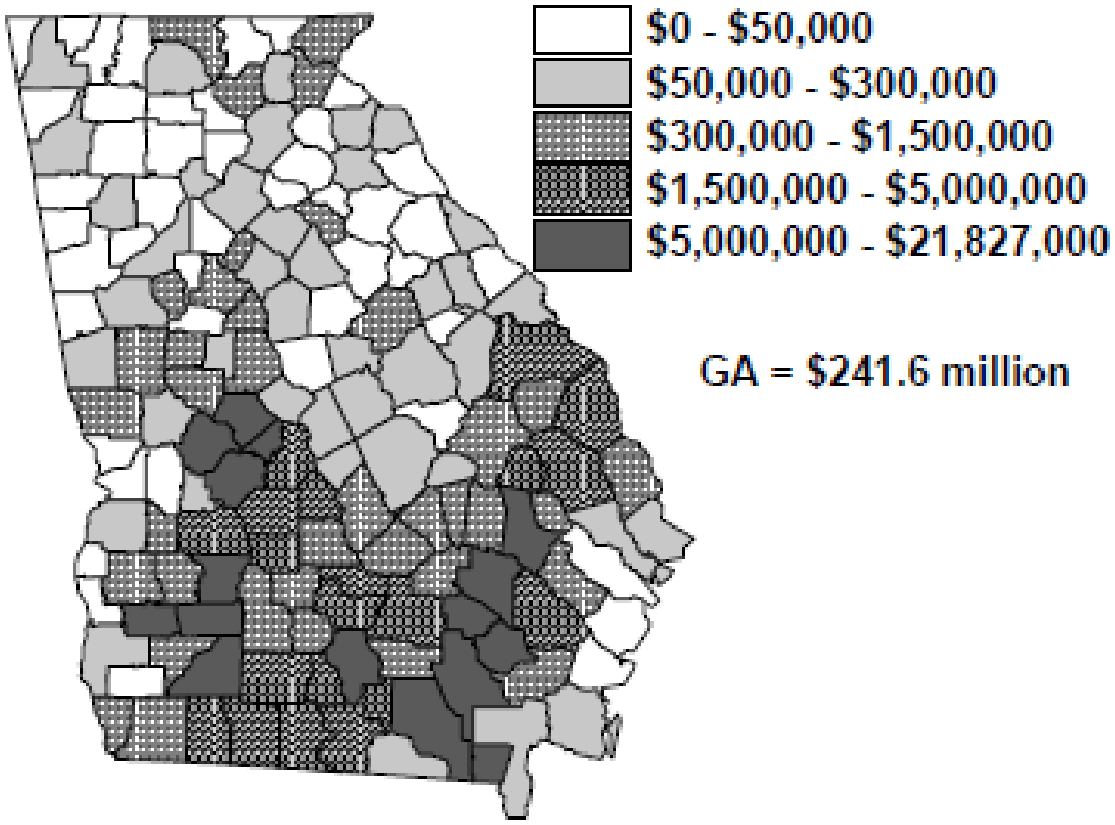

Figure 2.3. 2007 Georgia County Production Value of Fruit and Nut Crops.
Source: 2007 Georgia Farm Gate Value Report, AR-08-01, 2008.

Over 97% of all blueberry plants are grown in Southeast Georgia where these counties are located (Figure 2.4.). The figure shows were most blueberry plants are located with the highest concentration of berries being 50,000 bushes or more in the counties colored yellow. Other counties contribute to blueberry production in North Georgia but not as substantially as the southeastern counties. Between 1991 and 2002, production acreage increased 81%, plant numbers increased by 246% but total number of growers decreased by 32% (Florkowski, 2004).

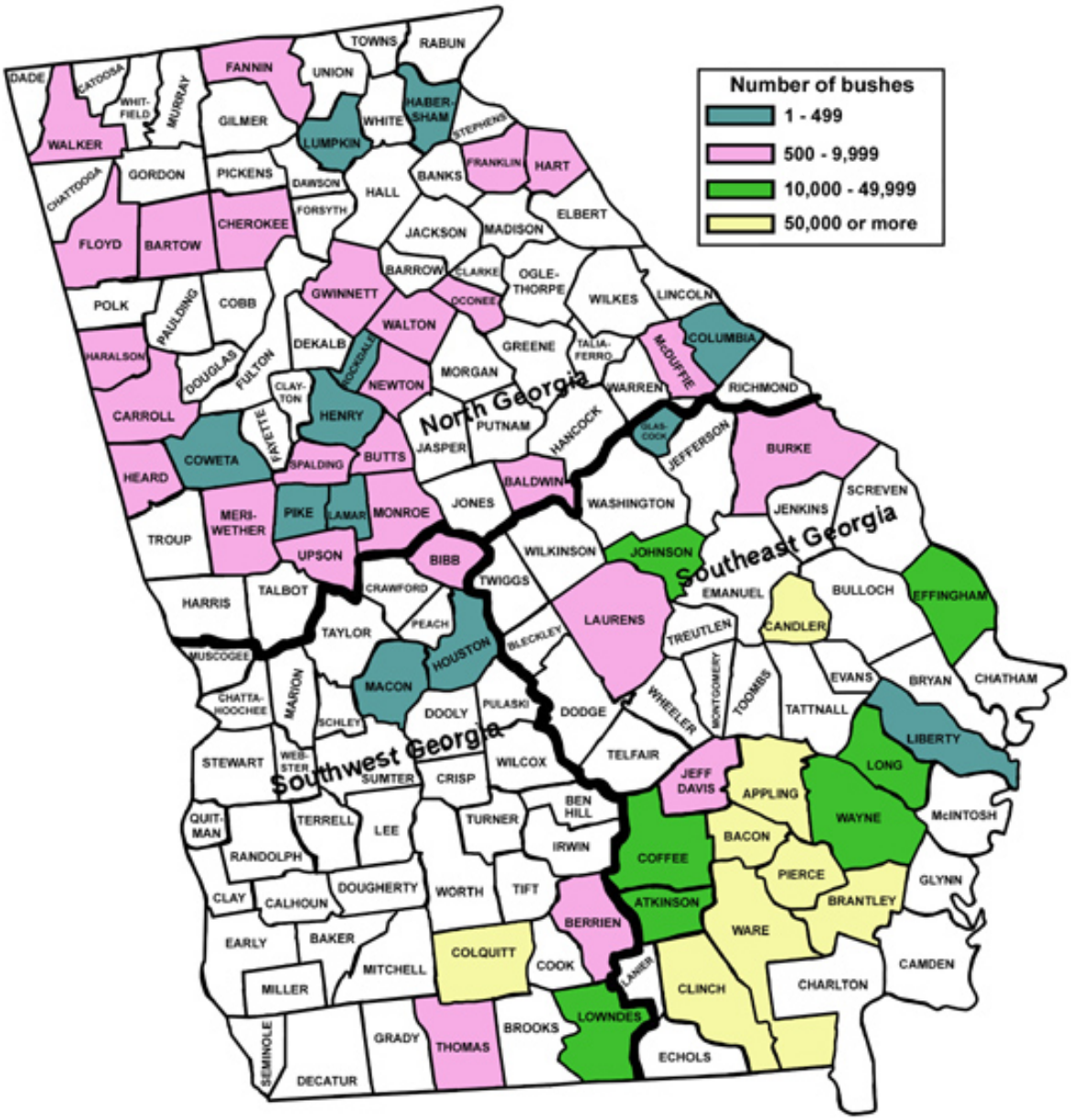

Figure 2.4. Georgia Total Blueberry Plants by County in 2002.
Source: Florkowski, W.J. 2004. Commercial Blueberry Inventory and Prospectus: Georgia, 2002. University of Georgia, Research Report, Number 693

CHAPTER 3

LITERATURE REVIEW

3.1. Introduction

An overview of current and past literature will be discussed in this chapter. Blueberry production theory will be reviewed with details into current conventional production methods for Georgia. The advent of the National Organic Program and its implementation are reviewed followed by organic blueberry production methods in Georgia. Marketing of both organic and conventional blueberries is discussed at length to determine what is driving the production of blueberries in the United States and abroad.

3.2. Blueberry Production Theory

Blueberry production is a function of all the major factors represented in equation all things being equal:

$$\mathbf{S_B = f\ (x_1, x_2, x_3, x_4, \ldots. x_n)}$$

Where:

S_B = Supply of Georgia Blueberries;

x_1 = Cultivar and Site Selection;

x_2 = Soil Preparation;

x_3 = Pest and Disease Control;

x_4 = Irrigation;

x_n = Other factors, such as weather and adopted technology;

3.2.1 Conventional Production

3.2.1.1. Cultivar Selection

When producing blueberries in any region of the world, proper cultivar selection is essential. Article 2.1 of the *International Code of Nomenclature for Cultivated Plants* defines a cultivar as "an assemblage of plants that has been selected for a particular attribute or combination of attributes, and that is clearly distinct, uniform and stable in its characteristics and that, when propagated by appropriate means, retains those characteristics" (Art. 2.2)(Brickell et al., 2004).

All cultivars have different characteristics such as harvest time, yield, annual cropping consistency, disease resistance, winter hardiness, chilling requirements, drought tolerance, heat tolerance, and fruit quality. A grower should consider cultivars based on the target market, site available and harvest methods. Machine harvesting requires cultivars that are not hard to remove from the bush, not soft, and do not have a concentrated ripening period. Fresh market or processed berries have different characteristics such as the ability to be shipped with minimal fruit damage and loss (Powell et al., 2002).

Time to harvest is important when selecting a cultivar for production. Early ripening cultivars have a higher risk of suffering from spring freeze damage so if these cultivars are selected an investment in freeze protection will be required to minimize eventual crop loss during spring season. The costs of production will increase if an early season cultivar is selected. However, the earlier ripening berries receive higher market premiums even though it is questionable whether the premium price received is enough to offset the increased cost of production. Rabbiteye cultivars are usually mid-to-late ripening plants (Powell et al., 2002).

3.2.1.2. Site Selection

Prior to deciding on cultivar is determining where plantings can be established. If the ability to plant anywhere is available, then plant where the cultivar of choice grows best, but this is not an option for most growers. The site is already predetermined and the cultivar selection follows from this point. Proper site selection is crucial for a successful commercial planting. Such factors as soil, climate, economic and markets must all be considered when deciding on a site. The most critical factors to be determined before planting are soil type, soil drainage, pH, elevation with respect to cold air movement, water availability, fertility and sunlight exposure (Powell et al. 2002).

Rabbiteyes grow on various soil types but perform best on well-drained acidic soils with a pH ranging from 4.2-5.5. Elemental sulfur can be added to the soil to lower the pH to desired level. Rabbiteyes have a deeper root system than highbush but it is still relatively shallow. Strong roots develop in moist, fertile, well-drained soil (Powell et al. 2002). Sands and loamy sands that have 2% or more organic matter are preferred.

Water table should be at least 20 inches below the surface for adequate soil drainage to prevent root injury. Raised beds are often used in blueberry production as well as incorporating drainage ditches to ensure proper soil drainage. Blueberry growth and yield are considered proportional to the soil organic matter content, thus soils low in organic matter should incorporate organic content prior to planting to increase plant performance (Powell et al. 2002).

Virgin pineland soil is among the best sites in the southeast for blueberry production. Pine forests usually have low pH soils and usually grow well on well-drained loamy sand, which is perfect for blueberries. If the wood has been burned prior to planting, the ash will raise the pH and reduce the soil's suitability for blueberry production. Old farmland can be used but farmers typically have more problems with production (Powell et al. 2002).

Good air circulation is ideal since it reduces risk of freeze damage and fungus disease. Low-lying sites should not be planted with blueberries because they are likely to be frost pockets. Plant blueberries on elevated sites with good air circulation and which will provide cold air drainage that will prevent frost damage (Powell et al. 2002).

3.2.1.3. Soil Preparation and Management

3.2.1.3.1. Soil Preparation

Prior to establishing plantings a soil test should be conducted to determine nutrient and pH levels. The soil should be acidic with a pH range of 4.2-5.5 for rabbiteye plantings. Organic content should be 2% or greater. If it is lower than this consider planting a cover crop before the blueberries or use mulches to increase organic matter over time. Adding organic matter to the soil can be costly and time consuming, soils should be relatively high in organic matter to be considered a good site. Raised beds can be used on sites with marginal soils and poor drainage (Powell et al. 2002).

3.2.1.3.2. Weed Control

Weed control is crucial in production as blueberries are poor competitors for water and nutrients. Herbicides can be used to eliminate perennial weeds. Organic mulch applied in a thick layer can help control weeds, conserve soil moisture, maintain soil acidity, and supply organic matter to soil, when applied in a thick layer. Mulched highbush cultivars yielded two to

three times more than non-mulched plants but rabbiteye yields were not as remarkable when mulched. Each year about 2 inches of new mulch should be added to compensate for decomposing mulch. Weed control near the plants base and irrigation line is controlled by synthetic chemicals and sometimes with mulch (Powell et al. 2002).

Preemergence and postemergence synthetic herbicides are the best choice for reducing weeds in the rows (Powell et al. 2002). Proper timing of herbicide applications can eliminate a majority of weeds. Hand hoeing and shallow cultivation can be implemented.

3.2.1.3.3. Fertilization

Blueberry plants are sensitive to soluble fertilizers, such as the nitrate form of nitrogen. Over fertilization can cause damage and can burn the plant if applied too close to the plant base. When fertilizer rates are higher than recommended plants can become damaged with signs of pale yellow chlorosis of the leaves, low vigor, and even death (Powell et al. 2002).

Hand applications are often implemented during the first two growing season, application is easily spread per plant by hand. High quantity of nitrogen or organic matter residues remaining on site may reduce the need for nitrogen in the first year. Ammonium sulfate is a decent source of nitrogen which can be used if the pH is close to 5.5. Urea and organic cottonseed meal is another source of nitrogen (Powell et al. 2002).

Overall fertilization is a customized process that is unique to individual fields and soil tests and/or analysis must be conducted to determine what is needed per site. No general application standard is available that will guarantee the crop's nutrient demands are met effectively and efficiently. General suggestions on conventional fertilization in Georgia are provided on the web site of the Southern Region Small Fruit Consortium (www.smallfruits.org).

3.2.1.3.4. Irrigation

Irrigation is deemed essential on larger commercial planting sides for best possible growth and production. New plants require continual water for survival at a rate of an inch to 2 inches per week during the growing season. Watering of young plants during dry periods will increase plant growth, decreasing the age in which reach full production. Maintained soil moisture in the root zone promotes excellent blueberry growth and increases fruit size and yield. Insufficient soil moisture decreases berry quality and yields. During August and September irrigation can increase growth and fruit bud formation, potentially increasing next seasons yield. Drip irrigation is usually placed on the ground surface near the base of the plant. The drip system is considered more efficient than overhead irrigation (Florkowski, 2004; Powell et al., 2002).

In Alabama rabbiteye production rule of thumb, is an application rate of about 3,600 to 4,000 gallons of water per acre per day in hot weather, translating out to about 6 to 8 gallons per mature bush. The peak water requirement for a mature bush with a full-crop load is 12 gallons per day. Thus an irrigation system must be able to provide at least 8 gallons of water per plant per day which is about a total pumping capacity of 4, 840 gallons per acre per day. Younger bushes need less water dependent on plant size. Blueberries should be watered twice a week in dry conditions or more dependent on soil type and drainage rates (Powell et al. 2002).

Overhead sprinkler irrigation can be used but is not water efficient. Overhead irrigation can cause splitting of the berries if not applied early in the morning or after each harvest of berries. The largest benefit of overhead irrigation is the ability to protect against late spring freezes. Spring frosts account for the largest loss of berries each year (Powell et al. 2002).

3.2.1.3.5. Pollination

Powell et al. (2002) discusses pollination of rabbiteye blueberry cultivars which are partially or completely self-unfruitful and require the transfer of pollen from one cultivar to another cultivar to develop an adequate fruit set. A fruit set is the stage where blueberry flowers develop into berries. Sometimes the cross-pollination results in larger berries, seed content and earlier ripening berries as well as a good fruit set. It is important to interplant pollen-compatible cultivars that bloom around the same time, each cultivar should be planted in a single row with no more than 2 adjacent rows of the same cultivar to ensure proper pollination. Cross-pollination is usually accomplished by solitary bees (i.e., Carpenter Bees) in Alabama's rabbiteye crops. Honeybees are not effective because of the structure of a blueberry flower, the honeybees tongue cannot reach the nectar so they usually go through holes of flower petals made by carpenter bees and thus do not retrieve any pollen (Powell et al. 2002).

Chemical stimulation of fruit set is possible by spraying the hormone gibberellic acid when the flowers are elongated but not yet open. A second application can be made 10-14 days later during the evening to maximize drying time and absorption of the acid (Powell et al. 2002).

Rabbiteye cultivar fruit matures 82-90 days after the corolla drop (petals fall) and the harvest season for a cultivar is usually 3-6 weeks. The early ripening cultivars can add 3 more weeks onto harvest but are more attractive because of higher prices at market. But as discussed earlier there is a higher likelihood of crop loss from spring frosts (Powell et al. 2002).

3.2.1.3.6. Yields

Rabbiteyes will reach full maturity after 6 to 9 years of production and can remain productive for 30 to 40 years. On irrigated, well-managed, mature fields rabbiteye yields can be 8,000 to 12,000 pounds per acre. Harvesting can begin as early as year two with a yield

between 100 to 500 pounds per acre. About 20 to 25 pints of fruit are produced per rabbiteye plant compared to 7 to 10 pints of fruit per highbush plant in Alabama. This difference in yield can be attributed to the origination of species; rabbiteyes are native to Georgia and Florida and grow piously in hot summers (Powell et al. 2002).

3.3. Organic Agriculture

3.3.1. Historical Overview

In 1980, the United States Department of Agriculture directed a team of scientist to investigate the motivations for the shift to organic production methods by farmers in the United States and abroad. Evaluations of organic technology and management, economic impacts, costs, benefits, limitations, etc, were all investigated. The reasoning for organic farming remains vastly the same in 1980 as in 2008 as stated by the USDA Study Team on Organic Farming (1980). The most articulated concerns are as follows:

> "1) Sharply increasing costs and uncertain availability of energy and chemical fertilizer, and our heavy reliance on these inputs.
> 2) Steady decline in soil productivity and tilth from excessive soil erosion and loss of soil organic matter.
> 3) Degradation of the environment from erosion and sedimentation and from pollution of natural waters by agricultural chemicals.
> 4) Hazards to human and animal health and to food safety from heavy use of pesticides.
> 5) Demise of the family farm and localized marketing systems."

Rural and urban communities, in 1980, were demonstrating growing interest in organic agriculture because of a shared ideology that sustainable and stable yielding agriculture can be reached through the development of technologies that conserve non-renewable resources, preserve soils and are at the same time socially and economically responsible (USDA, 1980).

