2017

Current Issues of Highbush Blueberry Producers with Pick-Your-Own Operations in the Northeastern United States

Brian T. Gould

Follow this and additional works at: <https://researchrepository.wvu.edu/etd>

Recommended Citation

Gould, Brian T., "Current Issues of Highbush Blueberry Producers with Pick-Your-Own Operations in the Northeastern United States" (2017). *Graduate Theses, Dissertations, and Problem Reports*. 5699.
<https://researchrepository.wvu.edu/etd/5699>

This Thesis is protected by copyright and/or related rights. It has been brought to you by the The Research Repository @ WVU with permission from the rights-holder(s). You are free to use this Thesis in any way that is permitted by the copyright and related rights legislation that applies to your use. For other uses you must obtain permission from the rights-holder(s) directly, unless additional rights are indicated by a Creative Commons license in the record and/ or on the work itself. This Thesis has been accepted for inclusion in WVU Graduate Theses, Dissertations, and Problem Reports collection by an authorized administrator of The Research Repository @ WVU. For more information, please contact researchrepository@mail.wvu.edu.

Current Issues of Highbush Blueberry Producers with Pick-Your-Own Operations
in the Northeastern United States

Brian T. Gould

Thesis submitted to the
Davis College of Agricultural, Natural Resources and Design
at West Virginia University
in partial fulfillment of the requirements
for the degree of

Master of Science
in
Agricultural and Extension Education

Deborah A. Boone, Ph.D., Chair
Harry N. Boone, Jr., Ph.D.
Jessica M. Blythe, Ph.D.

School of Design and Community Development

Morgantown, West Virginia
2017

Keywords: Blueberry Producers, Highbush Blueberries, Issues with Blueberry
Production

Copyright 2017 Brian T. Gould

ABSTRACT

Current Issues of Highbush Blueberry Producers with Pick-Your-Own Operations in the Northeastern United States

Brian T. Gould

The main purpose of this descriptive study was to identify current issues faced by Northeastern pick-your-own highbush blueberry producers. The study found that average northeastern pick-your-own highbush blueberry producers had been in business 25.99 years and maintained from 0.25 to 45 acres of blueberries. Targeted issues included insects, disease, weeds, wildlife management, and marketing. Top issues identified by highbush blueberry producers were: Japanese beetles, mummy berry, and birds, as well as blueberry maggot, witches broom, weed management, labor/labor costs, weather, government regulation, and spotted wing drosophila. It was found that a majority of the producers did not plan to expand their operations in the next 5 years and had not planted new cultivars since 1999. This study sought to identify contact frequency and form of information exchanged between pick-your-own producers and their local Extension Service. Participants reported they had contact with an extension agent/specialist once every six months and information was exchanged mostly in the form of newsletters and farm visits. Findings indicated that producers preferred to receive information in the form of e-mail and identified online websites as their best source of blueberry information.

DEDICATION

I would like to dedicate this research to the late Thomas W. McCutcheon, Ph.D., whose previous work inspired this study.

I would also like to dedicate this research to my first cousin, Allie N. Moore, who would have attended her first semester of college in the fall of 2015, but passed away at an early age on January 1, 2006.

ACKNOWLEDGMENTS

I would like to acknowledge my parents James B. Gould and Christie L. Gould, for being loving, supportive, and encouraging both emotionally and financially throughout my educational studies, no matter what challenges they were facing in their own lives. Even when I did not want to do it myself or thought I couldn't, they always pushed me to pursue a higher level of academic success and never faltered in their belief that I could.

I would like to acknowledge my academic advisor Dr. Deborah Boone for always supporting, encouraging, and pushing me to achieve my goals no matter what we faced in my undergraduate and graduate studies. Dr. Boone's guidance pushed me over the limits of what I believed I could achieve, and in doing so gave me new found confidence and taught me that as I go forward in life, I can achieve whatever I set my mind to with enough hard work and dedication.

Special thanks to my research committee members Dr. D. Boone, Dr. H. Boone, and Dr. J. Blythe. Without their knowledge, expertise, and professional guidance throughout my career and research at West Virginia University, none of this would have been possible.

My siblings Brittany, Brooklyn, and Ballard Gould were always by my side supporting and encouraging me regardless of what time of the night it was throughout my academic career. Setting an excellent example for them to aspire to academically, is an intricate part of what kept me focused on my studies. Special thanks to Brooklyn Gould in contributing to envelope stuffing for this research.

My grandparents Doye Gould, Clinton and Beverly Nichols, as well as Chuck and Joyce Drake have supported me financially and emotionally during academic career. They were always available for me to consult and garner guidance from their wisdom anytime I felt the need to talk with them.

I'd like to give a special thanks to my good friends Lawson, Dawn, Brie, and Taylor for supporting me emotionally and with my research efforts throughout the process.