Many reasons farmers produce and consumers purchase organic products today are for similar reasons such as environmental concerns, food safety, and social benefits. The transition to organic was believed to lessen the adverse effects of conventional farm production with a long-term goal of sustainable and profitable farming systems. Financial motives as well as environmental concerns have contributed to conversion to organic agriculture (USDA, 1980; Dimitri and Richman, 2000; Nieberg and Offermann, 2003).

Due to growing interest in organic farming but lack of structure the United States Department of Agriculture (USDA) was required under the Organic Foods Production Act (OFPA) of 1990 to develop a set of national organic standards for organic agriculture and develop a certification program (Klonsky, 2003). The organic industry actually sought federal oversight and promoted the implementation of OFPA (Lipson, 2007). The National Organic Program (NOP) became effective in October 2002, where full compliance with these standards were necessary to obtain the USDA organic label (Klonsky, 2003). With this program a list of prohibited non-synthetic and allowed synthetic compounds were made available to the public via the USDA's Agricultural Marketing Service website (http://www.ams.usda.gov).

According to a 1980 USDA report:

> *"Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control insects, weeds, and other pests."*

A technical definition of organic agriculture was developed in 1994 by the National Organic Standards Board (NOSB) with four major points as cited from the USDA's National Agriculture Library:

> *"1) Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony.*
>
> *2) Organic' is a labeling term that denotes products produced under the authority of the Organic Foods Production Act. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological whole.*
>
> *3) Organic agriculture practices cannot ensure that products are completely free of residues; however, methods are used to minimize pollution from air, soil and water.*
>
> *4) Organic food handlers, processors and retailers adhere to standards that maintain the integrity of organic agricultural products. The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people."*

Essentially organic agriculture implies restricted use of synthetic farm inputs at all stages of production in order to minimize environmental impacts from excessive use. The inputs are governed by the Organic Materials Review Institute (OMRI) and Federal Organic Standards (FOS). Soil health is of great concern and organic farmers must show they are not 'soil mining' but are instead improving soil tilth over time through specific management techniques. Ideally organic production utilizes ecological principles to maintain production with minimal interference between the ecology-farming linkage. Organic farmers must harness and use ecology-farming linkages to their advantage to minimize external inputs and increase internal resource recycling (USDA, 1980).

In order for a producer to market their goods as organic one must be certified through the USDA's NOP. Organic farmers must monitor soil annually until soil organic matter reaches 2%, at this point monitoring occurs every 5 years. An organic farm plan is mandated for each grower to outline their plans for soil improvement and crop management. To be considered an organic farm three years of organic production is needed prior to certification if the field was used prior in conventional production. If the field is recently cleared and never used for agriculture production three years of organic production is not needed (Krewer and Walker, 2006).

3.3.2. Organic and Conventional Production

Klonsky and Tourte (1998) described the differences and similarities between organic farmers and conventional farmers. Organic farmers operate under a different set of constraints than conventional farmers from production and marketing to regulations. Even though the systems are ideologically different some similarities exist between the two agricultural practices. Land preparation, cultivation, irrigation and planting are similar practices for both (Klonsky and Tourte, 1998). Farm sizes are comparable with farms studied in 1980 being 300-500 acres under organic production (USDA, 1980) but many organic farms average less than 5 acres (Klonsky et.al. 2002).

The major differences in production are soil and pest management. Organic fertilizers require some time to decompose and mineralize prior to being plant available nutrients, unlike conventional fertilizers which are available for plant uptake when applied. A cover crop is often incorporated to increase organic matter, add nitrogen through nitrogen-fixing processes, provide habitat for beneficial insects, suppress weed growth and reduce soil erosion (Klonsky and Tourte, 1998).

Cover crops, crop rotation, sequential plantings and water management are all practices incorporated by organic growers to reduce pest damage. Not only do these production practices reduce insect damage but also reduce disease, aid in weed control and increase beneficial insect populations. Insects are not exclusive per production method, each method experiences the same pest problems but organic producers have observed that pests do not pose serious production problems if soil fertility and crop health are managed and biological controls are employed. Pesticides are available but are usually less effective at treating acute problems than prohibited synthetic pesticides, thus organic agriculture must focus on long-term preventive measures and not quick fixes. Weed management is the largest obstacle all organic producers must face. Many weed control strategies must be employed to manage weeds such as, hand weeding, flame weeding, mulching, mechanical cultivation, animal grazing and water management. Mechanical cultivation and hand weeding are the most commonly used to manage weeds unlike conventional production where synthetic herbicides are utilized (Klonsky and Tourte, 1998).

3.3.3. Organic Blueberry Production

3.3.3.1. Georgia Organic Blueberries

Organic agriculture production in Georgia is regulated by the Georgia Department of Agriculture where producers are required to register. Certification can be gained from any state or private certifiers that are accredited through USDA's NOP. Registration is required with the Georgia Department of Agriculture at no cost to organic producers (Krewer and Walker, 2006). Packers and processors must also be certified organic to maintain the organic seal.

Rabbiteye blueberry plant characteristics lend themselves to organic blueberry production in Georgia. Most organic blueberry producers are in Oregon, Washington and Michigan with few organic berries from California, Georgia and New Jersey. Since Georgia's blueberries ripen before the other major organic states, Georgia has an excellent market window for fresh organic berries (Krewer and Walker, 2006; Fonsah et al., 2006).

3.3.3.2. Organic Weed Management

As discussed earlier from Klonsky and Tourte (1998), weed control is the greatest challenge to organic farmers. In organic blueberry production the first three years of establishment is when weed management is most crucial. Weed management will optimized fruit yield and fruit quality while reducing crop damage and/or loss from competition with weeds for water, light and nutrients (Monks and Mitchem, 2006). Difficult-to-control perennial weeds are very common in blueberry fields but not common in other crops, posing a unique problem for organic blueberry cultivation (Monks and Mitchem, 2006). In Georgia, two weed control methods of cultivation and mulching are examined.

3.3.3.2.1. Mulching

Mulching is currently being addressed in the research conducted for this thesis. Organic mulching increases soil organic content, conserves soil moisture, provides excellent weed management, soil temperature regulation, soil and waterborne disease suppression and slow nutrient release. Soil moisture is extremely important in blueberry growth since blueberry roots lack root hairs which are the primary sites for water and mineral absorption (Kuepper and Diver, 2004; Krewer and Walker, 2006).

But if a grower decides to mulch with pine bark, cultivation is no longer an option for weed control because the blueberry roots will grow into the mulch layer and cultivation can damage the root system (Krewer and Walker, 2006). If weeds begin to grow hand hoeing and mowing will eliminate the weeds during the summer.

Krewer and Walker (2006), discussed advantages of organic mulches from previous research conducted in Georgia on both mature and young organic blueberries. Pine straw provided good weed control with minimal nitrogen fixation and is excellent mulch for blueberry establishment but has not been researched on mature bushes. A layer at least 4 inches thick is needed for good results for pine straw, pine bark, and wheat straw. Pine bark and wheat straw have provided good weed control on established buses. Wheat straw improved blueberry shoot growth the year of application and provided good weed control the second year after deterioration. Pine bark and pine straw prevent many weeds from germinating but require that additional mulch be placed annually to maintain effectiveness and mulch layer. If weeds do grow through the mulch layer they should be hand pulled, hoed or spot sprayed with organic herbicides.

Plastic mulches are available for organic production. Krewer and Walker (2006) used these mulches as well in previous research. Nursery ground cover will last 4-5 years and can be laid around the plants by hand or machine. Drip irrigation should be placed below the plastic prior to application. The plant is placed through an 'X' cut into the plastic. The hole is then covered with pine bark to seal the planting hole. This material is being used in the blueberry plantings researched in this thesis. Plant growth is similar to pine straw mulch. When the plastic begins to break down it must be removed from the site.

Plastic mulch used in strawberry production can also be implemented in organic blueberry production but it limits rainfall and fertilizer infiltration into the plant bed (Krewer and Walker, 2006). The lack of infiltration encourages surface root growth making the plants more drought and winter injury susceptible (Kuepper and Diver, 2004). Irrigation must be provided by drip tape installed under the mulch. Fertilizers are put down during pre-planting and supplemental organic fertilization is provided through the drip irrigation system. White-on-black plastic is another mulch option that keeps temperatures cooler in the summer. The expected lifespan of the plastic is 3 years and when it begins to deteriorate it must be removed. This system provides weed free growing conditions except for nut sedge (Krewer and Walker, 2006).

3.3.3.2.2. Cultivation and Alternative Weed Control

Winter mechanical cultivation can be used on blueberries. A rotary hoe or Friday plow is utilized from November to March, under the bushes. During the growing season, a mowing head can be attached to the rotary hoe to cut weeds under bushes. Hand hoeing and weed pulling can be utilized during the summer as well. When operating a rotary hoe under young bushes it is easy to damage the root system and disturb the plant. If implementing cultivation as a method of weed control, all irrigation lines should be buried at least 8 inches deep and overhead irrigation should be placed closer to the bush.

Organic pre-emergent weed control is limited to a product known as Dynaweed which is corn gluten. It is a granular material that is placed on the ground then incorporated with rainfall or machinery. It provides minimal germination control but also supplies 10% nitrogen and 1% phosphorus (Krewer and Walker, 2006).

Several post-emergent weed control methods have been tested by Krewer and Walker (2006) in Georgia organic blueberry fields including Matran and Alldown, burn-down organic herbicides. These are effective on small winter weeds but are ineffective on grasses. They are useful on spot spraying weeds in mulched beds. Hand hoeing and weed pulling are used regularly during the summer.

3.3.3.3. Disease Control and Prevention

Rabbiteye blueberries are ideal organic berries because they are hardy and suffer less from disease than other blueberry species but they are still susceptible to some diseases. When establishing plantings, choosing an isolated site outside the main blueberry belt in southeast Georgia can reduce disease problems during production as discussed by Krewer and Walker (2006). Mummy berry (*Monilinia vaccinii-corymbosi*is) is less common outside the main blueberry belt.

If the site is already chosen and planted organic disease control options are very limited. Copper compounds and lime sulfur can be implemented but have little to no effect on *Botrytis cinerea* (botrytis blight and fruit rot) and *Monilinia vaccinii-corymbosi* (mummy berry). Mummy berry can be reduced by burying the mummified berry under the plants. This must be completed before the mummified berry produces apothecia in late winter. A rake should remove many mummified berries from around the base of the bush to the aisle prior to burying them into the soil. A fresh mulch layer should be applied before the apothecia emerges on mulched plantings. Serenade fungicide can be implemented during a mummy berry outbreak (Scherm and Krewer, 2008).

3.3.3.4. Insect Control

Organic production in Georgia faces less insect pressure since blueberry maggot fly is not common in many areas. Locations with maggot fly pressure can use the organic insecticide rotenone to control the spread of the fly. *Bacillus thuringensis* (biobit or javelin) can be applied for cranberry or cherry fruit worm presents an issue in production. Insect control should only be implemented as needed since many organic insecticides have a broad range of effects (Krewer and Walker, 2006).

3.3.3.5. Irrigation

Drip irrigation near the plant base is ideal for organic production because it can limit weed growth while delivering water directly to the plant (Krewer, personal communication, 2008). Drip can increase soil pH in times of drought if the water source is high in pH. This is an important issue with drip irrigation in organic production. Although elemental sulfur can be used to lower the pH, sulfuric acid can not lower the pH in organic production systems. Acidic sources such as citric acid and vinegar are still experimental in lowering pH of irrigation water. Drip irrigation is less expensive than overhead irrigation which most organic blueberry producers operate on less than 5 acres (Fonsah et al., 2005).

Overhead irrigation provides frost protection from late spring freezes as well as soil water. Overhead irrigation is more expensive and is mainly implemented on larger operations. Late spring frost causes more crop loss than any other factor so the risks of crop loss must be compared to the costs of incorporating overhead irrigation into the operation.

3.3.4. Organic Economics

Research on various organic crops has shown they outperformed their conventional counterparts, being cited as reasoning for transition to organic by some farmers. Organic grain and soybean production in the Midwestern United States was found to be more profitable without price premiums than conventional production due to higher comparable yields in dry periods and climates with lower input costs (Dimitri and Greene, 2002). Another study in Washington State found that organic apple production was more profitable, better tasting, similar yields, and was more energy efficient and environmentally sustainable than conventional methods of production. The profitability of organic farming varies from farm to farm, soil type, climate, production methods, etc. all lend themselves to specific farm characteristics. Organic apple production in Washington State may be profitable but in New York under different biophysical factors may not be profitable (Reganold et al., 2001).

Research in Europe has shown that organic yields are significantly lower when compared to conventional agriculture production. The opportunity to obtain higher prices for organic products may offset the decrease in yield as discovered in Germany and Great Britain where 40-75% of total organic farm profits were due to organic price premiums (Nieberg and Offermann, 2003). The differences of organic yields makes current research on organic blueberry production costs and returns crucial to determining whether this production system would provide acceptable economic returns for Southern Georgia growers compared to conventional production.

In some years, organic blueberries have received a price premium 100% above conventional products (Krewer and Walker, 2006). Organic blueberry production may be more expensive than conventional blueberry production but this is offset by price premiums. Since blueberries are expensive to establish and maintain, growers do not realize a return until about the 7th year of production, but can remain productive for over 20 years (Kuepper and Diver, 2001).

Harvest patterns are fairly predictable based on region in which they are grown with rabbiteyes in Georgia, Florida and Texas ripening early in the season. The earlier the berries are harvested the better the price premium the grower receives (Kuepper and Diver, 2001). Florida southern highbush plants can be harvested before May 25th when the North Carolina highbush crop is picked, giving it large price premiums (Williamson and Lyrene, 1995).

3.4. Marketing of Organic Products and Blueberries

3.4.1. Organic Market Overview: Domestic and Abroad

In 2004, the organic food and drink market was valued at $27.8 billion. Sales in 2005 passed $30 billion with largest market growth occurred in North America which expanded by over $1.5 billion a year. North America and Europe comprise 96% of global revenues in organic food and drink. North America only represents 4.4% of total global organic farmland but accounts for 47% of global revenues and is the fastest growing organic market in the world. The markets estimated worth of $14.5 billion in 2005 has experienced an increase of $2.3 billion since 2004 (Sahota, 2007).

America has the fifth largest quantity of organic farmland in the world with more than 2 million acres. Between 1997 and 2003 organic farmland increased by 63% to 2.2 million acres but only counts for 0.2% of total farmland. Specialty organic cropland was between 1-5% of

total specialty cropland, accounting for the largest percentage of organic cropland in 2003. The states with the most organic acreage were Texas, California, and Alaska. California has a high concentration of organic fruit and vegetable growers (Sahota, 2007).

In North America organic demand is so high that many sectors are experiencing supply shortages resulting in importation of organic products instead of financing and increasing domestic acreage. More than $1 billion is spent on importing organic products to the United States resulting in an 8:1 import-to-export ratio. Seeds and grains are being imported from Europe and Asia while herbs and spices are coming from Latin America and Asia (Sahota, 2007). Many manufacturers foresee the limited domestic supply of organic ingredients and raw products to be their greatest challenge in the expanding market (Lipson, 2007).

Supermarkets sell 60% of organic foods while specialty retailers sell 37% and were the predominant seller of organic and natural foods until being overtaken in sales by supermarkets in the late 1990's. The increase in competition between retailers is expected to drive future market growth. High market growth rates are attracting commercial retailers to the organic industry such that retailers like Wal-Mart, Publix, Safeway and Kroger are all increasing their organic food selection. This is increasing availability of organic goods, increasing industry confidence, promoting increased organic crop production and allowing processors to produce more organic products (Sahota, 2007).

Fresh produce and dairy are the most purchased items. Fruit and vegetable purchases alone generated $5.4 billion in sales in 2005 while dairy sold $2.1 billion. Organic meat has the least amount of sales but is the fastest growing organic foods category with a 55% increase in sales from 2004 to 2005. Organic livestock must be fed certified organic feed which will increase growth in the organic feed sector as organic meat sales increase (Lipson, 2007).

The European market is valued at $14.4 billion 2005 with an increase of sales by about 5%. Organic fruit and vegetable products are experiencing the highest growth within the organic industry. Organic sales are mainly through 2 marketing channels; supermarkets comprising 50% and specialty retailers with 46% of organic food sales. Specialty retailers accounted for a majority of sales in the 1990's but have since lost marketing ground to large supermarkets. Europe contains the larger number of organic food and beverage companies with more than 8000 companies. Similar to the United States many sectors of the organic food industry is comprised of non-organic food companies (Sahota, 2007).

3.4.2. Blueberry Domestic Price Trends

Since 2005 domestic prices for blueberries have been increasing. The national average price for 2005 is $1.44 per pound by 2006 the price increased to $1.76. The national average price in 2007 was $1.84 per pound nationwide while Florida's average price per pound was $5.00 (USDA/NASS, 2008).

Georgia's average per pound price was $1.22, $1.90, and $2.54 in 2005, 2006 and 2007, respectively (USDA/NASS, 2008), this is illustrated in figure 3.2. The figure demonstrates all blueberry prices in Georgia from 2000-2007, this includes southern highbush and rabbiteye blueberries. The high was reached in 2007 with a value over $3.00 per pound this was most likely due to crop loss experienced during the season. Price fluctuations have occurred in the last 15 years in Georgia but the overall trend is an increase received grower's price. Since 1993 Georgia's conventional blueberry price trend has been increasing and although a study by Fonsah et al. (2006) utilized $5 for a flat of 3.3.lbs containers this is not true for all the states.

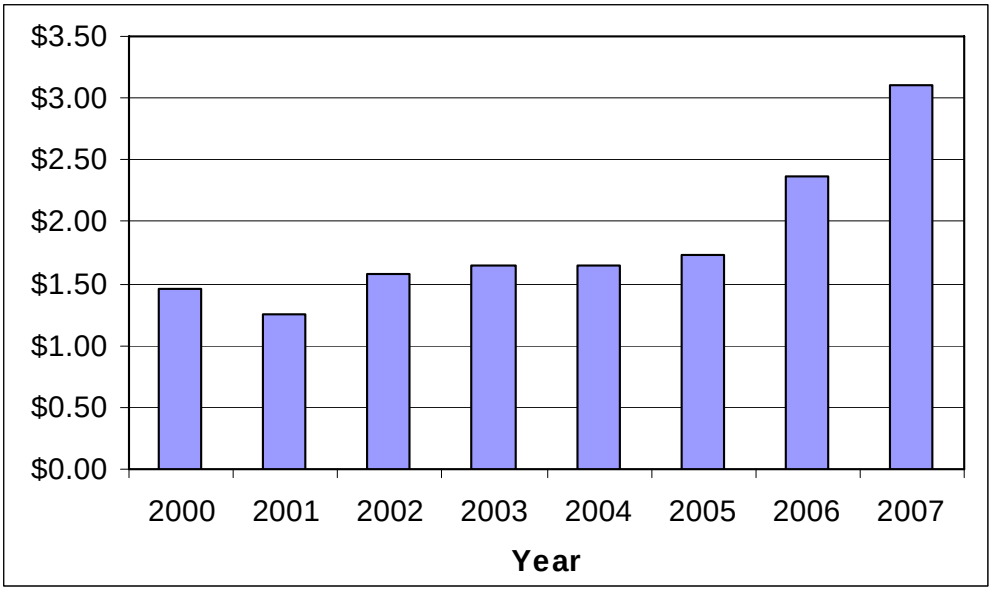

Figure 3.1. Price per pound of blueberries in Georgia from 2000-2007.
Source: 2007 Blueberry Statistics. New Jersey Agricultural Statistics Service, 2008.

3.4.3. Import Market Trend

Commercial blueberry production in South America has increased since the early 1990's with the crop being introduced to the region in 1979 to evaluate its potential as a fruit crop. Chile was the first to begin commercial development followed by Argentina, Uruguay and Brazil. The four countries total 10,721 tons of yield under 9,452 acres of production in 2004. Chile produces the majority of commercial blueberries with a yield of 9,666 tons from 6,178 acres representing 90% of total production. The world's third largest producer of berries is Chile (Bañados, 2006).

The increase in blueberry production is due to increasing demand for off-season berries in the Northern Hemisphere. Supply of blueberries is demanded year round even with domestic climate limitations. The market window for South American berries is from September till the end of April. North America harvest blueberries from March until August. Most of the berries

are hand harvested and fresh market exported to United States and Europe. Chile exports 86% of its fresh berries to the United States while 10% goes to Europe via plane and an increasing number of climate controlled shipments which are a third of the cost of plane shipments (Bañados, 2006). Argentina exports over 95% of its total fresh berry harvest to Europe and the United States with the United States receiving the bulk of the fresh berries (Bañados, 2006).

3.4.4. Yield Trend

The Georgia blueberry yield trend since 2000 has been relatively stable around 4,000 pounds per acre. The greatest yield experienced over those seven years was experienced in 2006 with a yield of 4,500 pounds per acre (figure 3.4). In Figure 3.4, Georgia blueberry yields are shown in pounds per acre from 2000-2007. The yields are for southern highbush and rabbiteye blueberries produced in the state. A significant decrease was experienced in 2007 due to a late spring frost which reduced yields to 2,000 pounds per acre (New Jersey Agricultural Statistics, 2008).

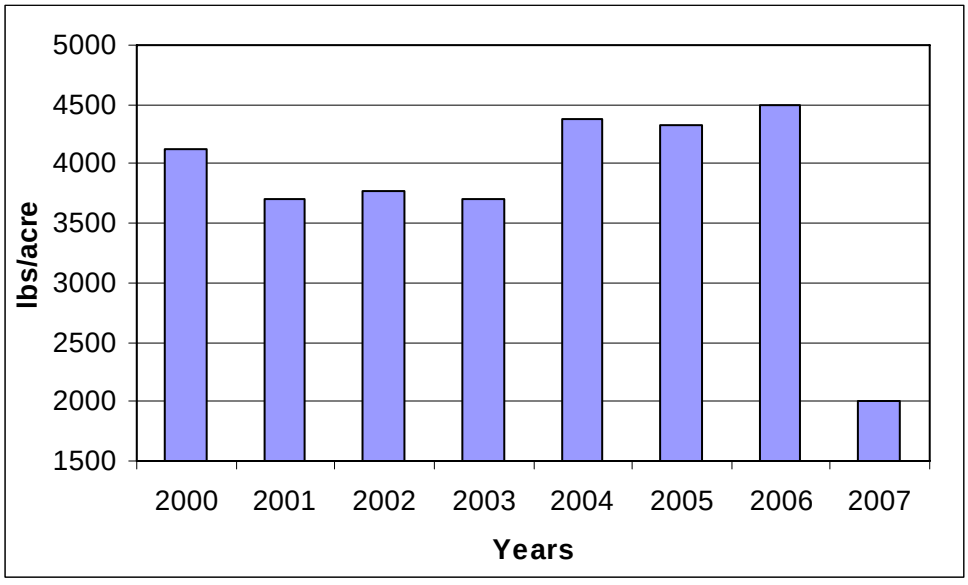

Figure 3.2.: Georgia blueberry pounds per acre yields from 2000-2007.
Source: 2007 Blueberry Statistics. New Jersey Agricultural Statistics Service, 2008.

3.4.5. Exchange Rate

The exchange rate by definition is, "the price of foreign currency stated in terms of the domestic currency." As of October 31st, 2008 a single United States dollar is equivalent to €0.7844. There is an inherent risk when converting domestic money to foreign money due to the uncertainty of each day's exchange rate. In the short term, exchange rate fluctuates with changing supply and demand conditions. The value is determined by the perceived value by traders in foreign exchange markets. Factors that affect the exchange rate is the countries relative economic strength, monetary activity, deficits, surpluses and level of exports and imports (Keowin et al., 2006).

3.4.7. Marketing Companies

3.4.7.1. Organic Marketing Companies

In North America there is an estimated 1000 companies involved in the production and supply of organic foods (Sahota, 2007). Many of these companies are large multinational food companies such as Dean Foods, Pepsi-Cola, and General Mills. Large conglomerates (i.e., Hain Celestial and SunOpta) and retailers (Whole Foods Market and Planet Organic) are acquiring small specialty organic food companies.

Whole Foods Market is the largest natural and organic retailer in the world and is publicly traded on the stock exchange. The company generated $4.7 billion in sales in 2005 and employs more than 30,000 employees. It is the first retailer to voluntarily obtain organic certification for its retailing practices from the USDA. Whole foods have even started to purchase organic foods that are locally grown. Organic food companies are listed on the stock exchange only in North America (Lipson, 2007; Sahota, 2007).

The world's largest organic and natural food company is Hain Celestial which reported $544 million in 2004 sales. It is the largest seller in over 13 of the top natural and organic food categories. General Mills is another leading food manufacturer and has acquired many organic brands including SunRise and Small Planet Foods which owns Cascadian Farm and Muir Glen organic food companies (Sahota, 2007). Many food manufacturers are purchasing smaller organic brands.

3.4.7.2. Blueberry Marketing Companies

A few companies exist that solely market blueberries in the United States, one such marketing group is "The Blueberry People". Formed in 1936 originally known as the Michigan Blueberry Growers Association, "The Blueberry People" are a producer-owned blueberry marking cooperative. Since its conception "The Blueberry People" have developed educational programs for best management practices in production and harvest and have attempted to solve challenges within the blueberry industry. Membership has been expanding outside of Michigan since the 1940's with Indiana, Georgia, Florida, British Columbia and Miss-Lou Blueberry Growers Cooperative Association all becoming members. "The Blueberry People" own and operate blueberry packing, receiving, cooling, and shipping facilities across the country with one located in Alma, Georgia. Total annual sales are over $130 million from over 300 growers (MBG Marketing, 2008).

Driscoll's is a large berry marketing company that specializes in blueberries, strawberries, blackberries and raspberries. Driscoll's has also been marketing organic berries and have committed to increasing organic acreage and promotes natural cultivation practices. A nationally recognized brand, Driscoll's is carried in over 50 grocery stores. The company

originated in 1944 and is still family owned and operated. A group of strawberry farmers developed "The Strawberry Institute of California." Plant breeding and production led to better berry varieties. Berries are grown conventionally and organically throughout the world. There are more than 300 farmers in six states and eight countries (Driscoll's, 2008).

3.4.8. Consumer Demand

Blueberry consumption in the United States has been increasing since the mid-1990's, starting around 30,000 metric tons in 1994 to 50,000 metric tons in 2003 (USDA/ERS, 2008). The increase in consumption represents increased consumer demand for the product. In 2004, Americans ate more than half-pound of blueberries each, a consumption increase of more than double. The increase in demand is largely due to recent health studies demonstrating the blueberries health benefits. Blueberries are high in vitamin C, potassium, fiber, and antioxidants which reduce aging, increase brain activity and lower cholesterol (St. John, 2008). Blueberries have the highest antioxidant activity over all other fruits and vegetables (Oregon Dept. of Agriculture, 2008). This increase in consumption due to health benefits has been seen in Europe and Asia.

Organic food sales have increased 17% to 21% annually (Bellows et al., 2008). Consumer demand is driven by perceptions that organic foods have no chemical residues (Park and Lohr, 1996). In addition taste, health, freshness and convenience are the primary drivers of organic food consumption (Bellows et al., 2008). Public benefits of organic foods such as environmental benefits are secondary to private benefits (i.e. taste) when consumers decide to purchase organic goods. A survey conducted by Bellows et al., illustrates that only 13% of consumers regularly purchase organic products while 31% occasionally buy organics. The

survey demonstrates that more individuals value organic production methods than actually purchase organic goods (Bellows et al., 2008). Organic demand is so high that suppliers have resorted to importing organic products (Sahota, 2007). More than $1 billion is spent on importing products (Libson, 2007). Price premiums do discourage buying but this will not inhibit the organic industry from growing, in fact the price premiums will encourage an increase in supply which will subsequently increase competition and eventually decrease price (Bellows et al., 2008).

The increase in demand is continuing for organic and conventional blueberries, Oregon has increased production by 3 million pounds in 2007 over 2006 production and anticipates a record breaking yield in 2008 (Oregon Dept. of Agriculture, 2008). Georgia has also increased production over the years and consumers are still purchasing blueberries and as long as demand remains high production will continue to increase.

CHAPTER 4

METHODOLOGY

4.1. Introduction

This study encompasses three main components: production, marketing, and economic analysis. Blueberry production was focused on four different organic mulch production systems: pine bark, pine straw, ground cover and non-mulched. Blueberry marketing covered domestic and foreign price trends, import and export market trends and organic demand.

4.2. Sampling Plan

The organic rabbiteye blueberry production research was conducted at two separate field sites that were organized and operated similarly, i.e. the Bacon County- Blueberry Research and demonstration farm located in Alma, Georgia and the University of Georgia's Blueberry Research Farm in Alapaha, Georgia. Alma, Georgia is approximately four hours from the University of Georgia's main campus located in Athens, Georgia. Tifton UGA campus is three and a half hours from Athens, Georgia but is about thirty minutes from Alapaha and one and one-half hours from Alma, respectively (figure 4.1.).

The Alapaha site has been implementing organic production methods since 2002 under the supervision of Dr. Gerard Krewer. Organic mulching experiments were conducted to determine which method provided the best weed control, plant growth and yield. A new planting with expanded treatments and the same cultivar was established in Alma in November 2006. Pine bark, pine straw, ground cover and non-mulched were among the mulches included in the Alma

organic experiment. The other mulches in the Alma organic experiment were not included in this study as there was only 2 years of data available. Alma was included in the study because it provided data for production years one and two, in more detail than available from Alapaha.

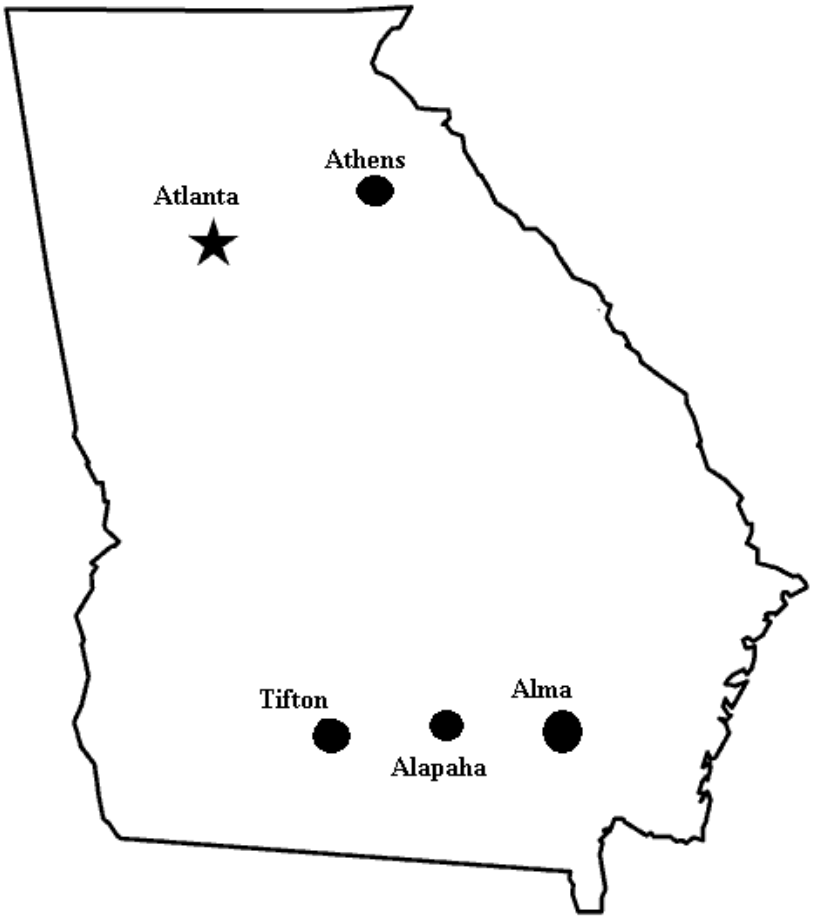

Figure 4.1.: Georgia State Map with Atlanta, Athens, Alma, Alapaha and Tifton.
Source: Georgia map. http://www.50states.com/maps/georgia.gif

Alapaha experimental design was a randomized complete block including four treatments with four replications and seven plants replication per treatment for a total of 28 plants per treatment, established in July 2002. Alma experimental design was a randomized complete block including eight treatments with four replications and seven plants replications per treatment for a total of 28 plants per treatment, planted in November 2006.

Production, weed, mulching and yield data were collected directly from these two sites. Yield data was collected each year since the second year of production until the seventh. Information on mulching time was collected in year one of production by collecting time-series data and transforming it into a single laborer time then extrapolating it to an acre. No historical data was found as there is limited information on organic blueberry yields and prices. The yield trends discussed in the previous chapter were from conventional blueberry yields in Georgia. No such data set for Georgia organic blueberries has been created prior to this study. Pricing data was collected via blueberry specialist, extension agents, retailers and professors. Each item included in the budget was checked for retail prices available in Tifton, Georgia. Most contact was made via phone, where specific questions were asked (i.e., how much is a new 30 hp tractor?). Information on the equipment was provided as well from the various sources stated previously. Marketing data was obtained from recent publications, United States Department of Agriculture, Food and Agriculture Organization, and National Agriculture Statistics Service. Specific marketing data for organic blueberries (i.e., organic price per pound estimate for 2008) was provided by South Georgia producers. All information was obtained through verbal or email communication.

4.3. Data Collection

Data for the four different organic blueberry production systems were collected from primary and secondary sources. Secondary sources were from recent publications on organic marketing and various departments and international organizations. The USDA, FAO, and the NASS were some of the secondary data sources. Primary data was obtained from actual production data collected from the field (i.e. yield) and personal communication with blueberry producers and agriculture suppliers in southeast Georgia.

4.3.1. Production

All quantities and applications of fertilizers, insecticides, fungicides, irrigation, labor and other stated were actual site practices. Much of the data was received, reviewed and confirmed by producers, extension agents and blueberry specialists. The equipment used on site and considered crucial for blueberry production was included in the fixed cost budgets. All equipment was used at both field sites. Equipment prices were quoted from local agriculture supply companies for new equipment. Most contact was made through phone calls where specific questions asked were the purchase price for a new 30 hp tractor or how much does pine bark mulch cost per acre for blueberries planted at 4' × 12' spacing and other general questions about management practices in the region.

The quantities and applications of mulch were from actual usage amounts on site. Mulching data was from the mulching at time of planting at Alma in November 2006. Time-motions were recorded for every replicate during mulch placement and weeding event. Weeding time data was collected at each weed removal event. The times collected for mulching and weed removal were converted to one laborer and extrapolated to one-acre

Alapaha blueberry site has been under organic production for seven years. Some harvest in years' three to seven of the establishment cost of the budget was experienced at Alapaha, Georgia. The first yield which occurs in budget year two was from the two year old Alma plantings. The yields were used in this way because data collection at Alapaha for the first two years was not complete. All yield collected was from plants grown between both sites and have experienced the same weather patterns as other blueberry operations in those areas. The harvest time was 3 to 6 weeks. During this time frame hand harvesting occurred 3 to 4 times per blueberry site. Each individual harvest was documented by yield per plant for each mulch

treatment. This was then averaged together and increased to an acre for a finalized yield in pounds per acre using a spacing of 4 by 12 feet between plants or 907 plants per acre. In 2007 a freeze occurred in April which reduced yields in the seventh year of production (Krewer et al., 2008). Yield multiplied by price per unit determined gross returns for fresh organic blueberries.

4.3.2. Marketing

The information on average blueberry prices was received from a local producer. The individual quoted the average price per pound for organic blueberries that producers received for their crop. The price received was the producer price and does not reflect prices received upon retail sale. Trade information was obtained through various sources such as, USDA, NASS, and ERS publications.

4.3.3. Price

An average price for Georgia organic blueberries was given from a local producer for the 2008 harvest season. The price given was the average price organic growers received upon sale of their crop. Each grower received different prices and prices vary from year to year, week to week, and day to day during the harvest season which lasts from late April until July. To adjust for these fluctuations the average price per pound for organic blueberries was used. The 2008 prices were used for each year of the enterprise budgets and represent a 'normal' production year. A 'normal' production year was defined as a year without extreme weather and late spring frosts which reduced yield and increased prices significantly.

Prices for fixed costs were obtained from a local tractor supply companies, such as Batten Tractor located in Baxley and MSI Agri-Supply in Tifton, Georgia. All equipment prices are for new equipment and are assumed to be used 100% of the time for organic blueberry production.

Irrigation cost data were obtained by a blueberry establishment contractor as well as the drip irrigation budget developed by Fonsah et al. (2008). Drip irrigation was used on both farms. 'Brightwell' rabbiteye blueberry bloom in mid-March when chance of freeze is low, reducing the need to have frost protect overhead irrigation. Drip irrigation was the only irrigation cost considered in this study.

Fertilizer, pesticides, and mulch prices were all obtained from surrounding agricultural supply stores and directly from the distributors. Labor cost was cited from local blueberry producers and was the average wage rate received by workers. All prices were accurate as of September 2008. No historical data was employed in the price estimates for inputs.

4.4. Data Analysis

4.4.1. Risk-Rated Enterprise Budgets

The organic blueberry budgets were similar to other agricultural crop budgets and provide financial information for agricultural producers. Information placed in the budget was the most accurate available and was obtained by individuals familiar with blueberry production. The enterprise budget acted as part of an entire farm budget that analyzes producers' total operation and represents a single point on the production function. The producers' goal of an enterprise budget was to predict all revenue and expenses in order to maximize net income. The budget provides one solution for the combination of production factors utilized (Bradford and Debertin, 1985). Information provided allows farmers to determine what aspects of an operation were essential to production and profitability.

This study developed four enterprise budgets for each production method covering seven years of production data. The different production methods were based on mulching systems used to produce organic blueberries. These mulches were pine bark, pine straw, ground cover (black plastic), and bare soil (non-mulched/control). The version used for the format and assumptions were established in the 2005 University of Georgia "Estimated Cost and Economics for Rabbiteye Blueberries in Georgia (Fonsah et al., 2005; Fonsah et al., 2006; Fonsah et al., 2007; Fonsah et al., 2008).