Extended family such as my uncles, aunts, cousins, and family friends also deserve some special thanks for always supporting and encouraging me to achieve my life goals.

TABLE OF CONTENTS

Abstract	ii
Dedication	iii
Acknowledgments	iv
Table of Contents	v
List of Tables	vii
Chapter I: Introduction.....	1
Purpose.....	5
Objectives	5
Limitations	6
Chapter II: Review of Literature.....	7
Wildlife	7
Insects	8
Diseases.....	9
Marketing.....	10
Chapter III: Methodology	13
Purpose.....	13
Objectives	13
Research Design.....	14
Population	14
Instrumentation	14
Data Collection	16
Chapter IV: Findings.....	19
Purpose.....	19
Objectives	19

Analysis.....	20
Demographics	20
Insects	27
Diseases.....	30
Weeds.....	38
Management.....	39
Extension.....	42
Chapter V: Summary, Conclusions, and Recommendations	50
Purpose.....	50
Objectives	50
Summary	51
Conclusions.....	53
Recommendations.....	55
Recommendations for Further Research.....	57
References.....	58
Appendices.....	61
Appendix A: Initial Cover Letter.....	62
Appendix B: Questionnaire.....	64
Appendix C: Follow-up Cover Letter	77
Appendix D: Responses to Open Ended Questions.....	79
Appendix E: Lowbush Blueberry Data.....	126
Vita	133

LIST OF TABLES

Table	Title	Page
1	Reliability of Major Parts of Instrument.....	16
2	Comparison of Means Early-late Respondents for Pick-Your-Own Blueberry Survey	18
3	Respondents Involvement in Commercial Blueberry Production	20
4	Demographic Information of Northeastern Pick-Your-Own Blueberry Producers.....	22
5	Year Last Blueberry Planting Occurred.....	24
6	Producer Plans for Pick-Your-Own Blueberry Operation Expansion	25
7	Pick-Your-Own Producer Farm Classification.....	26
8	Type of Produce Market Where Blueberries Are Sold.....	27
9	Pick-Your-Own Operation Insect and Mite Severity.....	31
10	Pick-Your-Own Highbush Blueberry Disease Severity in Northeast.....	36
11	Pick-Your-Own Highbush Blueberry Operation Weed Severity in Northeast.....	40
12	Pick-Your-Own Highbush Blueberry Management Problems in Northeast.....	43
13	Frequency of Pick-Your-Own Highbush Blueberry Producer Contact with Extension Agent in Northeast.....	44
14	Last Year Information Received from Extension Service	45
15	Form Information was Last Received from Extension	46
16	Form Pick-Your-Own Highbush Blueberry Producers Like Receiving Information	47
17	Pick-Your-Own Producer Best Source of Blueberry Information.....	48
18	Lowbush Pick-Your-Own Operation Insect and Mite Severity.....	127
19	Lowbush Pick-Your-Own Operation Disease Severity	129
20	Lowbush Pick-Your-Own Operation Weed Severity	131

21	Lowbush Pick-Your-Own Operation Management Problems.....	132

CHAPTER I

Introduction

Production of highbush blueberry's in the United States has increased from 71 million to over 400 million pounds in the last forty years (US Highbush Blueberry Council, 2008). Growers increased highbush blueberry production acreage from 2003-2008 an estimated 51% from 63,360 to 95,607 acres (US Highbush Blueberry Council, 2008). A more health conscious America has increased blueberry consumption over 93% from 1998-2008 driving market demand upward at exponential rates (US Highbush Blueberry Council, 2008). We can expect this trend to continue as total blueberry production increased from 589.1 million pounds to 703.4 million pounds during a two-year period from 2013-2015 (Cook, Peacock, Malensky, & Granatstein, 2015). Although wholesale markets such as retail stores and large processors are options for producers to sell their produce, direct markets offer the producers the highest asking and receiving prices for their fresh blueberries. Pick-your-own (PYO) operations can remove the entire harvest cost for the producer, however consumer variability in choosing which berries they pick, can result in loss of crop due to it being left in the field (Demchak, 2017).

Wildlife damage presents a challenge to blueberry production, with bird species alone causing massive crop losses ranging from 6-20% of total crops (Gough, 1994). A study conducted in the United States found that a majority of the producers reported bird damage as serious to moderately serious, which has a major negative impact on blueberry production (Avery, Nelson, John, & Cone, 1991). Three of the bird species responsible for the most blueberry crop damage are starlings, robins, and grackles, with crows, cedar waxwings and 15 other species also contributing to crop losses (Gough, 1994). There are

various forms of bird management methods, which can be used to limit damages, including visual repellents, auditory repellents, and netting. The most effective of which is netting, however this can be a high cost strategy for permanent netting ranging from \$1000-\$3000 per acre (Gough, 1994). An effective chemical repellent called Mesurol, was briefly available and highly effective, however it was banned for use in fruit production due to major environmental concerns (Avery, 1991). Deer are also responsible for a large portion of the crop damage and loss of produce in the United States (Vercauteren, Lavelle, & Hygnstrom, 2006). On average New York orchards suffer a loss of up to \$15,000 of annual income due to wildlife damage caused mostly by deer and bird species (Vercauteren et al., 2006).

Insects such as Japanese beetles and cranberry fruitworms present challenges to highbush blueberry production. A 2006 Michigan study found that blueberry growers reported a median economic loss of \$72 per acre (Szendrei & Isaacs, 2006).

Japanese beetle adults start emerging in early July and feed and mate on the bushes until mid-September, which coincides with the period of highbush blueberry harvest. Many highbush blueberry growers manage grass (Poaceae) in row middles to suppress weeds and maintain soil quality. However, this provides ideal habitat for Japanese beetle development (Szendrei et al., 2005), since adult female Japanese beetles lay eggs in grass-covered moist soil (Fleming, 1972; Potter & Held, 2002; Régnière et al., 1981). Conditions in and around crop fields can favor or inhibit survival and reproduction of Japanese beetles depending on whether fundamental requirements for the pest population development

are met (Vittum et al., 1999). In many Michigan highbush blueberry fields and along the perimeter of those fields, a mix of different monocotyledonous and broadleaved weeds are commonly used to maintain soil structure, provide conditions where agricultural machinery can be driven during wet conditions, reduce soil erosion, and prevent pesticide and fertilizer runoff. These areas provide ideal conditions for Japanese beetle where both the egg-laying and larval developmental requirements are met. (Szendrei & Isaacs, 2006, p 83)

In a 2009 study Van Timmerman and Isaacs established the importance of cultivar selection for producers in the United States. Outdated cultivar types and early blooming cultivars of blueberry plants present major pest management issues for producers due to very high susceptibilities to insects such as the Japanese beetle and cranberry fruitworm (Van Timmerman & Isaacs, 2009).

Highbush blueberry production is subjected to various diseases that can account for up to 60% of total yield loss from one disease such as mummy berry, if left unchecked (Schilder, n.d.). Schilder (n.d.) reports 12 diseases that can affect and cause severe damage to blueberry crops pre-harvest and another 12 that can affect crops post-harvest. Some of these diseases can cause problems as simple as a blemish on the berries, however retail marketers expect blemish, mold, and insect free berries (Cook et al., 2015). The expectation of blemish free berries makes the relatively easy introduction and crop contamination of disease throughout the production process, a severe problem, even though the berry may be perfectly eatable after washing (Gough, 1994; Schilder, n.d.).

Importance in cultivar selection to combat blueberry disease like insects, was identified as being of high importance in a study by Ehlenfeldt, Polashock, and Stretch, (2010a). *Coville*, a long-term blueberry cultivar standard maintained and produced by many producers, was found to have one of the lowest resistances to mummy berry and fruit infection disease (Ehlenfeldt et al., 2010a). The continued wide spread use of a cultivar with such a high disease susceptibility, illustrates the importance of producer cultivar selection when conducting new plantings for their operations (Ehlenfeldt et al., 2010a).

Major advancements in biotechnology in the last 16 years, provides highbush blueberry growers access to cultivars that are less susceptible to many of the current issues while still producing high quality berries (Jez, Lee, & Sherp, 2016). With the completion of sequencing the first plant genome in 2000, new computational data, and continually developing spectro analysis technology, blueberry plant variation has never been greater (Jez, Lee, & Sherp, 2016). Traditional cross breeding practices in 1911 were responsible for the first hybrid cultivars which lead to increased weather hardiness and higher quality berries (Gough, 1994). Cross breeding can take many years to achieve the desired goal, but advancements in biotechnologies have led to being able to genetically modify a plants genome to specifically fit desired traits and characteristics needed in the highbush blueberry industry (Jez et al., 2016).

The blueberry market is expected to continue its upward trend in expansion, while yield losses due to disease, insects, and wildlife will continue to present challenges for growers. Biotechnology has presented growers with new cultivars or “types” of blueberry plants that can help reduce losses as a result of many of these issues. With innovations in

biotechnology being so new, farmers may not be aware that better options for new plantings or replacement of current bushes exist. The purpose of this study is to identify current issues faced by Northeastern pick-your-own blueberry growers, so research and educational programs can be developed to identify possible solutions to these issues via better suited cultivars or management practices and/or educational programs/literature that can assist growers.

Purpose

The purpose of this study is to identify current issues faced by pick-your-own blueberry producers in the Northeastern states. This study sought to determine operation related demographics, blueberry producers' preferred methods for obtaining information related to blueberries, and how much interaction and assistance they get from their Extension Service. In addition, the research study will determine current issues producers in the Northeast are experiencing in pick-your-own blueberry production.