4.4.2. Comparative Analysis of Cost Returns

A comparative analysis of costs and returns per acre of organic blueberries produced under pine straw, pine bark, ground cover and non-mulched production systems was completed. Data from the budget was used to determine which production method was the lowest cost, cost efficient and which was superior in terms of profit margin.

4.4.3. Sensitivity Analysis

Sensitivity Analysis was the study of how changes in the output of a model can be divided to different sources of variation and how the model responds to the information put into it (Saltelli et al., 2000). A simpler way to explain sensitivity analysis was the study of relationships between the inputs and outputs of a model.

Inputs were subject to many sources of uncertainty including uncertainties in the natural system which impose a limit on the confidence in the output of the model. To deal with the input variable uncertainties, sensitivity analysis was created. It was used to increase the confidence of the model by providing an understanding of how the model reacts to changes in input (Saltelli et al., 2000).

Riskiness and profitability margin for organic rabbiteye blueberries was conducted under five different price and yield scenarios. The sensitivity analysis was set-up to consider changes in price per pound, yields and costs by -20%, -10%, -5%, base year, +5%, +10%, and +20%. Each change was observed in a separate table. These tables were reviewed in the next chapter.

4.4.4. Stochastic Dominance Analysis

Stochastic dominance analysis (SD) was an efficiency measure used to determine the risk efficient set of alternatives when challenged with uncertain outcomes (Byrd, 2005). The set of alternatives was ranked based on a minimal set of assumptions concerning individual producers' risk bias. First-degree and second-degree stochastic dominance were two basic variations of stochastic dominance utilized in this research.

4.4.4.1. First-Degree Stochastic Dominance

First-degree stochastic dominance (FSD) used the behavioral assumption of non-satiation, which meant "more was always preferred to less." An agent will maximize their utility of expected wealth but were never satisfied with consumption. This required an agents utility function to be increasing and have a positive first derivative, i.e. $U_1(y) > 0$. Population probability distributions of the random variable must be expressed in cumulative probability distribution functions (CDFs) as a requirement of FSD (Andersen, 1977). If F(y) represents a distribution function with random variable (y), then the relationship between probability density function for the random variable (y), noted as F'(y), and the distribution function F(y) would be stated as:

$$F(y) = \int_{-\infty}^{y} f(t)dt$$

where t was used as the variable of integration (Wackerly et al., 2002; Byrd, 2005). A comparison of two continuous CDF's, F_1 and G_1 defined over an interval of [0, 1], each representing a set of risky alternatives, if $F_1(y) \leq G_1(y)$ for all possible (y) in the range [0, 1] with at least one strong inequality then F is said to dominate G. For this example G was considered to be stochastically inefficient because it was dominated while F is stochastically efficient (Anderson, 1977). Relatively few distributions were eliminated under the FSD criterion. The second stochastic dominance concept includes more restrictive concepts of efficiency to produce a more significant result regarding stochastic efficiency.

4.4.4.2. Second-Degree Stochastic Dominance

Second-degree stochastic dominance (SSD) more restrictive concepts of efficiency provides a basis for eliminating inefficient FSD distributions. SSD includes an additional assumption of risk-aversion to the decision making process. The utility function was monotonically increasing and strictly concave over the range [a,b] of possible payoffs which was equivalent to assuming $U_1(x) > 0$ and $U_2(x) < 0$ (Anderson, 1977).

SSD ranks alternative states by interpreting their probability density functions as CDFs, similar to FSD. For a distribution to be considered dominant it must lay more to the right in terms of differences of area between the CDF curves. Distributions that are dominated are never preferred by utility-maximizing risk-averse decision makers. The more restrictive set of assumptions about risk preference allows SSD to determine the most efficient set of alternatives (Anderson, 1977).

This study used SSD to determine which organic blueberry production method was most efficient. SSD was utilized because it uses a ranking system for a set of producers, makes valid generalizations concerning producers' behavior, and the additional assumption of risk preference makes it the most efficient choice for a large group of producers whose specific utility functions are unknown. The goal was to identify the most efficient production method out of the set of four methods through the SSD analysis.

4.5. Limitations of Study

The following were major shortcomings experienced during this study: (1) limitation of data both current and historical; and (2) insufficient literature on organic blueberry production and marketing in Georgia and the Southeast.

Data collection was provided but not ample. Some years of un-averaged yield data was unavailable which limited the econometric analysis choices for this study. Alma's blueberry site would have generated more individual observations but had limited years of data. There was no complete documentation of organic blueberry yields for Georgia over a period of years; this limited the studies ability to compare yields from various locations in Georgia. Conventional blueberry data was used to illustrate yield trends and price trends in Georgia over several years. Ideally more literature about Georgia organic blueberry production would have been available. General organic literature is available but specific to Georgia is limited. Marketing data for organic blueberries was also quite limited, but organic fruits and vegetable marketing provided general information.

CHAPTER 5

EMPIRICAL RESULTS AND INTERPRETATION

5.1. Introduction

Each method of production generated data that was compiled into a total of 28 budgets. The 4 methods of production for organic blueberries were analyzed using enterprise budgets, second-degree stochastic dominance methods and sensitivity analysis, respectively. The second-degree stochastic dominance ranked the methods based on yield, gross revenue and net returns under two risk aversion preferences.

5.2. Organic Blueberry Production System

5.2.1. Site Description and Prep

The budget information was obtained from two separate sites in southern Georgia. The sites were originally virgin pineland forest that was cut and cleared of all timber. A track hoe then removed all stumps from the plot as well as pushed debris to the edge of the field. The land clearing was contracted out for about $800 per acre, shown in table 5.1. The remaining debris was cut with a drum chop then a woods harrow. Land was leveled, subsoiled and bedded. Each organic mulch production method experienced the same site preparation and budget values.

5.2.2. Cultivar Selection for Study

The rabbiteye cultivar selected for each site was 'Brightwell'. The cultivar has been one of the most reliable blueberry plants after recorded freezes in Georgia since 1993. 'Brightwell' was released by University of Georgia in 1983. The berries are medium-large size, very firm, round, good color, and flavor. A one trade gallon size blueberry plant cost $1.85 per plant for a total cost $1,678 per acre (Krewer and NeSmith, 2006).

5.2.3. Soil Prep

Soil samples were collected from the field and analyzed to determine fertilizer rates required. Each production method received identical treatment in terms of soil preparation during the first year as shown in table 5.1. The soil was prepped with 200 lbs/acre of bone meal prior to planting. Nature Safe (8-5-5) fertilizer was also applied prior to planting and throughout the growing season. The fertilizer regiment for Nature Safe (8-5-5) was 227 lbs/acre in the first year of production for a total cost of $99.88. Some sites will require the addition of elemental sulfur but this was not needed for the first year. The total land preparation cost was about $1,300 per acre including land clearing as shown in table 5.1.

Table 5.1. First Year Organic Rabbiteye Blueberry Budget under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
Land Preparation					
Elemental Sulfur	1	lb	0	$0.56	$0.00
Bone Meal	1	acre	200	$0.66	$132.00
Land clearing	1	acre	1	$800.00	$800.00
Fertilizer (8-5-5)	4	acre	227	$0.44	$99.88
Harrowing	3	acre	3	$40.00	$120.00
Sulfur Application / Incorp.	1	acre	1	$0.00	$0.00
Bedding	1	acre	1	$175.00	$175.00
Planting					
Plant 4 x 12	1	acre	907	$1.85	$1,677.95
Planting labor	1	hr	20	$7.50	$150.00
Transplanter rental	1	acre	1	$220.00	$220.00
Mulch Pine Bark	1	cu. yd	268	$11.25	$3,015.00
MPB Application Labor	1	hr	10	$7.50	$75.00
Weed Control					
Hand Weeding (4 times/yr)	4	hr	24	$7.50	$180.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Application (Tractor and Sprayer)	3	hr	1	$27.00	$27.00
Labor	3	acre	1	$22.50	$22.50
Pruning (manual)	1	hr	3	$7.50	$22.50
Mowing	9	hr	9	$9.50	$85.50
Irrigation (1 acre-in per event)	1	acre	1	$16.97	$16.97
Fertilizer					
Nature Safe 8-5-5	4	lb	187	$0.44	$82.28
Labor - Fertilizer Application	4	hr	4	$7.50	$30.00
Interest on operating costs		$	$7,193.30	7.00%	$503.53
TOTAL OPERATING COSTS					**$7,809.11**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$7,809.11	0.15	$1,171.37
IRRIGATION		Acre	1	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$2,067.48**
TOTAL ESTABLISHMENT COSTS PER ACRE					**$9,876.59**

5.2.4. Weed Control

Weed control was a major problem in blueberry fields as discussed previously. Aisles were maintained by mowing while the sides of the beds used a hillside cultivator to reduce weed pressure. Hand weeding was done about 4 times yearly. Each production method had varying weed control times which were captured in the total cost of production and were represented in

the net returns analysis. Labor was estimated at a rate of $7.50 per hour. The cost of mulch and the amount of time hand weeding were one of the major cost differences between the production methods. Tables 5.2, 5.3 and 5.4 provide information on production differences between mulches.

Total pine bark mulch costs are displayed in table 5.1. and 5.2. The total costs of all mulches implemented in production are shown in table 5.2. The cost of mulch for all seven years of production for pine bark was $4,995 per acre. Pine bark must be recharged every few years which increased operating cost by $990 for each recharge. Pine straw also needed to be recharged every 2 years resulting in $2,267.50 mulch cost every other year. Control was a bare-soil production system that required no mulch at zero cost. Ground cover was only placed once during the first production year through the seventh, and cost $159.80 per acre.

Table 5.2. Total Cost for Each Mulch per Acre, 2008.

	Pine Bark	Pine Straw	Ground Cover	Control
Year 1	$3,015.00	$2,267.50	$159.80	$0.00
Year 2	$0.00	$0.00	$0.00	$0.00
Year 3	$990.00	$2,267.50	$0.00	$0.00
Year 4	$0.00	$0.00	$0.00	$0.00
Year 5	$0.00	$2,267.50	$0.00	$0.00
Year 6	$0.00	$0.00	$0.00	$0.00
Year 7	$990.00	$2,267.50	$0.00	$0.00
Total Cost	**$4,995.00**	**$9,070.00**	**$159.80**	**$0.00**

Each method had different times required for hand weeding labor. The values include labor used to apply the mulch. In table 5.3., the control/non-mulched production method had the highest total cost for hand weeding during its production span of $5,925. The lack of mulch required more manual weeding during the year compared to the other production methods. Pine bark had the least amount of hours spent weeding for a total cost of $2,818.95. Pine bark was mechanically spread onto the beds which lowered labor cost compared to pine straw which was spread manually.

Table 5.3. Total Weed Management Labor Cost for Each Mulch Production Method per Acre, 2008.

	Pine Bark	Pine Straw	Ground Cover	Control
Year 1	$255.00	$690.00	$1,575.00	$180.00
Year 2	$253.95	$262.50	$420.00	$3,015.00
Year 3	$382.50	$922.50	$622.50	$570.00
Year 4	$480.00	$435.00	$585.00	$540.00
Year 5	$480.00	$922.50	$562.50	$540.00
Year 6	$480.00	$435.00	$585.00	$540.00
Year 7	$487.50	$922.50	$480.00	$540.00
Total Cost	**$2,818.95**	**$4,590.00**	**$4,830.00**	**$5,925.00**

The total cost for weed management per organic production method was shown in table 5.4. The most expensive method was pine straw due to the high cost of the mulch which must be reapplied every 2 years by manual labor. Pine bark was the 2nd most expensive for total cost at $7,813.95. The least expensive mulching method was the control as there was no mulch and the only cost incurred was for weed management labor.

Table 5.4. Total Weed Management Cost per Production Method, 2008.

	Pine Bark	Pine Straw	Ground Cover	Control
Year 1	$3,270.00	$2,957.50	$1,734.80	$180.00
Year 2	$253.95	$262.50	$420.00	$3,015.00
Year 3	$1,372.50	$3,190.00	$622.50	$570.00
Year 4	$480.00	$435.00	$585.00	$540.00
Year 5	$480.00	$3,190.00	$562.50	$540.00
Year 6	$480.00	$435.00	$585.00	$540.00
Year 7	$1,477.50	$3,190.00	$480.00	$540.00
Total Cost	**$7,813.95**	**$13,660.00**	**$4,989.80**	**$5,925.00**

5.2.5. Fertilization

The unit cost for Nature Safe (8-5-5) was $0.44 per pound. Nature Safe (8-5-5) fertilizer was applied at 227 lbs/acre in the first year of production. The second year the fertilizer was increased to 453 lbs/acre at a cost of $199.32. Nature Safe (8-5-5) was increased in the third year to 680 lbs/acre. The fourth until the seventh year of production the fertilizer was applied at 907 lbs/acre for a rate of $399.08. Each method experienced the same fertilization regime.

5.2.6. Irrigation

Drip irrigation was implemented during the site preparation. In table 5.5., the total annual cost incurred for drip irrigation was $151.01 based on 10 acres of production. The cost included drilling, pump, repairs, and annual electricity costs. Total annual fixed cost was $1,340.43 for new equipment and when the cost was spread over 10 acres, it reduces the annual fixed cost to $134.04. These costs were variable from site to site. Some producers install overhead irrigation for freeze protection but it was not included in this study.

Table 5.5. Drip Irrigation Budget for Organic Blueberry Production based on 10 acres, 2008.

BASED ON	**10**	ACRES
SPACING		**4 x 12'**
INTEREST ON INVESTMENT CAPITAL		7.00%
TAXES & INSURANCE		0.015
DEPTH OF WELL IN FEET		350

INVESTMENT AND ANNUAL FIXED COSTS

ITEM	**NEW COST**	**YRS.LIFE**	**DEPREC.**	**INTEREST**	**TAX & INS.**
PIPE & FITTINGS	$550	20	28	19	4
Drip tape	$400	7	57	14	3
WELL (4") (50 Gals/min)	$4,000	25	160	140	30
PUMP & MOTOR	$4,000	15	267	140	30
FILTER & AUTO	$1,000	10	100	35	8
Water meter	$1,500	10	150	53	11
INSTALLATION	$1,000	20	50	35	8
TOTAL INVESTMENT	**$12,450**		**811**	**436**	**93**
TOTAL ANNUAL FIXED COSTS					**$1,340.43**
ANNUAL FIXED COSTS PER ACRE					**$134.04**
OPERATING COSTS					
MOTOR SIZE (HP)			5		
REPAIRS			50		
ANNUAL PUMPING HOURS			200		
ELECTRICITY					
Demand (standby charge) per YEAR			60		
Rate $ per KWH			0.08		
ANNUAL ENERGY COST			120		
ANNUAL ENERGY COST PER ACRE					$11.97
OPERATING COST PER ACRE PER YEAR					**$16.97**
TOTAL ANNUAL COSTS PER ACRE					**$151.01**

5.2.7. Pollination

Blueberries require beehives onsite for pollination. The second year of production experienced the first crop and required one hive for about $50.00. Production years 3 and 4 had 2 hives while the number increased to 3 hives for years 5, 6 and 7. Each year new hives have to be purchased. Gibberellic acid was used every year after the second year of production to aid in stimulating the plant to set a good crop of fruit for a cost of a $1.00 per ounce (Table 5.6).

5.2.8. Pest and Disease Control

Each production method received the same treatment for pest and disease control as shown in table 5.6. The organic insecticide used was *Entrust: Spinosad* at a cost of $500 per acre. *Organic Gem fish oil* was implemented as a fungicide which cost $7.75 per gallon delivered. This cost can change depending on shipping distance and total amount purchased. For this study 1 ton was purchased and shipped to Tifton. *Serenade* was used to control mummy berry (*Monilinia vaccinii-corymbosi*). In the fifth year *Serenade* was used at a total cost of $81 per acre as shown in table 5.6. The insecticide and fungicides were applied using a tractor and sprayer which are included in the fixed cost budgets.

5.2.9. Yield

The main source of revenue for blueberry production was the quality of the yield. Each production method had varying yields each year. Yield and weed control were the major differences between each production method. All other practices were the same. Overall yield was highest for pine straw and worst for bare soil (control). Each year the yields vary, for production year 6 a severe frost occurred that reduced the yields significantly (figure 5.1.). For years 2-4, pine straw had higher yields than the other production methods. In the fifth year pine bark yielded the most berries and continued that trend until the seventh year where it had a 14,000 lbs/acre yield just under 5,000 lbs/acre more than pine straw (table 5.12. provides a summary of yields for all production methods per year).

Table 5.6. Fifth Year Organic Rabbiteye Blueberry Budget under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	64	$7.50	$480.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$2,459.55	7.00%	$172.17
TOTAL OPERATING COSTS					**$2,631.72**
Harvesting & Marketing Costs					
Custom Harvesting	lbs		8271	0.65	$5,376.15
Custom Packing	lbs		8271	0.66	$5,458.86
Cooling, Handling & Brokerage (Fresh -15%)	$		10835.01	15%	$1,625.25
TOTAL Harvesting & Marketing Costs					**$12,460.26**
Total Variable Costs					**$15,091.98**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$2,631.72	0.15	$394.76
IRRIGATION		Acre	1	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,290.88**
TOTAL PRODUCTION COSTS					**$16,382.85**
Less Return From Receipts - Fresh			8271	$3.50	$28,948.50
Net Return from Receipts - Fresh					**$28,948.50**
NET RETURNS PER ACRE					**$12,565.65**

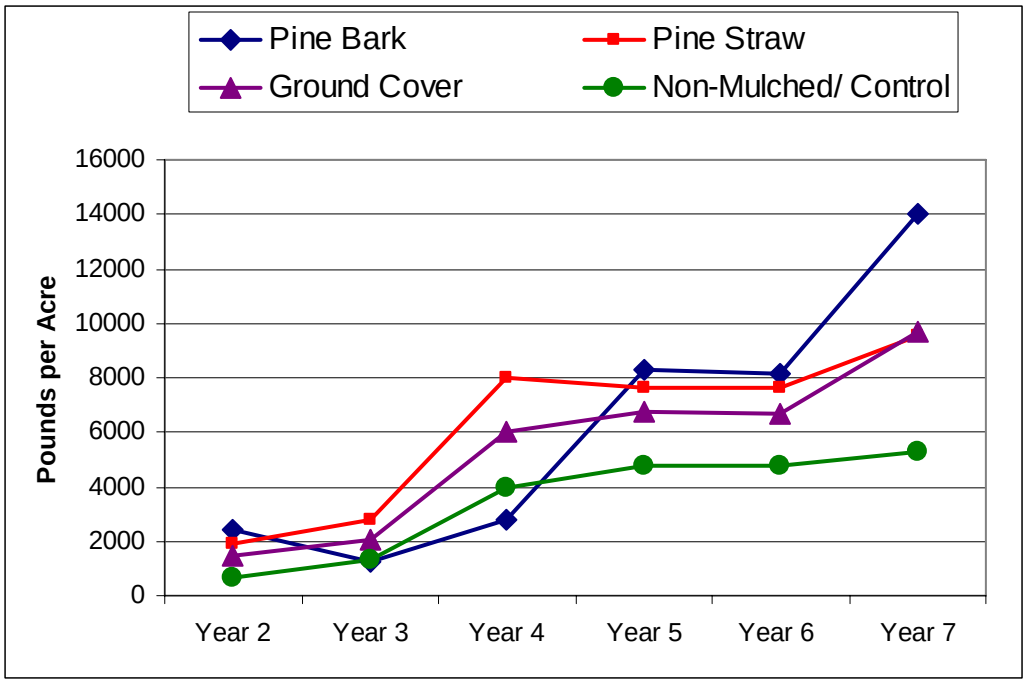

Figure 5.1.: Organic blueberry yield per acre from production years 2 – 7, under different mulching systems, 2008.