Objectives

The objectives of the research study were:

1. Identify the demographics related to farm size, age, and size of blueberry operations including types of blueberries grown and plants per acre.
2. Identify current issues producers are experiencing with insects and mites.
3. Identify current issues producers are experiencing with blueberry diseases.
4. Identify current issues and management practices for wildlife and pest weeds.
5. Identify how often producers have contact with and receive information from their local Extension Service/Agent.

6. Identify what form producers prefer receiving information and what format they consider to be their best source of blueberry information.

Limitations

This study was limited to the Northeastern blueberry producers listed on the available PickYourOwn.org website. Producers not listed or declined to participate in the online web-site were excluded from this study. Only producers in the 12 states of West Virginia, Pennsylvania, Maryland, Delaware, New Jersey, Rhode Island, Massachusetts, Connecticut, New York, Vermont, New Hampshire, and Maine were included in this study, all other producers were excluded.

CHAPTER II

Review of Literature

The review of literature found a number of issues that impact blueberry production, including animals, insects, diseases and marketing. Previous research is important in identifying current issues that exist in blueberry production.

Wildlife

Birds were identified as being the greatest pest of all animals, contributing to up to 20 percent of total crop losses costing growers millions in net profits nationwide (Gough, 1994). Voles, rabbits and deer were also identified as contributing to the total loss by animal pests, however, at a much lower rate than birds (Gough, 1994). Gough (1994) noted that netting, audio, visual, and chemical management practices were used to deal with these types of issues.

Avery (1991) conducted a survey of the entire United States in which 84% of the respondents identified bird damage to their highbush blueberry crops as severe to moderately severe. European Starlings, American Robins, and the common Grackle were the three most common species causing damage to blueberry crops (Avery, 1991). The survey also found dissatisfaction with every type of bird management technique except netting (Avery, 1991). Although netting is effective, due to its high cost of implementation and maintenance, small farms who suffer disproportional bird damage and need it the most, do not use netting (Avery, 1991).

Deer were associated with more agricultural crop loss than any other species of wildlife (Vercauteren et al. 2006). Vercauteren et al. (2006) found that agriculture producers suffer on average \$500 or around 10% of total crop loss due to wildlife. In

1993, the top ten corn producing states lost an estimated 21 million dollars of profit to wildlife damage associated to mostly deer and bird wildlife species (Vercauteren et al. 2006). It is common for orchards in New York State to experience approximately \$15,000 in annual income loss due to wildlife damage (Vercauteren et al., 2006). The most common and widely used deer control techniques included, state issued depredation permits and wildlife exclusion fencing (Vercauteren et al., 2006). In many cases producers view fencing as being too cost prohibitive to be profitable and did not install fencing unless they were issued government financial assistance for building deer proof fencing (Vercauteren et al., 2006).

Insects

Szendrei and Isaacs (2006) studied current Japanese beetle management issues in highbush blueberry production and found that management practices used to promote soil quality and provide weed control, were in fact creating the perfect breeding habitat for the Japanese Beetle. This study also found that producers reported an average economic loss of \$72 per acre due to damage from the Japanese beetle (Szendrei & Isaacs, 2006). A slight majority (63%) of the respondents identified Japanese beetles to be extremely severe to severe and the most widely used current management practices were foliar insecticides and clean cultivation (Szendrei & Isaacs, 2006).

A study by Van Timmerman and Isaacs (2009) using ten different widely used cultivar varieties of highbush blueberries, to identify the susceptibility to Japanese beetles and cranberry fruitworm, found the *Duke* cultivar variety to have the highest cranberry fruitworm cluster infestation rate. Japanese beetle feeding preferences were identified to be the greatest on the *Brigitta* cultivar variety (Van Timmerman & Isaacs, 2009).

Researchers identified the most likely cause of the high infestation and feeding rates on these cultivars to be the fact that these are early fruiting cultivar types. Likewise, the later fruiting cultivars exhibited the lowest rates of cranberry fruitworm infestations and Japanese beetle foliage damage (Van Timmerman and Isaacs, 2009). The cultivars *Toro* and *Bluegold* are late fruiting cultivars and exhibited the lowest levels of Japanese Beetle foliage damage (Van Timmerman & Isaacs, 2009). *Legacy* and *Elliot* are late fruiting cultivars and performed the best on combined resilience for both Japanese beetle damage and cranberry fruitworm infestations (Van Timmerman & Isaacs, 2009).

Diseases

Schilder (n.d.) notes that mummy berry if left unchecked throughout the growing season can cause up to 60% of total yield loss, and low grade quality for the remaining 40%, bringing very low market prices for the growers. Mummy berry has a temperature range of 50-57 degrees Fahrenheit in which it thrives, which corresponds to the spring growth of early producing blueberry cultivars (Schilder, n.d.). Schilder (n.d.) also identified spring frosts and long blooming periods as factors that can severely increase the infection rate of mummy berry. Other common blueberry diseases which can affect blueberry crops both pre-harvest and post-harvest allowing for a high contamination potential if left unchecked include phomopsis twig blight, botryosphaeria stem blight, botrytis blight, phytophthora root rot, crown gall, powdery mildew, and armillaria root rot (Schilder, n.d.).

Ehlenfeldt, Polashock, and Stretch (2010a) identified and ranked cultivar varieties from least to most susceptible to mummy berry and fruit infection. The *Bluejay* cultivar variety was one of the highest-ranking cultivars resistant to both mummy berry

and fruit infection, and demonstrated resistance at the highest degree of reliability (Ehlenfeldt et al., 2010a). Other cultivars identified by this study to be among the most resistant included *Patriot*, *Weymouth*, *Gem*, *June*, *Bluegold*, and *Cabot* (Ehlenfeldt et al., 2010a).

Marketing

Over the last 40 years' blueberry production has increased fivefold, from 71 million pounds in 1968 to 407 million pounds in 2008 (US Highbush Blueberry Council, 2008). This report focused mainly on production in the United States for both import and export of blueberry crops, overall indicating that blueberry demand and supply will continue to increase due to a more health conscious educated American populous (US Highbush Blueberry Council, 2008). Domestic markets are underdeveloped on a local level, making it difficult for small producers to find markets to sell the entirety of their crop, bringing some small farmers a loss in possible income (US Highbush Blueberry Council, 2008). The US Highbush Blueberry Council (2008) estimated that by 2015, American blueberry production would rise from 400 million pounds per year to 900 million pounds per year. One of the largest market drivers of blueberry consumer purchases remains the "Health Halo" American consumers have adopted (US Highbush Blueberry Council, 2008).

Oregon State University presented a two-day course in blueberry production for growers and presented literature on marketing demands and management practices which identified current trends in highbush blueberry markets and management (Cook, 2015). A 20% increase in blueberry production was seen from 2013 to 2015 as predicted.

Blueberry retail markets are looking for blueberry producers with a product that has a

good berry size, good taste, and a long shelf life, with taste being the most important variable to consumers (Cook, 2015).

Increasing consumer demand for fresh blueberries, has caused the prices for fresh-market blueberries to remain relatively high ranging from 2-5 dollars per pint (Demchak, 2017). Fresh-market blueberries are normally sold in plastic pint containers in markets such as wholesale, auctions, marketing cooperatives, local retail markets, and processors. Direct market options for blueberry producers include farmers markets, roadside stands, and pick-your-own operations (Demchak, 2017). Demchak (2017) identified direct market options, as providing the producer with the ability to ask and receive higher than wholesale market prices for their produce. Direct market options do have drawbacks which include advertising expenses, facility construction, facility maintenance, and employee payroll (Demchak, 2017). Producers with pick-your-own operations save money by removing operation harvest costs, however producers must be willing to accept that not all fruit will be harvested (Demchak, 2017).

The review of literature found that birds and deer are the two-species responsible for the largest portion of blueberry crop loss due to wildlife damage. The three types of birds most responsible for crop destruction are European Starlings, American Robins, and the common Grackle. Japanese beetles have been found to be a very serious current insect issue for northeastern blueberry producers, with mummy berry being identified as one of the top current disease issues facing the industry. Japanese beetles were found to be such a major current issue due to weed control practices used by the blueberry producers, that create perfect breeding habitats for the beetles. Early blooming cultivars coinciding with spring weather conditions, were identified as being the primary causes of

the annual onset and severity of the mummy berry disease. Blueberry production and market consumption have shown exponential growth over the past 40 years and are expected to continue to grow, with growth being driven by the American “Health Halo.” Direct markets such as pick-your-own, U-pick and farm stands offer producers the highest selling prices for their blueberry produce, with consumers looking for a large berry size and good taste.

CHAPTER III

Methodology

Purpose

The purpose of this study is to identify current issues faced by pick-your-own blueberry producers in the Northeastern states. This study sought to determine operation related demographics, blueberry producers' preferred methods for obtaining information related to blueberries, and how much interaction and assistance they get from their Extension Service. In addition, the research study will determine current issues producers in the Northeast are experiencing in pick-your-own blueberry production.

Objectives

The objectives of the research study were:

1. Identify the demographics related to farm size, age, and size of blueberry operations including types of blueberries grown and plants per acre.
2. Identify current issues producers are experiencing with insects and mites.
3. Identify current issues producers are experiencing with blueberry diseases.
4. Identify current issues and management practices for wildlife and pest weeds.
5. Identify how often producers have contact with and receive information from their local Extension Service/Agent.
6. Identify what form producers prefer receiving information and what format they consider to be their best source of blueberry information.