5.3. Results of Enterprise Budget Analysis

Among the four production methods, a comparative analysis was made between revenues, yields and net returns. The goal was to identify the most efficient mulching system through stochastic dominance analysis. The study used the statistical software package *Simetar* (Richardson et al., 2008). The program constructed the cumulative distribution functions using the average yields, total revenue and net returns of each method as the random variable. The average yields, total revenues and returns constituted observations within a set and was interpreted as a measure of a given level of wealth corresponding to each organic production method. Each observation was assigned equally weighted probabilities within each set in proportion to the observations contribution to the whole set. For instance, given 4 observations within a set, each observation would be assigned a probability of (ρ=.25) due to each observations equal likelihood of occurrence.

The summary statistics provided were mean, standard deviation, and coefficient variance. The standard deviation served as a measure of uncertainty. Standard deviation of a data set must be understood in the context of the mean. Coefficient variance was a unit less measure that standardizes the relative riskiness of the set which was better when comparing data sets with different means. Both the standard deviation and the coefficient variance measure riskiness, thus a higher value was less favorable.

Stochastic dominance analysis ranked each method according to "Most Preferred" to "Least Preferred" for two different risk aversion levels. The less risk averse rankings had a lower "Risk Aversion Coefficient" (RAC) of 0.000001 while the highly risk averse rankings had a RAC of 0.003 in the program *Simetar's* stochastic dominance tool. These numbers represent a level of risk aversion a producer may have. The lower risk aversion coefficient represented a low risk-averse producer while the high risk aversion coefficient represented a producer who was highly risk averse.

5.3.1. Stochastic Results

5.3.1.1. Yield Rankings

The four organic production methods were based on four different mulching systems which were: pine bark, pine straw, ground cover (fabric) and the control which was bare soil. For the average yield levels from year 2 through year 7, the pine straw production method was most preferred for both RAC levels. Pine straw had the lowest coefficient variance value of 49.9 which represents the least risky production method in terms of yield. Pine straw yields were less than pine bark for years 2, 5, 6, and 7, respectively but for years 3 and 4 pine straw yields were greater (figure 5.1.). Pine bark yields were more consistent and did not increase or decrease drastically during the seven years of production. A risk averse producer would prefer a

guaranteed yield from the pine straw production system over the pine bark production system which has uncertain yields even though the pine bark mulch can significantly outperform the stable yielding pine straw system because there was a chance that pine bark will experience significant crop loss. The producer does not want to risk a low yield in order to obtain a high yield. A consistent yield was preferred even though it was not the maximum yield that was obtained.

Pine Bark was 2nd most preferred followed by ground cover for the low risk averse producer due to the standard deviation compared to the mean (Table 5.7.). The least preferred production method was the non-mulched control. Controls' coefficient variance was lower than pine bark with a value of 56.8 but the standard deviation was further from the mean, which also represents a more risk inherent production system.

The high risk averse producer would prefer ground cover yields over pine bark even though pine bark yields were superior in the later years. Ground cover yields were more consistent while pine bark yields fluctuated throughout the seven years of production. Ground cover also had a lower coefficient variance than pine bark. A producer with high risk aversion would prefer a low risk method.

Table 5.7.: Simetar Production Ranking Results for Organic Blueberry Yields, 2008.

	RAC 0.000001	RAC 0.003	Std Dev	Coef Var	Mean
Pine Bark	2nd Most Preferred	3rd Most Preferred	4,901.7	79.7	6,150.2
Pine Straw	Most Preferred	Most Preferred	3,117.1	49.9	6,251.1
Ground Cover	3rd Most Preferred	2nd Most Preferred	3,107.7	57.1	5,442.9
Control	Least Preferred	Least Preferred	1,969.4	56.8	3,469.5

5.3.3.2. Revenue Rankings

The total revenues ranked the pine straw mulching system was the most preferred production method (Table 5.8.). Pine straw had the lowest coefficient variance of 51.5. The 2nd most preferred was pine bark followed by ground cover (fabric) the 3rd most preferred organic production method under a less risk averse producer. The coefficient variance was higher for pine bark than ground cover but pine barks' standard deviation difference was less. The highly risk averse producer would prefer the lower coefficient variance of ground cover (fabric), the 2nd most preferred. The least preferred method was the non-mulched control due to the large difference in standard deviation compared to the mean.

Table 5.8.: Simetar Production Ranking Results for Organic Blueberry Revenues, 2008.

	RAC 0.000001	RAC 0.003	Std Dev	Coef Var	Mean
Pine Bark	2nd Most Preferred	3rd Most Preferred	17,156.0	79.7	21,525.5
Pine Straw	Most Preferred	Most Preferred	11,175.6	51.5	21,721.1
Ground Cover	3rd Most Preferred	2nd Most Preferred	10,876.9	57.1	19,049.4
Control	Least Preferred	Least Preferred	6,892.9	56.8	12,143.3

5.3.3.3. Net Return Rankings

Production methods were ranked differently for net returns under the different RACs as shown in table 5.10. For the low risk averse producer pine bark was the most preferred production method followed by pine straw. Figure 5.2. illustrates the differences in net returns between the four production methods from years 2 through 7. Pine bark generated a net return over $25,000 per acre in the seventh year of production. The low risk averse producer would prefer the method that has the highest returns regardless of consistency, this was illustrated in the coefficient variance of 113.7. Pine bark experienced two years of losses and remained the most

preferred method due to the small difference between standard deviation and the mean. Ground cover was 2nd most preferred production method under the lower RAC. The standard deviation compared to the mean was less for ground cover resulting in a higher ranking than pine straw which has a lower coefficient variance.

Table 5.9.: Simetar Production Ranking Results for Organic Blueberry Net Returns, 2008.

	RAC 0.000001	RAC 0.003	Std Dev	Coef Var	Mean
Pine Bark	Most Preferred	3rd Most Preferred	10,423.7	113.7	9,165.5
Pine Straw	3rd Most Preferred	2nd Most Preferred	6,249.6	81.0	7,719.1
Ground Cover	2nd Most Preferred	Most Preferred	6,500.5	83.3	7,806.5
Control	Least Preferred	Least Preferred	4,883.8	450.0	3,256.4

For the high risk averse producer, ground cover was the most preferred method of production. Ground cover never experienced negative net returns unlike the other organic production methods therefore it consistently generated a profit. In the seventh year of production ground cover only made $17,000 per acre which was $8,000 less than pine bark (figure 5.11). Ground cover also had a low coefficient variance and a smaller standard deviation difference compared to the mean, thus it was the least risky production method. Pine straw was the second most preferred production method as it only experienced one year of negative returns and had the lowest coefficient variance but had a greater difference between the mean and the standard deviation making it more risky than ground cover.

5.3.3.4. Summary of Stochastic Rankings

Non-mulched (control) was ranked the least preferred production method consistently. Without the weed control provided by the mulch the non-mulched plants performed poorly. The yield of non-mulched technology was lower and (figure 5.1.) contributed to overall reduced revenue. Ground cover (fabric) was an overall good performer. Net returns were never negative under this technology (figure 5.2.). Pine straw experienced positive net returns for all years except production year 3.

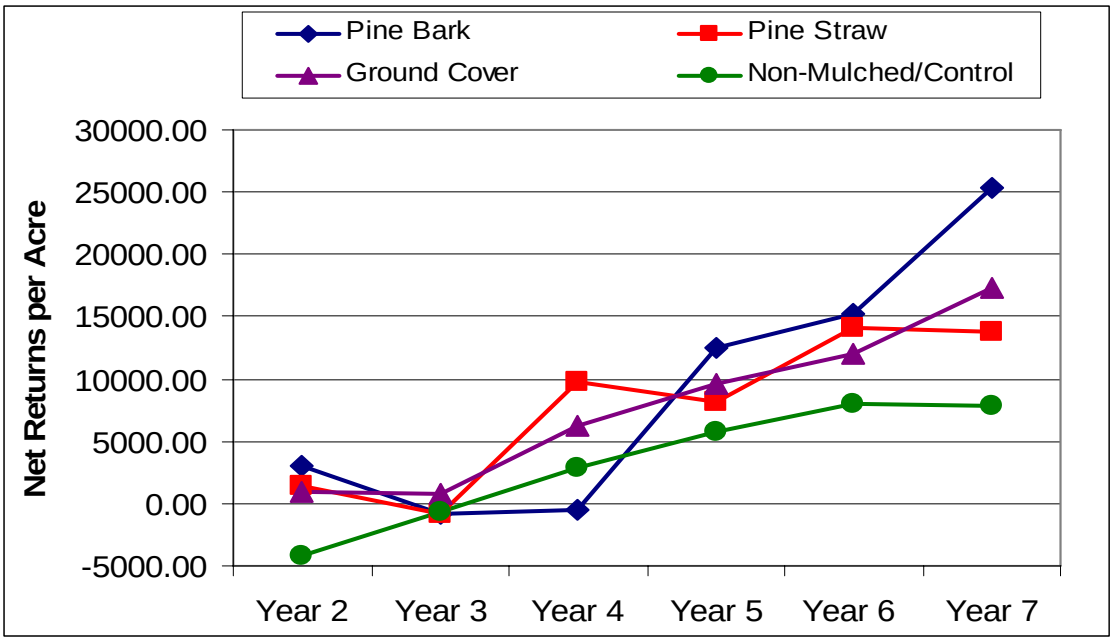

Figure 5.2.: Organic blueberry net returns per acre from production years 2 – 7, under different mulching systems, 2008.

Table 5.10., provides a summary of the yields, revenues, and net returns from the organic blueberry data. Rankings are based on the lower RAC of 0.000001. The table provides easy comparison of yields between each production method from years 2 through 7. Net returns were negative in year 3 except for ground cover which experienced net returns throughout the seven years of production. Pine bark and control were the two methods to experience a negative return for two years. Pine bark was still the most preferred method in terms of net returns for the low risk averse producer.

Table 5.10.: Table summary of yield, revenue, net returns and stochastic dominance preference rankings for each organic mulch production method

		Production Method			
		Pine Bark	Pine Straw	Control	Ground Cover
Yield (lbs/acre)	Year 2	2,435.90	1,670.39	680.00	1,500.00
	Year 3	1,252.00	2,759.40	1,320.00	2,059.60
	Year 4	2,757.00	8,018.00	3,959.00	6,019.00
	Year 5	8,271.00	7,618.00	4,799.00	6,719.00
	Year 6	8,136.00	7,603.00	4,789.00	6,705.00
	Year 7	14,049.00	9,567.00	5,270.00	9,655.00
Revenue	Year 2	$3,150.00	$6,793.43	$2,379.51	$5,248.93
	Year 3	$4,382.00	$9,658.03	$4,620.00	$7,208.53
	Year 4	$9,649.50	$28,064.28	$13,857.17	$21,065.70
	Year 5	$28,948.50	$26,664.56	$16,796.57	$23,515.20
	Year 6	$28,476.00	$26,608.75	$16,761.36	$23,465.75
	Year 7	$49,171.50	$33,484.50	$18,445.00	$33,792.50
Net Returns	Year 2	$2,963.19	$1,437.88	-$4,125.82	$872.29
	Year 3	-$760.80	-$867.48	-$682.23	$814.26
	Year 4	-$488.86	$9,719.48	$2,831.76	$6,205.59
	Year 5	$12,565.65	$8,104.73	$5,745.03	$9,544.08
	Year 6	$15,307.06	$14,129.20	$8,001.86	$12,085.06
	Year 7	$25,406.85	$13,790.74	$7,767.79	$17,315.52
Stochastic Dominance Rankings*	Yield	2nd Most Preferred	Most Preferred	Least Preferred	3rd Most Preferred
	Revenues	2nd Most Preferred	Most Preferred	Least Preferred	3rd Most Preferred
	Returns	Most Preferred	3rd Most Preferred	Least Preferred	2nd Most Preferred

***Efficient set based on SDRF at lower RAC of 0.000001**

5.3.2. Sensitivity Analysis Results

For each production method a sensitivity analysis was conducted on price per pound, yield and average total cost of production. All the berries were considered to be sold fresh. The price, yield and cost were all altered by percentages of -20%, -10%, -5%, base year, +5%, +10%, and +20%. The percentage changes were interpreted as 20% less of the base year variable (-20%) or a 5% increase in the base year variable (+5%). Each production method had varying results. In table 5.11., pine bark production method price per pound changes were reviewed for effect on total net revenues.

Table 5.11.: Sensitivity Analysis for Pine Bark Price Changes, 2008.

Actual Average Yield per acre	5894	5894	5894	5894	5894	5894	5894
Price Scenario (% of Ave. Price factor)	-20%	-10%	-5%	base year	5%	10%	20%
Actual Price Received $3.5 ($/lb)	$2.80	$3.15	$3.33	$3.50	$3.68	$3.85	$4.20
Altered Revenue	$16,503.67	$18,566.63	$19,598.10	$20,629.58	$21,661.06	$22,692.54	$24,755.50
Actual Average Cost/Acre	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51
Altered Average Returns/Acre	$4,833.15	$6,896.11	$7,927.59	$8,959.07	$9,990.55	$11,022.03	$13,084.99

The yield was averaged over 6 years of production which was 5894 lbs/acre. The prices represent percentage change from the base year price of $3.50 per pound. A 20% decrease (-20%) from the base year price reduced the pine bark mulch system net returns from $4,833.15 per acre to $4,125.92. On the other hand, a price 5% increase (+5%) than the base year price generated a net return of $9,990.55 per acre which was an increase of $1,031.48, compared with the base year.

Results of a sensitivity analysis on changes in pine bark production yields by the same percentages provided are illustrated in table 5.12. Altering the yield changed the revenues and net returns experienced in the base year. Reducing the yield by -10% of the average total pine bark yield resulted in a net return of $6,896.11 per acre, which was a $2,062.96 loss of returns compared to the base year yields.

Table 5.12.: Sensitivity Analysis for Pine Bark Yield Changes, 2008.

Actual Average Yield per acre	5894	5894	5894	5894	5894	5894	5894
Yield Scenerio (% of avg Yield)	-20%	-10%	-5%	base year	5%	10%	20%
Estimated Average Yield	4715	5305	5599	5894	6189	6484	7073
Altered Average Revenue	$16,503.67	$18,566.63	$19,598.10	$20,629.58	$21,661.06	$22,692.54	$24,755.50
Actual Average Cost/Acre	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51
Altered Average Returns/Acre	$4,833.15	$6,896.11	$7,927.59	$8,959.07	$9,990.55	$11,022.03	$13,084.99

The last type of sensitivity analysis conducted was based on changing total average cost. For pine bark, costs the average cost was $11, 670.51. A 5% reduction resulted to $11,086.99 as the net returns become $10,438.54 /acre (table 5.13.). Average revenue for pine bark production was $21,525.53. The decreased cost increased the net returns. The remainder of the sensitivity analysis results for each method is in Appendix H.

Table 5.13.: Sensitivity Analysis for Pine Bark Cost Changes, 2008.

Actual Average Yield	5894	5894	5894	5894	5894	5894	5894
Cost Scenario (% of Ave. Yield)	-20%	-10%	-5%	base year	5%	10%	20%
Actual Average Actual Cost	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51	$11,670.51
Actual Average Revenue	$21,525.53	$21,525.53	$21,525.53	$21,525.53	$21,525.53	$21,525.53	$21,525.53
Altered Average Estimated Cost	$9,336.41	$10,503.46	$11,086.99	$11,670.51	$12,254.04	$12,837.56	$14,004.62
Altered Average Returns/Acre	$12,189.11	$11,022.06	$10,438.54	$9,855.01	$9,271.49	$8,687.96	$7,520.91

CHAPTER 6

SUMMARY AND CONCLUSION

6.1. Summary and Conclusion

The purpose of this study was to determine if organic blueberry production is economically viable in Georgia and which production method is the most efficient. Similar studies have been conducted about the viability of conventional blueberry production in Georgia (Fonsah et al., 2005; Fonsah et al., 2006; Fonsah et al., 2007; Fonsah et al., 2008). Organic blueberry production incorporates different production techniques than conventional production which alters cost and revenue between the two production systems. The changes in cost and revenue as well as the most efficient organic production method has not been reviewed for Georgia growing conditions, prompting the need for this study.

The four production systems observed were four separate organic mulch systems. The mulches include; pine bark, pine straw, ground cover and bare soil. For seven years, rabbiteye blueberries were observed for each production method with factors of production recorded. The different mulching systems in our study received the same fertilizer, weed management, pesticide, harvesting, production practices and maintenance treatment. Amount of yield and labor spent for weeding were the two major differences between mulching systems. These differences ultimately determine the cost and revenues of the production method experienced throughout the seven years of production.

Enterprise budgets were developed for each method for seven years of production for a total of 28 budgets. Fixed cost budgets were developed for pine bark and the remaining mulch production systems. The only difference between the fixed cost budgets was the inclusion of a Mill Creek mulcher for pine bark mulch applications, all other mulches were applied by hand labor. If applied commercially, the ground cover would be applied in one day with plastic mulch laying machine. Drip irrigation costs were included in a separate budget to determine annual cost incurred for the system.

The information provided by these budgets was then compiled and analyzed using second-degree stochastic dominance analysis in the program *Simetar* (Richardson et al., 2008). The program allowed the implementation of efficiency criteria employed by agricultural economist to determine an optimal choice among a set of risk alternatives. Second-degree stochastic dominance was used because of more restrictive assumptions. The results of the analysis ranked each method based on yields, revenues and net returns providing for the most optimal method available in the set of available organic mulches. Pine straw organic mulch production was ranked most preferred method in yields and revenues. Pine bark was most preferred for net returns for a low risk averse producer. Non-mulched control was consistently ranked the least preferred organic production method.

Each organic production method observed was based on readily available materials in South Georgia. These results may not translate the same to Alabama or Florida blueberry production but were consistent with South Georgia production practices. The findings of this study can help producers and extension agents have a realistic look of how an organic blueberry crop reacted to different production practices.