Research Design

A descriptive survey was utilized to collect data from the target population. This allows the collection of a wide scope of information, quantitative in nature. Descriptive research asks questions about the nature, incidence, or distribution of variables. Rather than manipulating variables, it involves only describing them (Ary, Jacobs, & Razavieh, 2002). The design of this study was primarily quantitative and included several open-ended questions.

Population

After extensive efforts to locate a list of blueberry producers in the Northeastern United States and finding none available, the US Highbush Blueberry Council recommended we use the most available list found on-line at PickYourOwn.org, a pick-your-own berry farm website (<http://www.pickyourown.org/>). The site was utilized to identify pick-your-own blueberry producers in 12 Northeastern states (N = 616). States include West Virginia, Pennsylvania, Maryland, Delaware, New Jersey, Rhode Island, Massachusetts, Connecticut, New York, Vermont, New Hampshire, and Maine. If the producers on the PickYourOwn.org web-site indicated that they had blueberries, their contact information was gleaned from the site and became part of our population. Using Krejcie and Morgan (1920) it was determined that a research sample of 237 was needed. The computer software Statistical Package for the Social Sciences (SPSS) was used to pull a random sample of 237 blueberry producers from the compiled list of 616.

Instrumentation

A six-part survey instrument was developed to collect the quantitative data. Part one of the instrument utilized both open and close-ended questions that gathered

demographic data. Items included: number of years growing blueberries, farm size, number of plants, farm classification, and markets in which the produce is sold. Part two of the survey consisted of Likert type questions to gather data regarding insect and mite problems. Part three utilized Likert type questions to gather information on disease problems. Part four consisted of both Likert type and open-ended questions to gather data on common weed problems and management. Part five utilized both Likert type and open-ended questions to obtain data on wildlife and nutrient management problems. Part six used close-ended questions to obtain data on how often the producers have contact with their state Extension Service/Agents, what form they received information in, what form they most like receiving information in, and what they considered to be their best source of information. The level of influence for all Likert type questions were measured on a four-point scale that ranged from 1 = Never a problem, 2 = rarely a problem, 3 = occasional problem, and 4 = annual problem.

Content and face validity for this survey instrument were established by a panel of three Department of Agriculture and Extension Education faculty members, at the West Virginia University. Internal consistency of the instrument was determined using the Spearman-Brown Coefficient, Split-Half statistical formula. All four major parts were found to have Exemplary reliability (Robinson, Shaver, & Wrightsman, 1991) (see Table 1).

Table 1

Reliability of Major Parts of Instrument

Construct	Spearman-Brown Coefficient	Robinson Reliability
Insects and Mites	.799	Exemplary
Diseases	.758	Exemplary
Weeds	.767	Exemplary
Management	.626	Exemplary

Data Collection

Recommendations from Dillman's (2000) Tailored Design Method were used to design data collection methods. Packets were sent to each member of the target population via the United States Postal Service. Each packet contained a hand-signed cover letter explaining the purpose of the study (see Appendix A), a copy of the questionnaire (see Appendix B), and a prepaid return envelope. The packets were mailed to the pre-determined sample population (n= 237) on April 3, 2017. Two weeks after the first mailing, a second and final mailing (see Appendix C) was sent to non-respondents. A total response rate of 93 (39%) producer answered surveys was achieved. Given the source of our population 27 (11%) of the packets were returned marked as undelivered. Efforts were made to resend the undeliverable packets by searching for new addresses, however, many of the farm addresses marked as undeliverable, were later determined to have gone out of business.

Non-response bias issues were addressed by comparing early and late respondents (Miller & Smith, 1983). An independent t-test was conducted on the following variables using the statistical analysis software, SPSS; number of years growing blueberries, size of

farm in acres, and number of acres of high bush blueberries. A Cronbach's alpha level was set prior ($\alpha \leq .05$) to establish significance of the data.

The population for this study consisted of 68 early respondents and 25 late respondents. An independent t-test statistical procedure was used to determine if statistical differences existed between the means of the two groups. The null hypothesis $H_0 = M_{\text{early}} = M_{\text{late}}$, was tested. The alternative hypothesis was $H_1 = M_{\text{early}} \neq M_{\text{late}}$.

The mean number of years growing blueberries for early respondents was 25.03 with a standard deviation of 14.34. The mean number of years growing blueberries for late respondents was 29.22 with a standard deviation of 12.90. The independent t-test statistical analysis results ($t = -1.114$, $df = 77$) were not significant at ($\alpha \leq 0.05$). The researchers fail to reject the null hypothesis $H_0 = M_{\text{early}} = M_{\text{late}}$.

Early respondents exhibited a mean of 124.21 with a standard deviation of 137.40 for size of farm in acres. Late respondents had a mean of 201.47 with a standard deviation of 607.53. Independent t-test results for size of farm in acres ($t = -9.31$, $df = 78$) were not significant at ($\alpha \leq 0.05$). The researchers fail to reject the null hypothesis $H_0 = M_{\text{early}} = M_{\text{late}}$.