The organic food phase has been gaining popularity each year. More individuals were becoming health and environmentally conscience which translates into purchasing more 'green' products such as organic fruits and vegetables. Georgia producers have an ability to receive higher price premiums for their fruit by producing organic blueberries. This premium can translate to increased net returns while reducing environmental impacts of agriculture production. Organic blueberry production is an alternative to conventional production in Georgia.

6.2. Suggestions for Further Research

Additional research concerning organic blueberry production in Georgia can expand on the findings of this study through several outlets. First, continued research into economically viable organic mulches on newly planted blueberry sites. The effect these mulches have on yields, costs and revenues can be compared to the mulches analyzed in this study. Research can also be conducted on the organic fertilizer and pesticide effectiveness on yields, costs and revenues.

A more extensive data set could be used to perform a regression which can account for producers' varying degrees of risk aversion across a larger collection of viable production systems. As advancements are made in research and development of organic agriculture as well as increased consumer awareness, enterprise budgets and programming models can be modified to account for the changing cost structure of these new organic production methods. Georgia organic blueberry producers can evolve with production and marketing changes to remain top blueberry producers in the United States.

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APPENDICES

APPENDIX A
Pine Bark Enterprise Budgets

First Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
Land Preparation					
Elemental Sulfur	1	lb	0	$0.56	$0.00
Bone Meal	1	acre	200	$0.66	$132.00
Land clearing	1	acre	1	$800.00	$800.00
Fertilizer (8-5-5)	4	acre	227	$0.44	$99.88
Harrowing	3	acre	3	$40.00	$120.00
Sulfur Application / Incorp.	1	acre	1	$0.00	$0.00
Bedding	1	acre	1	$175.00	$175.00
Planting					
Plant 4 x 12	1	acre	907	$1.85	$1,677.95
Planting labor	1	hr	20	$7.50	$150.00
Transplanter rental	1	acre	1	$220.00	$220.00
Mulch Pine Bark	1	cu. yd	268	$11.25	$3,015.00
MPB Application Labor	1	hr	10	$7.50	$75.00
Weed Control					
Hand Weeding (4 times/yr)	4	hr	24	$7.50	$180.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Application (Tractor and Sprayer)	3	hr	1	$27.00	$27.00
Labor	3	acre	1	$22.50	$22.50
Pruning (manual)	1	hr	3	$7.50	$22.50
Mowing	9	hr	9	$9.50	$85.50
Irrigation (1 acre-in per event)	1	acre	1	$16.97	$16.97
Fertilizer					
Nature Safe 8-5-5	4	lb	187	$0.44	$82.28
Labor - Fertilizer Application	4	hr	4	$7.50	$30.00
Interest on operating costs		$	$7,193.30	7.00%	$503.53
TOTAL OPERATING COSTS					**$7,809.11**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$7,809.11	0.15	$1,171.37
IRRIGATION		Acre	1	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$2,067.48**
TOTAL ESTABLISHMENT COSTS PER ACRE					**$9,876.59**

APPENDIX A
(continued)

Second Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	453	$0.44	$199.32
Fertilizer labor (Spreading 8-5-5)	4	acre	1.4	$7.50	$10.50
Gibberellic acid	2	Oz	40	$1.00	$40.00
Weed Control					
Hand weeding	3	hr	34	$7.50	$253.95
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Tractor and Sprayer (labor)	6	hr	6	$27.00	$162.00
Manual Pruning	1	hr	3	$22.50	$67.50
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	3	acre	3	$7.50	$22.50
Irrigation	1	acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	1	$50.00	$50.00
Interest on operating costs		$	$1,175.24	7.00%	$82.27
TOTAL OPERATING COSTS					**$1,307.50**
Harvesting & Marketing Costs					
Harvesting (manuel)		lbs	2435.90	0.65	$1,583.34
Custom Packing		lbs	2314.11	0.66	$1,527.31
Cooling, Handling & Brokerage (Fresh - 15%)		$	2314.11	15%	$52.07
TOTAL Harvesting & Marketing Costs					**$3,162.71**
Total Variable Costs					**$4,470.22**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$1,307.50	0.15	$196.13
IRRIGATION		Acre	1	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
TOTAL FIXED COSTS					**$1,092.24**
TOTAL PRODUCTION COSTS					**$5,562.46**
Less Return From Receipts		$	2435.90	$3.50	$8,525.65
NET RETURNS PER ACRE					**$2,963.19**

APPENDIX A
(continued)

Third Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	AMOUNT	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	680	$0.44	$299.20
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Giberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	6	hr	50	$7.50	$375.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$2,038.17	7.00%	$142.67
TOTAL OPERATING COSTS					**$2,180.84**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	1252.00	0.65	$813.80
Custom Packing		lbs	1252.00	0.66	$826.32
Cooling, Handling & Brokerage (Fresh - 15%)		$	4382.00	15%	$98.60
Total Harvesting & Marketing Costs					**$1,738.72**
TOTAL VARIABLE COSTS					**$3,919.55**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$2,180.84	0.15	$327.13
IRRIGATION		Acre	1	134.04	$134.04
LAND (lease)		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,223.24**
TOTAL PRODUCTION COSTS					**$5,142.80**
Less Return From Receipts		$	1252	$3.50	$4,382.00
NET RETURNS PER ACRE					**-$760.80**

APPENDIX A
(continued)

Fourth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Milled Pine Bark recharge (~2")	1	cu. yd	88	$11.25	$990.00
Weed Control					
Hand Weeding	6	hr	64	$7.50	$480.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$3,399.55	7.00%	$237.97
TOTAL OPERATING COSTS					**$3,637.52**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	2757	0.65	$1,792.05
Custom Packing		lbs	2757	0.66	$1,819.62
Cooling, Handling & Brokerage (Fresh -15%)		$	9649.50	15%	$1,447.43
TOTAL Harvesting & Marketing Costs					**$5,059.10**
Total Variable Costs					**$8,696.61**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$3,637.52	0.15	$545.63
IRRIGATION		Acre	1	134.04	$134.04
LAND (lease)		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,441.75**
TOTAL PRODUCTION COSTS					**$10,138.36**
Less Return From Receipts - Fresh			2757	$3.50	$9,649.50
Net Return from Receipts - Fresh					**$9,649.50**
NET RETURNS PER ACRE					**-$488.86**

APPENDIX A
(continued)

Fifth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	64	$7.50	$480.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$2,459.55	7.00%	$172.17
TOTAL OPERATING COSTS					**$2,631.72**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	8271	0.65	$5,376.15
Custom Packing		lbs	8271	0.66	$5,458.86
Cooling, Handling & Brokerage (Fresh -15%)		$	10835.01	15%	$1,625.25
TOTAL Harvesting & Marketing Costs					**$12,460.26**
Total Variable Costs					**$15,091.98**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$2,631.72	0.15	$394.76
IRRIGATION		Acre	1	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,290.88**
TOTAL PRODUCTION COSTS					**$16,382.85**
Less Return From Receipts - Fresh			8271	$3.50	$28,948.50
Net Return from Receipts - Fresh					**$28,948.50**
NET RETURNS PER ACRE					**$12,565.65**

APPENDIX A
(continued)

Sixth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	1	lb	907	$0.44	$399.08
Fertilizer - Spreading	4	acre	4	$8.33	$33.32
Weed Control					
Hand Weeding	8	hr	64	$7.50	$480.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	5	pt	5	$25.00	$125.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	hr	3	$27.00	$81.00
Tractor and Sprayer (labor)	3	acre	3	$30.00	$90.00
Manual Pruning	1	hr	3	$25.00	$75.00
Mowing	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$1,655.37	7.00%	$115.88
TOTAL OPERATING COSTS					**$1,771.24**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	8136	0.65	$5,288.40
Custom Packing		lbs	8136	0.66	$5,369.76
Cooling, Handling & Brokerage			10658.16	15%	$239.81
Total Harvesting & Marketing Costs					**$10,897.97**
TOTAL VARIABLE COSTS					**$12,669.21**
FIXED COSTS					
TRACT & EQUIP		Acre	1	0.00	$0.00
Overhead & Management		$	$1,771.24	0.15	$265.69
IRRIGATION		Acre	1	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$499.73**
TOTAL PRODUCTION COSTS					**$13,168.94**
Less Return From Receipts - Fresh			8136	$3.50	$28,476.00
Net Return from Receipts - Fresh					**$28,476.00**
NET RETURNS PER ACRE					**$15,307.06**

APPENDIX A
(continued)

Seventh Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Bark Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.50	$30.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Milled Pine Bark recharge (~2")	1	cu. yd	88	$11.25	$990.00
MPB Application / Incorporation	1	acre	1	$7.50	$7.50
Weed Control					
Hand Weeding	6	hr	64	$7.50	$480.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$7.50	$82.50
Mowing	9	hr	3	$7.50	$22.50
Hill side cultivation labor	9	hr	9	$7.50	$67.50
Irrigation		acre	1	$16.97	$16.97
Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$3,291.55	7.00%	$230.41
TOTAL OPERATING COSTS					**$3,521.96**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	14049	0.65	$9,131.85
Custom Packing		lbs	14049	0.66	$9,272.34
Cooling, Handling & Brokerage			18404.19	15%	$414.09
TOTAL Harvesting & Marketing Costs					**$18,818.28**
Total Variable Costs					**$22,340.24**
FIXED COSTS					
TRACT & EQUIP		Acre	1	662.08	$662.08
Overhead & Management		$	$3,521.96	0.15	$528.29
IRRIGATION		Acre	1	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,424.41**
TOTAL PRODUCTION COSTS					**$23,764.65**
Less Return From Receipts - Fresh			14049	$3.50	$49,171.50
Net Return from Receipts - Fresh					**$49,171.50**
NET RETURNS PER ACRE					**$25,406.85**

APPENDIX B
Fixed Cost Budgets

Estimated Total Annual Fixed Machinery Costs for Rabbiteye Blueberry under Pine Bark Mulch in Georgia, 2008.

Acres (10)	10
Interest	7.0%

Item	Crop Percentage	Purchase Price	Salvage Value	Yrs. Life	Deprec.	Int	Tax&Ins	FC/Ac
Backpack sprayer,herbicide (2)	100%	$376.00	75	5	60	16	3	7.91
Fertilizer sprayer	100%	$450.00	90	10	36	19	4	5.87
Sprayer,airblast	100%	$8,000.00	1600	10	640	336	67	104.32
Rotary Mower(6')	100%	$1,500.00	300	10	120	63	13	19.56
Hill Side Cultivator	100%	$1,800.00	360	10	144	76	15	23.47
V Blade - Cultivator	100%	$800.00	160	20	32	34	7	7.23
Millcreek Mulcher	100%	$12,500.00	500	10	1200	455	91	174.60
Tractor (30 HP)*	100%	$15,000.00	3000	20	600	630	126	135.60
Rotovator	100%	$2,000.00	400	20	80	84	17	18.08
Truck-used (harv't & Packg)	100%	$17,000.00	3400	20	680	714	143	153.68
Lug carts (4)	100%	$0.00	0	10	0	0	0	0.00
Harvester (Pull Behind)	100%	$0.00	0	20	0	0	0	0.00
Subsoiler	100%	$300.00	60	20	12	13	3	2.71
Spring-tooth Harrow	100%	$1,000.00	200	20	40	42	8	9.04
Total Investment		**$ 60,726**	**10145.2**		**3644**	**2480**	**496**	**662**

TOTAL FIXED COSTS	**$6,621**
FIXED COSTS per ACRE	**$ 662.08**

* These prices are for new equipments. Used equipments could be purchased.
Farm Size used for calculations = 10 Acres

Estimated Total Annual Fixed Machinery Costs for Pine Straw, Ground Cover, and Non-mulched Organic Rabbiteye Blueberry in Georgia, 2008.

Acres (10)	10
Interest	7.0%

Item	Crop Percentage	Purchase Price	Salvage Value	Yrs. Life	Deprec.	Int	Tax&Ins	FC/Ac
Backpack sprayer,herbicide (2)	100%	$376.00	$75.20	5	60	16	3	7.91
Fertilizer sprayer	100%	$450.00	$90.00	10	36	19	4	5.87
Sprayer,airblast	100%	$8,000.00	$1,600.00	10	640	336	67	104.32
Rotary Mower(6')	100%	$1,500.00	$300.00	10	120	63	13	19.56
Hill Side Cultivator	100%	$1,800.00	$360.00	10	144	76	15	23.47
V Blade - Cultivator	100%	$800.00	$160.00	20	32	34	7	7.23
Tractor (30 HP)*	100%	$15,000.00	$3,000.00	20	600	630	126	135.60
Rotovator	100%	$2,000.00	$400.00	20	80	84	17	18.08
Truck-used (harv't & Packg)	100%	$17,000.00	$3,400.00	20	680	714	143	153.68
Lug carts (4)	100%	$0.00	$0.00	10	0	0	0	0.00
Harvester (Pull Behind)	100%	$0.00	$0.00	20	0	0	0	0.00
Subsoiler	100%	$300.00	$60.00	20	12	13	3	2.71
Spring-tooth Harrow	100%	$1,000.00	$200.00	20	40	42	8	9.04
Total Investment		**$ 48,226**	**$9,645.20**		**2444**	**2025**	**405**	**487**

TOTAL FIXED COSTS	**$4,875**
FIXED COSTS PER ACRE	**$ 487.48**

* These prices are for new equipments. Used equipments could be purchased.
Farm Size used for calculations = 10 Acres

APPENDIX C
Pine Straw Enterprise Budgets

First Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Straw Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
Land Preparation					
Elemental Sulfur	1	lb	0	$0.56	$0.00
Bone Meal	1	acre	200	$0.66	$132.00
Land clearing	1	acre	1	$800.00	$800.00
Fertilizer (8-5-5)	4	acre	227	$0.44	$99.88
Harrowing	3	acre	3	$40.00	$120.00
Sulfur Application / Incorp.	1	acre	1	$0.00	$0.00
Bedding	1	acre	1	$175.00	$175.00
Planting					
Plant 4 x 12	1	acre	907	$1.85	$1,677.95
Planting labor	1	hr	20	$7.50	$150.00
Transplanter rental	1	acre	1	$220.00	$220.00
Pine Straw	1	bales	907	$2.50	$2,267.50
Pine straw Application Labor	1	hr	65	$7.50	$487.50
Weed Control					
Hand Weeding (4 times/yr)	4	hr	27	$7.50	$202.50
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Application (Tractor and Sprayer)	3	hr	1	$27.00	$27.00
Labor	3	acre	1	$22.50	$22.50
Pruning (manual)	1	hr	3	$7.50	$22.50
Mowing	9	hr	9	$9.50	$85.50
Irrigation (1 acre-in per event)	1	acre	1	$16.97	$16.97
Fertilizer					
Nature Safe 8-5-5	4	lb	187	$0.44	$82.28
Labor - Fertilizer Application	4	hr	4	$7.50	$30.00
Interest on operating costs		$	$6,880.80	7.00%	$481.66
TOTAL OPERATING COSTS					**$7,474.73**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	7474.73	0.15	$1,121.21
IRRIGATION		Acre	1.00	134.04	$134.04
LAND		$	1.00	100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,842.73**
TOTAL ESTABLISHMENT COSTS PER ACRE					**$9,317.46**

APPENDIX C
(continued)

Second Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Straw Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	453	$0.44	$199.32
Fertilizer labor (Spreading 8-5-5)	4	acre	1.4	$7.50	$10.50
Gibberellic acid	2	Oz	40	$1.00	$40.00
Weed Control					
Hand weeding	3	hr	35	$7.50	$262.50
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Tractor and Sprayer (labor)	6	hr	6	$27.00	$162.00
Manual Pruning	1	hr	3	$22.50	$67.50
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	3	acre	3	$7.50	$22.50
Irrigation	1	acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	1	$50.00	$50.00
Interest on operating costs		$	$1,233.79	7.00%	$86.37
TOTAL OPERATING COSTS					**$1,320.15**
Harvesting & Marketing Costs					
Harvesting (manuel)		lbs	1670.39	0.65	$1,085.75
Custom Packing		lbs	1586.87	0.66	$1,047.34
Cooling, Handling & Brokerage (Fresh - 15%)		$	1586.87	15%	$35.70
TOTAL Harvesting & Marketing Costs					**$2,168.79**
Total Variable Costs					**$3,488.95**
FIXED COSTS					
TRACT & EQUIP		Acre	1	487.48	$487.48
Overhead & Management		$	$1,320.15	0.15	$198.02
IRRIGATION		Acre	1	134.04	$134.04
LAND		$	$1.00	100.00	$100.00
TOTAL FIXED COSTS					**$919.54**
TOTAL ESTABLISHMENT COSTS					**$4,408.49**
Less Return From Receipts		$	$1,670.39	$3.50	$5,846.37
NET RETURNS PER ACRE					**$1,437.88**

APPENDIX C
(continued)

Third Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Straw Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	680	$0.44	$299.20
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Giberellic acid	2	Oz	80	$1.00	$80.00
Pinestraw recharge	1	bales	907	$2.50	$2,267.50
Pinestraw application labor	1	hr	65	$7.50	$487.50
Weed Control					
Hand Weeding	6	hr	58	$7.50	$435.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$4,853.17	7.00%	$339.72
TOTAL OPERATING COSTS					**$5,192.89**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	2759.44	$0.65	$1,793.63
Custom Packing- Fresh		lbs	2759.44	$0.66	$1,821.23
Cooling, Handling & Brokerage (Fresh - 15%)		$	9658.03	15%	$217.31
TOTAL Harvesting & Marketing Costs					**$3,832.17**
Total Variable Costs					**$9,025.06**
FIXED COSTS					
TRACT & EQUIP		Acre	1	$487.48	$487.48
Overhead & Management		$	$5,192.89	$0.15	$778.93
IRRIGATION		Acre	1	$134.04	$134.04
LAND (lease)		$	$1.00	$100.00	$100.00
OTHER			0.00	$0.00	$0.00
TOTAL FIXED COSTS					**$1,500.45**
TOTAL ESTABLISHMENT COSTS					**$10,525.51**
Less Return From Receipts		$	2759	$3.50	$9,658.03
NET RETURNS PER ACRE					**-$867.48**

APPENDIX C
(continued)

Fourth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Straw Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	6	hr	58	$7.50	$435.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$2,364.55	7.00%	$165.52
TOTAL OPERATING COSTS					**$2,530.07**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	8018.36	0.65	$5,211.94
Custom packing - Fresh		lbs	8018.36	0.66	$5,292.12
Cooling, Handling & Brokerage (Fresh -15%)		$	28064.28	15%	$4,209.64
Total Harvesting & Marketing Costs					**$14,713.70**
TOTAL VARIABLE COSTS					**$17,243.77**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$2,530.07	0.15	$379.51
IRRIGATION		Acre	1.00	134.04	$134.04
LAND (lease)		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,101.03**
TOTAL PRODUCTION COSTS					**$18,344.79**
Less Return From Receipts - Fresh			8018	$3.50	$28,064.28
Net Return from Receipts - Fresh					**$28,064.28**
NET REVENUE PER ACRE					**$9,719.48**

APPENDIX C
(continued)