Early respondents had a mean of 8.46 with a standard deviation of 18.81 for acres of Highbush blueberries maintained. Late respondents had a mean of 7.5 with a standard deviation of 6.86. The independent t-test results for acres of Highbush blueberries maintained ($t = .203$, $df = 75$) were not significant at ($\alpha \leq 0.05$). The researchers fail to reject the null hypothesis $H_0 = M_{\text{early}} = M_{\text{late}}$.

No statistical differences were found to exist between the means of the early and late respondents for all three variables ($\alpha \leq 0.05$). Although early and late respondents

were found to be similar in their responses to the variables (see Table 2), the researchers will not generalize beyond the 93 total respondents because of the small overall response rate.

Table 2

Comparison of Means Early-late Respondents for Pick-Your-Own Blueberry Survey

Variables	Early-late	N	Mean	SD	df	t
Years Growing Blueberries	Early	61	25.03	14.34	77	-1.114
	Late	18	29.22	12.90		
Size of Farm in Acres	Early	61	124.21	137.40	78	-.931
	Late	19	201.47	607.53		
Acres of Highbush Blueberries	Early	61	8.46	18.81	75	.203
	Late	16	7.5	6.86		

Note. n = 79

Results of this study will focused on pick-your-own highbush blueberry producers in the Northeastern United States. Although data were collected for lowbush blueberries during this study, only three respondents (.03%) responded to any questions regarding lowbush blueberry production. Responses relative to low-bush producers was so low and we could not assure anonymity of the respondents, the decision was made to focus on highbush blueberry producers only for the purpose of this study.

CHAPTER IV

Findings

Purpose

The purpose of this study is to identify current issues faced by pick-your-own blueberry producers in the Northeastern states. This study sought to determine operation related demographics, blueberry producers' preferred methods for obtaining information related to blueberries, and how much interaction and assistance they get from their Extension Service. In addition, the research study will determine current issues producers in the Northeast are experiencing in pick-your-own blueberry production.

Objectives

The objectives for the research study were:

1. Identify the demographics related to farm size, age, and size of blueberry operations including types of blueberries grown and plants per acre.
2. Identify current issues producers are experiencing with insects and mites.
3. Identify current issues producers are experiencing with blueberry diseases.
4. Identify current issues and management practices for wildlife and pest weeds.
5. Identify how often producers have contact with and receive information from their local Extension Service/Agent.
6. Identify what form producers prefer receiving information and what format they consider to be their best source of blueberry information.

Analysis

The data were coded and analyzed using the statistical software SPSS. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to analyze the data. Although 93 blueberry producers responded to the survey in some written form, only 88 producers provided data correlating to at least one survey question, that could be statistically analyzed using SPSS. Seventy-nine (89.8%) of the producers stated that they are currently involved in a commercial blueberry operation. Nine (10.2%) of producers responded that they are not currently involved in a commercial blueberry operation (see Table 3).

Table 3

Respondents Involvement in Commercial Blueberry Production

Involvement	Yes		No	
	N	%	N	%
Involved in commercial operation	79	89.8	9	10.2

Note. n = 88

Demographics

When asked about how many years' respondents had been growing blueberries, Northeastern blueberry producer survey respondents reported growing blueberries from one to 67 years with a mean of 25.99 (SD=14.05) years growing blueberries on their farm. Respondent farm size in acres ranged 2.5 acres to 2700 acres with a mean of 142.56 (SD=315.48). The overall acres of blueberries maintained ranged from a quarter acre (.25) to 45 acres with a mean of 6.04 (SD=8.09). When asked what the current age of

their farm was, producers reported a mean of 76.20 (SD=62.80), with a minimum age of seven and a maximum age of 292 years old.

The survey separated highbush and lowbush blueberry cultivars, providing producers the opportunity to answer questions pertaining to both types separately. Total acres of highbush blueberries maintained had a mean of 8.26 (SD=17) with a minimum of 0 and a maximum of 100 acres. However, lowbush blueberries acres maintained exhibited a mean of .41 (SD=2.90) with a minimum of 0 and a maximum of 25. The total percent of highbush blueberries maintained per farm had a mean of 97.07 (68.70). Respondents had a minimum of 0 and a maximum of 100 percent highbush blueberries grown. Percentage of total lowbush blueberries maintained per farm had a minimum of 0 and a maximum of 100, with mean of 2.93 (SD=16.80). The number of plants per acre ranged from 0 to 1350 plants per acre. Respondents showed a mean of 715 (SD=319.57) total blueberry plants per acre on their farms (see Table 4).

Respondents were asked an open-ended type question about how they would classify their current job title on the farm. A majority of 64 respondents classified their role as owner/manager. President, partner, and assistant-manager were also listed as current job titles by the respondents (see Appendix D).