Fifth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Straw Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Pine Straw Recharge	1	bales	907	$2.50	$2,267.50
Pinestraw Application	1	acre	65	$7.50	$487.50
Weed Control					
Hand Weeding	4	hr	58	$7.50	$435.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$5,169.55	7.00%	$361.87
TOTAL OPERATING COSTS					**$5,531.42**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	7618.446107	0.65	$4,951.99
Custom Packing - Fresh		lbs	7618.446107	0.66	$5,028.17
Cooling, Handling & Brokerage (Fresh -15%)		$	9980.16	15%	$1,497.02
TOTAL Harvesting & Marketing Costs					**$11,477.19**
Total Variable Costs					**$17,008.61**
FIXED COSTS					
TRACT & EQUIP		Acre	1	487.48	$487.48
Overhead & Management		$	$5,531.42	$0.15	$829.71
IRRIGATION		Acre	1	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,551.23**
TOTAL PRODUCTION COSTS					**$18,559.84**
Less Return From Receipts - Fresh			7618	$3.50	$26,664.56
Net Return from Receipts - Fresh					**$26,664.56**
NET RETURNS PER ACRE					**$8,104.73**

APPENDIX C
(continued)

Sixth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Straw Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	1	lb	907	$0.44	$399.08
Fertilizer - Spreading	4	acre	4	$8.33	$33.32
Weed Control					
Hand Weeding	8	hr	58	$7.50	$435.00
Pest and Disease Control					
Insecticide (Spinosad)	5	pt	5	$25.00	$125.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	hr	3	$27.00	$81.00
Tractor and Sprayer (labor)	3	acre	3	$30.00	$90.00
Manual Pruning	1	hr	3	$25.00	$75.00
Mowing	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$1,610.37	7.00%	$112.73
TOTAL OPERATING COSTS					**$1,723.09**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	7602.5	0.65	$4,941.63
Custom packing (Fresh handpick)		lbs	7602.5	0.66	$5,017.65
Cooling, Handling & Brokerage			9959.28	15%	$224.08
TOTAL Harvesting & Marketing Costs					**$10,183.36**
Total Variable Costs					**$11,906.45**
FIXED COSTS					
TRACT & EQUIP		Acre	1	80.59	$80.59
Overhead & Management		$	$1,723.09	0.15	$258.46
IRRIGATION		Acre	1	134.04	$134.04
LAND- Lease		$	$1.00	100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$573.09**
TOTAL PRODUCTION COSTS					**$12,479.55**
Less Return From Receipts - Fresh			7602.5	$3.50	$26,608.75
Net Return from Receipts - Fresh & Frozen					**$26,608.75**
NET RETURNS PER ACRE					**$14,129.20**

APPENDIX C
(continued)

Seventh Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Pine Straw Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.50	$30.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Pine Straw Recharge	1	bales	907	$2.50	$2,267.50
Pinestraw Application	1	acre	65	$7.50	$487.50
Weed Control					
Hand Weeding	6	hr	58	$7.50	$435.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$7.50	$82.50
Mowing	9	hr	3	$7.50	$22.50
Hill side cultivation labor	9	hr	9	$7.50	$67.50
Irrigation		acre	1	$16.97	$16.97
Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$5,004.05	7.00%	$350.28
TOTAL OPERATING COSTS					**$5,354.33**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	9567	$0.65	$6,218.55
Custom packing (Fresh handpick)		lbs	9567	$0.66	$6,314.22
Cooling, Handling & Brokerage			12532.77	15%	$281.99
TOTAL Harvesting & Marketing Costs					**$12,814.76**
Total Variable Costs					**$18,169.09**
FIXED COSTS					
TRACT & EQUIP		Acre	1	487.48	$487.48
Overhead & Management		$	$5,354.33	0.15	$803.15
IRRIGATION		Acre	1	$134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,524.67**
TOTAL PRODUCTION COSTS					**$19,693.76**
Less Return From Receipts - Fresh			9567	$3.50	$33,484.50
Net Return from Receipts - Fresh					**$33,484.50**
NET RETURNS PER ACRE					**$13,790.74**

APPENDIX D
Ground Cover Enterprise Budget

First Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Ground Cover Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Land Preparation					
Elemental Sulfur	1	lb	0	$0.56	$0.00
Bone Meal	1	acre	200	$0.66	$132.00
Land clearing	1	acre	1	$800.00	$800.00
Fertilizer (8-5-5)	4	acre	227	$0.44	$99.88
Harrowing	3	acre	3	$40.00	$120.00
Sulfur Application / Incorp.	1	acre	1	$0.00	$0.00
Bedding	1	acre	1	$175.00	$175.00
Planting					
Plant 4 x 12	1	acre	907	$1.85	$1,677.95
Planting labor	1	hr	20	$7.50	$150.00
Transplanter rental	1	acre	1	$220.00	$220.00
Plastic Mulch	1	box	4	$39.95	$159.80
Black Plastic Application labor	1	hr	186	$7.50	$1,395.00
Weed Control					
Hand Weeding (4 times/yr)	4	hr	24	$7.50	$180.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Application (Tractor and Sprayer)	3	hr	1	$27.00	$27.00
Labor	3	acre	1	$22.50	$22.50
Pruning (manual)	1	hr	3	$7.50	$22.50
Mowing	9	hr	9	$9.50	$85.50
Irrigation (1 acre-in per event)	1	acre	1	$16.97	$16.97
Fertilizer					
Nature Safe 8-5-5	4	lb	187	$0.44	$82.28
Labor - Fertilizer Application	4	hr	4	$7.50	$30.00
Interest on operating costs		$	$5,658.10	7.00%	$396.07
TOTAL OPERATING COSTS					**$6,166.44**
FIXED COSTS					
TRACT & EQUIP		Acre	1	487.48	$487.48
Overhead & Management		$	$ 6,166.44	0.15	$924.97
IRRIGATION		Acre	1	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,646.49**
TOTAL ESTABLISHMENT COSTS					**$7,812.93**

APPENDIX D
(continued)

Second Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Ground Cover Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	453	$0.44	$199.32
Fertilizer labor (Spreading 8-5-5)	4	acre	1.4	$7.50	$10.50
Gibberellic acid	2	Oz	40	$1.00	$40.00
Weed Control					
Hand weeding	3	hr	56	$7.50	$420.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Tractor and Sprayer (labor)	6	hr	6	$27.00	$162.00
Manual Pruning	1	hr	3	$22.50	$67.50
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	3	acre	3	$7.50	$22.50
Irrigation	1	acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	1	$50.00	$50.00
Interest on operating costs		$	$1,341.29	7.00%	$93.89
TOTAL OPERATING COSTS					**$1,485.18**
Harvesting & Marketing Costs					
Harvesting (manuel)		lbs	1499.69	0.65	$974.80
Custom Packing		lbs	1424.71	0.66	$940.31
Cooling, Handling & Brokerage (Fresh - 15%)		$	1424.71	15%	$32.06
TOTAL Harvesting & Marketing Costs					**$1,947.17**
Total Variable Costs					**$3,432.34**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$1,485.18	0.15	$222.78
IRRIGATION		Acre	1.00	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
TOTAL FIXED COSTS					**$944.30**
TOTAL PRODUCTION COSTS					**$4,376.64**
Less Return From Receipts		$	1499.69	$3.50	$5,248.93
NET RETURNS PER ACRE					**$872.29**

APPENDIX D
(continued)

Third Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Ground Cover Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	680	$0.44	$299.20
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Giberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	83	$7.50	$622.50
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$2,285.67	7.00%	$160.00
TOTAL OPERATING COSTS					**$2,445.66**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	2059.58	0.65	$1,338.73
Custom Packing		lbs	2059.58	0.66	$1,359.32
Cooling, Handling & Brokerage (Fresh - 15%)		$	7208.53	15%	$162.19
Total Harvesting & Marketing Costs					**$2,860.24**
TOTAL VARIABLE COSTS					**$5,305.91**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	2445.66	0.15	$366.85
IRRIGATION		Acre	1.00	134.04	$134.04
LAND (lease)		$	1.00	100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,088.37**
TOTAL PRODUCTION COSTS					**$6,394.27**
Less Return From Receipts		$	2059.58	3.50	$7,208.53
NET RETURNS PER ACRE					**$814.26**

APPENDIX D
(continued)

Fourth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Ground Cover Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	78	$7.50	$585.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$2,514.55	7.00%	$176.02
TOTAL OPERATING COSTS					**$2,690.57**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	6018.77	0.65	$3,912.20
Custom packing - Fresh		lbs	6018.77	0.66	$3,972.39
Cooling, Handling & Brokerage (Fresh -15%)		$	21065.70	15%	$3,159.86
TOTAL Harvesting & Marketing Costs					**$11,044.45**
Total Variable Costs					**$13,735.01**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$2,690.57	0.15	$403.58
IRRIGATION		Acre	1.00	134.04	$134.04
LAND (lease)		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,125.10**
TOTAL PRODUCTION COSTS					**$14,860.12**
Less Return From Receipts - Fresh			6019	$3.50	$21,065.70
Net Return from Receipts - Fresh					**$21,065.70**
NET RETURNS PER ACRE					**$6,205.59**

APPENDIX D
(continued)

Fifth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Ground Cover Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	75	$7.50	$562.50
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$2,542.05	7.00%	$177.94
TOTAL OPERATING COSTS					**$2,719.99**
Harvesting & Marketing Costs					
Custom Harvesting	lbs		6718.63	0.65	$4,367.11
Custom packing - Fresh	lbs		6718.63	0.66	$4,434.30
Cooling, Handling & Brokerage (Fresh -15%)	$		8801.40	15%	$1,320.21
TOTAL Harvesting & Marketing Costs					**$10,121.62**
Total Variable Costs					**$12,841.61**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$2,719.99	0.15	$408.00
IRRIGATION		Acre	1.00	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,129.52**
TOTAL PRODUCTION COSTS					**$13,971.12**
Less Return From Receipts - Fresh			6719	$3.50	$23,515.20
Net Return from Receipts - Fresh					**$23,515.20**
NET RETURNS PER ACRE					**$9,544.08**

APPENDIX D
(continued)

Sixth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Ground Cover Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	1	lb	907	$0.44	$399.08
Fertilizer - Spreading	4	acre	4	$8.33	$33.32
Weed Control					
Hand Weeding	4	hr	78	$7.50	$585.00
Pest and Disease Control					
Insecticide (Spinosad)	5	pt	5	$25.00	$125.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	hr	3	$27.00	$81.00
Tractor and Sprayer (labor)	3	acre	3	$30.00	$90.00
Manual Pruning	1	hr	3	$25.00	$75.00
Mowing	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$1,760.37	7.00%	$123.23
TOTAL OPERATING COSTS					**$1,883.59**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	6704.5	0.65	$4,357.93
Custom packing		lbs	6704.5	0.66	$4,424.97
Cooling, Handling & Brokerage			8782.90	15%	$197.62
TOTAL Harvesting & Marketing Costs					**$8,980.51**
Total Variable Costs					**$10,864.10**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	0.00	$0.00
Overhead & Management		$	1883.59	0.15	$282.54
IRRIGATION		Acre	1.00	134.04	$134.04
LAND		$	1.00	100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$516.58**
TOTAL PRODUCTION COSTS					**$11,380.69**
Less Return From Receipts - Fresh			6704.5	3.50	$23,465.75
Net Return from Receipts - Fresh					**$23,465.75**
NET RETURNS PER ACRE					**$12,085.06**

APPENDIX D
(continued)

Seventh Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Ground Cover Mulch Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.50	$30.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	64	$7.50	$480.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$7.50	$82.50
Mowing	9	hr	3	$7.50	$22.50
Hill side cultivation labor	9	hr	9	$7.50	$67.50
Irrigation		acre	1	$16.97	$16.97
Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$2,294.05	7.00%	$160.58
TOTAL OPERATING COSTS					**$2,454.63**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	9655	0.65	$6,275.75
Custom packing (Fresh handpick)		lbs	9655	0.66	$6,372.30
Cooling, Handling & Brokerage			12648.05	15.00%	$284.58
TOTAL Harvesting & Marketing Costs					**$12,932.63**
Total Variable Costs					**$15,387.26**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$2,454.63	0.15	$368.19
IRRIGATION		Acre	1.00	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,089.71**
TOTAL PRODUCTION COSTS					**$16,476.98**
Less Return From Receipts - Fresh			9655	$3.50	$33,792.50
Net Return from Receipts - Fresh					**$33,792.50**
NET RETURNS PER ACRE					**$17,315.52**

APPENDIX E
Non-mulched Enterprise Budgets

First Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Non-mulched Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
Land Preparation					
Elemental Sulfur	1	lb	0	$0.56	$0.00
Bone Meal	1	acre	200	$0.66	$132.00
Land clearing	1	acre	1	$800.00	$800.00
Fertilizer (8-5-5)	4	acre	227	$0.44	$99.88
Harrowing	3	acre	3	$40.00	$120.00
Sulfur Application / Incorp.	1	acre	1	$0.00	$0.00
Bedding	1	acre	1	$175.00	$175.00
Planting					
Plant 4 x 12	1	acre	907	$1.85	$1,677.95
Planting labor	1	hr	20	$7.50	$150.00
Transplanter rental	1	acre	1	$220.00	$220.00
Weed Control					
Hand Weeding (4 times/yr)	4	hr	24	$7.50	$180.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Application (Tractor and Sprayer)	3	hr	1	$27.00	$27.00
Labor	3	acre	1	$22.50	$22.50
Pruning (manual)	1	hr	3	$7.50	$22.50
Mowing	9	hr	9	$9.50	$85.50
Irrigation (1 acre-in per event)	1	acre	1	$16.97	$16.97
Fertilizer					
Nature Safe 8-5-5	4	lb	187	$0.44	$82.28
Labor - Fertilizer Application	4	hr	4	$7.50	$30.00
Interest on operating costs		$	$4,103.30	7.00%	$287.23
TOTAL OPERATING COSTS					**$4,502.81**
FIXED COSTS					
TRACT & EQUIP		Acre	$1.00	$487.48	$487.48
Overhead & Management		$	4502.81	0.15	$675.42
IRRIGATION		Acre	1	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,396.94**
TOTAL ESTABLISHMENT COSTS					**$5,899.75**

APPENDIX E
(continued)

Second Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Non-mulched Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	453	$0.44	$199.32
Fertilizer labor (Spreading 8-5-5)	4	acre	1.4	$7.50	$10.50
Gibberellic acid	2	Oz	40	$1.00	$40.00
Weed Control					
Hand weeding	3	hr	402	$7.50	$3,015.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	2	Oz	4	$62.50	$250.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Tractor and Sprayer (labor)	6	hr	6	$27.00	$162.00
Manual Pruning	1	hr	3	$22.50	$67.50
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	3	acre	3	$7.50	$22.50
Irrigation	1	acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	1	$50.00	$50.00
Interest on operating costs		$	$3,936.29	7.00%	$275.54
TOTAL OPERATING COSTS					**$4,261.83**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	679.86	0.65	$441.91
Custom Packing		lbs	645.87	0.66	$426.27
Cooling, Handling & Brokerage (Fresh - 15%)		$	645.87	15%	$14.53
TOTAL Harvesting & Marketing Costs					**$882.71**
Total Variable Costs					**$5,144.54**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$4,261.83	0.15	$639.27
IRRIGATION		Acre	1.00	134.04	$134.04
LAND		$	$1.00	$100.00	$100.00
TOTAL FIXED COSTS					**$1,360.79**
TOTAL ESTABLISHMENT COSTS					**$6,505.34**
Less Return From Receipts		$	680	$3.50	$2,379.51
NET RETURNS PER ACRE					**-$4,125.82**

APPENDIX E
(continued)

Third Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Non-mulched Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	4	lb	680	$0.44	$299.20
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Giberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	76	$7.50	$570.00
Pest and Disease Control					
Insecticide (Entrust:Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.50	$28.50
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$2,233.17	7.00%	$156.32
TOTAL OPERATING COSTS					**$2,389.49**
Harvesting & Marketing Costs					
Harvesting (Hand Picking) 1/		lbs	1319.73	0.65	$857.83
Custom Packing		lbs	1319.73	0.66	$871.02
Cooling, Handling & Brokerage (Fresh - 15%)		$	4620.00	15%	$103.95
Total Harvesting & Marketing Costs					**$1,832.80**
TOTAL VARIABLE COSTS					**$4,222.29**
FIXED COSTS					
TRACT & EQUIP		Acre	1	$487.48	$487.48
Overhead & Management		$	$2,389.49	$0.15	$358.42
IRRIGATION		Acre	1	$134.04	$134.04
LAND (lease)		$	$1.00	$100.00	$100.00
OTHER			0.00	$0.00	$0.00
TOTAL FIXED COSTS					**$1,079.94**
TOTAL ESTABLISHMENT COSTS					**$5,302.23**
Less Return From Receipts		$	1320	$3.50	$4,620.00
NET RETURNS PER ACRE					**-$682.23**

APPENDIX E
(continued)

Fourth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Non-mulched Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	6	hr	72	$7.50	$540.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	2	$50.00	$100.00
Interest on operating costs		$	$2,469.55	7.00%	$172.87
TOTAL OPERATING COSTS					**$2,642.42**
Harvesting & Marketing Costs					
Custom Harvesting	lbs		3959.19	0.65	$2,573.48
Custom packing - Fresh	lbs		3959.19	0.66	$2,613.07
Cooling, Handling & Brokerage (Fresh -15%)	$		13857.17	15%	$2,078.58
Total Harvesting & Marketing Costs					**$7,265.12**
TOTAL VARIABLE COSTS					**$9,907.53**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$2,642.42	0.15	$396.36
IRRIGATION		Acre	1.00	134.04	$134.04
LAND (lease)		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,117.88**
TOTAL PRODUCTION COSTS					**$11,025.42**
Less Return From Receipts - Fresh			3959	$3.50	$13,857.17
Net Return from Receipts - Fresh					**$13,857.17**
NET RETURNS PER ACRE					**$2,831.76**

APPENDIX E
(continued)

Fifth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Non-mulched Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.25	$29.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	4	hr	72	$7.50	$540.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$21.00	$231.00
Mowing	9	hr	3	$9.00	$27.00
Hill side cultivation labor	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination (One Hive)	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$2,519.55	7.00%	$176.37
TOTAL OPERATING COSTS					**$2,695.92**
Harvesting & Marketing Costs					
Custom Harvesting	lbs		4799.02	0.65	$3,119.36
Custom Packing	lbs		4799.02	0.66	$3,167.35
Cooling, Handling & Brokerage (Fresh -15%)	$		6286.72	15%	$943.01
Total Harvesting & Marketing Costs					**$7,229.73**
TOTAL VARIABLE COSTS					**$9,925.64**
FIXED COSTS					
TRACT & EQUIP		Acre	1	487.48	$487.48
Overhead & Management		$	$2,695.92	0.15	$404.39
IRRIGATION		Acre	1	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,125.91**
TOTAL PRODUCTION COSTS					**$11,051.55**
Less Return From Receipts - Fresh			4799	3.50	$16,796.57
Net Return from Receipts - Fresh					**$16,796.57**
NET RETURNS PER ACRE					**$5,745.03**

APPENDIX E
(continued)

Sixth Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Non-mulched Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Fertilizer - Nature Safe 8-5-5	1	lb	907	$0.44	$399.08
Fertilizer - Spreading	4	acre	4	$8.33	$33.32
Weed Control					
Hand Weeding	8	hr	72	$7.50	$540.00
Pest and Disease Control					
Insecticide (Spinosad)	5	pt	5	$25.00	$125.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	hr	3	$27.00	$81.00
Tractor and Sprayer (labor)	3	acre	3	$30.00	$90.00
Manual Pruning	1	hr	3	$25.00	$75.00
Mowing	9	hr	9	$9.00	$81.00
Irrigation		acre	1	$16.97	$16.97
Bees and Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$1,715.37	7.00%	$120.08
TOTAL OPERATING COSTS					**$1,835.44**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	4788.96	0.65	$3,112.82
Custom Packing		lbs	4788.96	0.66	$3,160.71
Cooling, Handling & Brokerage			6273.54	15%	$141.15
Total Harvesting & Marketing Costs					**$6,414.69**
TOTAL VARIABLE COSTS					**$8,250.14**
FIXED COSTS					
TRACT & EQUIP		Acre	1	0.00	$0.00
Overhead & Management		$	$1,835.44	0.15	$275.32
IRRIGATION		Acre	1	134.04	$134.04
LAND- Lease		$	$1.00	100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$509.36**
TOTAL PRODUCTION COSTS					**$8,759.50**
Less Return From Receipts - Fresh			4789	$3.50	$16,761.36
Net Return from Receipts - Fresh & Frozen					**$16,761.36**
NET RETURNS PER ACRE					**$8,001.86**

APPENDIX E
(continued)

Seventh Year Establishment and Maintenance Costs per acre for Georgia Organic Rabbiteye Blueberry under Non-mulched Production System, 2008.

ITEM	APPLI.	UNIT	QUANT.	PRICE	AMOUNT
OPERATING COSTS					
Fertilizers					
Elemental Sulfur	1	lb	300	$0.56	$168.00
Fertilizer - Nature Safe 8-5-5	4	lb	907	$0.44	$399.08
Fertilizer labor (Spreading 8-5-5)	4	acre	4	$7.50	$30.00
Gibberellic acid	2	Oz	80	$1.00	$80.00
Weed Control					
Hand Weeding	6	hr	72	$7.50	$540.00
Pest and Disease Control					
Insecticide (Spinosad)	4	Oz	8	$62.50	$500.00
Fungicide (Organic Gem fish oil)	4	Gal	4	$31.00	$124.00
Serenade (mummyberry)	3	Gal	3	$23.00	$69.00
Tractor and Sprayer (labor)	11	hr	11	$9.50	$104.50
Manual Pruning	1	acre	11	$7.50	$82.50
Mowing	9	hr	3	$7.50	$22.50
Hill side cultivation labor	9	hr	9	$7.50	$67.50
Irrigation		acre	1	$16.97	$16.97
Pollination	1	acre	3	$50.00	$150.00
Interest on operating costs		$	$2,354.05	7.00%	$164.78
TOTAL OPERATING COSTS					**$2,518.83**
Harvesting & Marketing Costs					
Custom Harvesting		lbs	5270	0.65	$3,425.50
Custom Packing		lbs	5270	0.66	$3,478.20
Cooling, Handling & Brokerage			6903.70	15%	$155.33
Total Harvesting & Marketing Costs					**$7,059.03**
TOTAL VARIABLE COSTS					**$9,577.86**
FIXED COSTS					
TRACT & EQUIP		Acre	1.00	487.48	$487.48
Overhead & Management		$	$2,518.83	0.15	$377.82
IRRIGATION		Acre	1.00	134.04	$134.04
LAND - Lease		$	$1.00	$100.00	$100.00
OTHER			0.00	0.00	$0.00
TOTAL FIXED COSTS					**$1,099.34**
TOTAL PRODUCTION COSTS					**$10,677.21**
Less Return From Receipts - Fresh			5270	$3.50	$18,445.00
Net Return from Receipts - Fresh					**$18,445.00**
NET RETURNS PER ACRE					**$7,767.79**

APPENDIX F
Drip Irrigation for Organic Rabbiteye Blueberry in Georgia, 2008.

BASED ON	**10**	ACRES
SPACING		**4 x 12'**
INTEREST ON INVESTMENT CAPITAL		7.00%
TAXES & INSURANCE		0.015
DEPTH OF WELL IN FEET		350

INVESTMENT AND ANNUAL FIXED COSTS

ITEM	**NEW COST**	**YRS.LIFE**	**DEPREC.**	**INTEREST**	**TAX & INS.**
PIPE & FITTINGS	$550	20	28	19	4
Drip tape	$400	7	57	14	3
WELL (4") (50 Gals/min)	$4,000	25	160	140	30
PUMP & MOTOR	$4,000	15	267	140	30
FILTER & AUTO	$1,000	10	100	35	8
Water meter	$1,500	10	150	53	11
INSTALLATION	$1,000	20	50	35	8
TOTAL INVESTMENT	**$12,450**		**811**	**436**	**93**
TOTAL ANNUAL FIXED COSTS					**$1,340.43**
ANNUAL FIXED COSTS PER ACRE					**$134.04**
OPERATING COSTS					
MOTOR SIZE (HP)			5		
REPAIRS			50		
ANNUAL PUMPING HOURS			200		
ELECTRICITY					
Demand (standby charge) per YEAR			60		
Rate $ per KWH			0.08		
ANNUAL ENERGY COST			120		
ANNUAL ENERGY COST PER ACRE					$11.97
OPERATING COST PER ACRE PER YEAR					**$16.97**
TOTAL ANNUAL COSTS PER ACRE					**$151.01**

APPENDIX G
Simetar Results

Simetar Results for Yield
Analysis of Stochastic Dominance with Respect to a Function (SDRF)

Efficient Set Based on SDRF at Lower RAC **0.000001**

	Name	Level of Preference
1	Pine straw	Most Preferred
2	Pine Bark	2nd Most Preferred
3	Fabric	3rd Most Preferred
4	Control	Least Preferred

Efficient Set Based on SDRF at Upper RAC **0.003**

	Name	Level of Preference
1	Pine straw	Most Preferred
2	Fabric	2nd Most Preferred
3	Pine Bark	3rd Most Preferred
4	Control	Least Preferred

*The efficient sets are not the same for both RAC values. This result suggests that the efficient set changes between the two RACs. Use SERF analysis to determine the RAC(s) where the efficient set changes.

Summary Statistics

	Name	Mean	Std Dev	Coef Var	Skewness	Minimum
1	Pine Bark	6,150.15	4,901.72	79.70	0.77	1,252.00
2	Pine straw	6,251.06	3,117.12	49.87	-0.75	1,940.98
3	Control	3,469.50	1,969.35	56.76	-0.83	680.00
4	Fabric	5,442.93	3,107.67	57.10	-0.21	1,500.00

Certainty Equivalents Under Alternative Utility Functions

Name	CE Under Exponential Utility		CE Under Power Utility	
	Lower	Upper	Lower	Upper
Pine Bark	6,140.15	1,836.30	6,144.92	1,543.47
Pine straw	6,247.01	2,510.78	6,247.75	2,247.05
Control	3,467.88	1,231.63	3,468.38	977.27
Fabric	5,438.91	2,040.22	5,440.01	1,803.31

Confidence Premiums Between Probability Distributions

	Dominant Series	Lower Bound Absolute Amount	Lower Bound Percent of Dominant Mean	Upper Bound Absolute Amount	Upper Bound Percent of Dominant Mean
1	Pine straw	The Most Dominant Distribution			
2	Pine Bark	106.87	1.71	674.48	10.79
3	Fabric	808.10	12.93	470.56	7.53
4	Control	2,779.13	44.46	1,279.15	20.46
2	Pine Bark	The Next Most Dominant Distribution			
3	Fabric	701.24	11.40	-203.92	-3.32
4	Control	2,672.26	43.45	604.67	9.83
3	Fabric	The Next Most Dominant Distribution			
4	Control	1,971.03	36.21	808.59	14.86

APPENDIX G
(continued)

Simetar Results for Revenues
Analysis of Stochastic Dominance with Respect to a Function (SDRF)

Efficient Set Based on SDRF at Lower RAC **0.000001**

	Name	Level of Preference
1	Pine Straw	Most Preferred
2	Pine Bark	2nd Most Preferred
3	Fabric	3rd Most Preferred
4	Control	Least Preferred

Efficient Set Based on SDRF at Upper RAC **0.003**

	Name	Level of Preference
1	Pine Straw	Most Preferred
2	Fabric	2nd Most Preferred
3	Pine Bark	3rd Most Preferred
4	Control	Least Preferred

*The efficient sets are not the same for both RAC values. This result suggests that the efficient set changes between the two RACs. Use SERF analysis to determine the RAC(s) where the efficient set changes.

Summary Statistics

	Name	Mean	Std Dev	Coef Var	Skewness	Minimum
1	Pine Bark	21,525.53	17,156.03	79.70	0.77	4,382.00
2	Pine Straw	21,721.08	11,175.55	51.45	-0.78	5,846.37
3	Control	12,143.27	6,892.89	56.76	-0.83	2,379.51
4	Fabric	19,049.44	10,876.87	57.10	-0.21	5,248.93

Certainty Equivalents Under Alternative Utility Functions

Name	CE Under Exponential Utility		CE Under Power Utility	
	Lower	Upper	Lower	Upper
Pine Bark	21,403.25	4,979.25	21,461.38	4,631.26
Pine Straw	21,668.94	6,443.62	21,679.89	6,098.99
Control	12,123.45	2,976.37	12,129.59	2,609.73
Fabric	19,000.12	5,845.25	19,013.62	5,519.66

Confidence Premiums Between Probability Distributions

	Dominant Series	Lower Bound Absolute Amount	Lower Bound Percent of Dominant Mean	Upper Bound Absolute Amount	Upper Bound Percent of Dominant Mean
1	Pine Straw	The Most Dominant Distribution			
2	Pine Bark	265.69	1.22	1,464.37	6.74
3	Fabric	2,668.83	12.29	598.37	2.75
4	Control	9,545.49	43.95	3,467.25	15.96
2	Pine Bark	The Next Most Dominant Distribution			
3	Fabric	2,403.13	11.16	-866.00	-4.02
4	Control	9,279.80	43.11	2,002.89	9.30
3	Fabric	The Next Most Dominant Distribution			
4	Control	6,876.67	36.10	2,868.88	15.06

APPENDIX G
(continued)

Simetar Results for Net Returns
Analysis of Stochastic Dominance with Respect to a Function (SDRF)

Efficient Set Based on SDRF at Lower RAC **0.000001**

	Name	Level of Preference
1	Pine Bark	Most Preferred
2	Fabric	2nd Most Preferred
3	Pine Straw	3rd Most Preferred
4	Control	Least Preferred

Efficient Set Based on SDRF at Upper RAC **0.003**

	Name	Level of Preference
1	Fabric	Most Preferred
2	Pine Straw	2nd Most Preferred
3	Pine Bark	3rd Most Preferred
4	Control	Least Preferred

*The efficient sets are not the same for both RAC values. This result suggests that the efficient set changes between the two RACs. Use SERF analysis to determine the RAC(s) where the efficient set changes.

Summary Statistics

	Name	Mean	Std Dev	Coef Var	Skewness	Minimum
1	Pine Bark	9,165.51	10,423.70	113.73	0.65	-760.80
2	Pine Straw	7,719.09	6,249.60	80.96	-0.47	-867.48
3	Fabric	7,806.13	6,500.53	83.27	0.29	814.26
4	Control	3,256.40	4,883.76	149.97	-0.64	-4,125.82

Certainty Equivalents Under Alternative Utility Functions

Name	CE Under Exponential Utility		CE Under Power Utility	
	Lower	Upper	Lower	Upper
Pine Bark	9,120.31	-285.62	9,176.92	19,836.36
Pine Straw	7,702.81	-270.56	7,892.19	-867.48
Fabric	7,788.53	1,208.22	7,800.44	1,026.82
Control	3,246.45	-3,528.58	3,268.77	7,270.88

Confidence Premiums Between Probability Distributions

	Dominant Series	Lower Bound Absolute Amount	Lower Bound Percent of Dominant Mean	Upper Bound Absolute Amount	Upper Bound Percent of Dominant Mean
1	Pine Bark	The Most Dominant Distribution			
2	Fabric	1,331.78	14.53	-1,493.84	-16.30
3	Pine Straw	1,417.50	15.47	-15.07	-0.16
4	Control	5,873.86	64.09	3,242.95	35.38
2	Fabric	The Next Most Dominant Distribution			
3	Pine Straw	85.73	1.10	1,478.77	18.94
4	Control	4,542.08	58.19	4,736.79	60.68
3	Pine Straw	The Next Most Dominant Distribution			
4	Control	4,456.35	57.73	3,258.02	42.21

APPENDIX H
Sensitivity Analyses

Sensitivity Analysis for Pine Straw Altering Price per Pound

Actual Average Yield per acre	6251	6251	6251	6251	6251	6251	6251
Price Scenario (% of Ave. Price factor)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Actual Price Received $3.5 ($/lb)	$2.80	$3.15	$3.33	$3.50	$3.68	$3.85	$4.20
Altered Revenue	$17,502.98	$19,690.85	$20,784.79	$21,878.72	$22,972.66	$24,066.59	$26,254.47
Actual Average Cost/Acre	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71
Altered Average Returns/Acre	$6,385.27	$8,573.14	$9,667.08	$10,761.01	$11,854.95	$12,948.89	$15,136.76

Sensitivity Analysis for Pine Straw Altering Yields

Actual Average Yield per acre	6251	6251	6251	6251	6251	6251	6251
Yield Scenerio (% of avg Yield)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Estimated Average Yield	5001	5626	5939	6251	5939	5626	5001
Altered Average Revenue	$17,502.98	$19,690.85	$20,784.79	$21,878.72	$20,784.79	$19,690.85	$17,502.98
Actual Average Cost/Acre	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71
Altered Average Returns/Acre	$6,385.27	$8,573.14	$9,667.08	$10,761.01	$9,667.08	$8,573.14	$6,385.27

Sensitivity Analysis for Pine Straw Altering Costs

Actual Average Yield	6251	6251	6251	6251	6251	6251	6251
Cost Scenario (% of Ave. Yield)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Actual Average Actual Cost	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71	$11,117.71
Actual Average Revenue	$21,721.08	$21,721.08	$21,721.08	$21,721.08	$21,721.08	$21,721.08	$21,721.08
Altered Average Estimated Cost	$8,894.17	$10,005.94	$10,561.82	$11,117.71	$11,673.59	$10,005.94	$8,894.17
Altered Average Returns/Acre	$12,826.91	$11,715.14	$11,159.26	$10,603.37	$10,047.49	$11,715.14	$12,826.91

APPENDIX H
(continued)

Sensitivity Analysis for Ground Cover Altering Price per Pound

Actual Average Yield per acre	5443	5443	5443	5443	5443	5443	5443
Price Scenario (% of Ave. Price factor)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Percentage Actual Price Received $3.5 ($/lb)	$2.80	$3.15	$3.33	$3.50	$3.68	$3.85	$4.20
Altered Revenue	$15,240.21	$17,145.24	$18,097.75	$19,050.27	$20,002.78	$20,955.29	$22,860.32
Actual Average Cost/Acre	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05
Altered Average Returns/Acre	$3,540.16	$5,445.19	$6,397.70	$7,350.22	$8,302.73	$9,255.24	$11,160.27

Sensitivity Analysis for Ground Cover Altering Yields

Actual Average Yield per acre	5443	5443	5443	5443	5443	5443	5443
Yield Scenerio (% of avg Yield)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Estimated Average Yield	4354	4899	5171	5443	5171	4899	4354
Altered Average Revenue	$15,240.21	$17,145.24	$18,097.75	$19,050.27	$18,097.75	$17,145.24	$15,240.21
Actual Average Cost/Acre	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05
Altered Average Returns/Acre	$3,540.16	$5,445.19	$6,397.70	$7,350.22	$6,397.70	$5,445.19	$3,540.16

Sensitivity Analysis for Ground Cover Altering Costs

Actual Average Yield	5443	5443	5443	5443	5443	5443	5443
Cost Scenario (% of Ave. Yield)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Actual Average Actual Cost	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05	$11,700.05
Actual Average Revenue	$19,049.44	$19,049.44	$19,049.44	$19,049.44	$19,049.44	$19,049.44	$19,049.44
Altered Average Estimated Cost	$9,360.04	$10,530.05	$11,115.05	$11,700.05	$12,285.05	$10,530.05	$9,360.04
Altered Average Returns/Acre	$9,689.40	$8,519.39	$7,934.39	$7,349.39	$6,764.38	$8,519.39	$9,689.40

APPENDIX H
(continued)

Sensitivity Analysis for Non-mulched (Control) Altering Price per Pound

Actual Average Yield per acre	3470	3470	3470	3470	3470	3470	3470
Price Scenario (% of Ave. Price factor)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Percentage Actual Price Received $3.5 ($/lb)	$2.80	$3.15	$3.33	$3.50	$3.68	$3.85	$4.20
Altered Revenue	$9,714.60	$10,928.93	$11,536.09	$12,143.25	$12,750.41	$13,357.58	$14,571.90
Actual Average Cost/Acre	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04
Altered Average Returns/Acre	$1,721.56	$2,935.88	$3,543.05	$4,150.21	$4,757.37	$5,364.53	$6,578.86

Sensitivity Analysis for Non-mulched (Control) Altering Yields

Actual Average Yield per acre	3470	3470	3470	3470	3470	3470	3470
Yield Scenerio (% of avg Yield)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Estimated Average Yield	2776	3123	3296	3470	3296	3123	2776
Altered Average Revenue	$9,714.60	$10,928.93	$11,536.09	$12,143.25	$11,536.09	$10,928.93	$9,714.60
Actual Average Cost/Acre	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04
Altered Average Returns/Acre	$1,721.56	$2,935.88	$3,543.05	$4,150.21	$3,543.05	$2,935.88	$1,721.56

Sensitivity Analysis for Non-mulched (Control) Altering Costs

Actual Average Yield	3470	3470	3470	3470	3470	3470	3470
Cost Scenario (% of Ave. Yield)	(-20%)	(-10%)	(-5%)	(Base year)	(5%)	(10%)	(20%)
Actual Average Actual Cost	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04	$7,993.04
Actual Average Revenue	$12,143.27	$12,143.27	$12,143.27	$12,143.27	$12,143.27	$12,143.27	$12,143.27
Altered Average Estimated Cost	$6,394.43	$7,193.74	$7,593.39	$7,993.04	$8,392.69	$7,193.74	$6,394.43
Altered Average Returns/Acre	$5,748.84	$4,949.53	$4,549.88	$4,150.23	$3,750.58	$4,949.53	$5,748.84