Table 4

Demographic Information of Northeastern Pick-Your-Own Blueberry Producers

Demographics	M	SD	Min	Max
Years growing blueberries	25.99	14.05	1.00	67.0
Size of farm in acres	142.56	315.48	2.50	2700.0
Acres of blueberries maintained	6.04	8.09	0.25	45.0
Acres of high bush blueberries	8.26	17.00	0.00	100.0
Acres of lowbush blueberry	0.41	2.90	0.00	25.0
Blueberry plants per acre	715.00	319.57	0.00	1350.0
Percent highbush blueberries	97.07	68.70	0.00	100.0
Percent low bush blueberries	2.93	16.23	0.00	100.0
Current age of farm	76.20	62.80	7.00	292.0

Note. n = 79

Given the low number of responses to lowbush blueberry questions, the results of this study will focused on pick-your-own highbush blueberry producers in the Northeastern United States. Although data were collected for lowbush blueberries during this study, only three respondents (.03%) responded to any questions regarding lowbush blueberry production. Responses relative to low-bush producers was so low and we could not assure anonymity of the respondents, the decision was made to focus on highbush blueberry producers only for the purpose of this study. Tables for the lowbush blueberry questions are included in Appendix E for full disclosure.

Respondents were asked in what year did they conduct their last blueberry planting. Seventeen (23.6%) respondents stated their last planting occurred between the years 1950-1999. Three (4.1%) producers said their last plantings occurred in the year

2000. While for the following years 2001, 2003, 2008, and 2017, one (1.4%) producer for each year reported their last planting occurred in the given year. Two (2.7%) producers each year last planted in 2006, 2007, and 2009 Producers showed an increase in plantings in 2010 with six (8.1%) respondents reported last plantings. The years 2011 and 2013 were reported by three (4.1%) participants as when their last plantings occurred. Ten (13.5%) respondents reported they had conducted new plantings in 2012. Four (5.4%) respondents reported their last plantings occurred in 2014, and in 2015, 14 (18.9%) producers indicated their last plantings were completed in 2016 (see Table 5).

Respondents were asked if they planned to expand their blueberry operation in the next five years. Fourteen (17.50%) stated they did intend on expanding their operation within the next five years. Forty-nine (61.25%) respondents stated they did not intend to expand their operation in the next five years. While 17 (21.25%) respondents indicated they may or may not expand their operation in the next five years (see Table 6).

Table 5

Year Last Blueberry Planting Occurred

Year	<i>f</i>	%
1950- 1999	17	23.6
2000	3	4.1
2001	1	1.4
2003	1	1.4
2006	2	2.7
2007	2	2.7
2008	1	1.4
2009	2	2.7
2010	6	8.1
2011	3	4.1
2012	10	13.5
2013	3	4.1
2014	4	5.4
2015	4	5.4
2016	14	18.9
2017	1	1.4

Note. n = 79

Table 6

Producer Plans for Pick-Your-Own Blueberry Operation Expansion

Plans	<i>f</i>	%
Yes	14	17.50
No	49	61.25
Maybe	17	21.25

Note. n = 79

Respondents were asked how they classify their farms. Ten (12.50%) producers classified their farm as an organic farm. Twenty-four (30%) respondents classified their farm as a natural farm. Forty-one (51.25%) respondents reported they classify their farm as local. Only two (2.50%) producers classified their farm as a certified organic farm. Eighteen (22.5%) respondents classified their farm as not certified (see Table 7). Fifteen (18.2%) producers did not identify with any of the available answers, and the majority of these respondents classified their farms as IPM and conventional type farms (see Appendix D).

Table 7

Pick-Your-Own Producer Farm Classification

Classification	Yes		No	
	<i>f</i>	%	<i>f</i>	%
Organic	10	12.50	70	87.50
Natural	24	30.00	56	70.00
Local	41	51.25	39	48.75
Certified Organic	2	2.50	78	97.50
Not Certified	18	22.50	62	77.50
Other	15	18.75	65	81.25

Note. n = 79

Farmers were also asked at what type of market they sell their produce. Seventy-six (95%) respondents stated they sold their produce in a U-Pick market. Nine (11.25%) producers reported selling produce through a CSA market. Farmer Markets was reported by 12 (15%) respondents as the location where they sold their produce. Seventeen (21.25%) respondents reported selling their produce to a Wholesale market. While, 33 (41.25%) respondents reported selling their produce at a Farm Stand (see Table 8). Only five (6.25%) respondents stated that they sell in other markets not listed on the survey such as restaurants (see Appendix D).

Table 8

Type of Produce Market Where Blueberries Are Sold

Market	Yes		No	
	<i>f</i>	%	<i>f</i>	%
You Pick	76	95.00	4	5.00
CSA	9	11.25	71	88.75
Farmers Market	12	15.00	68	85.00
Wholesale	17	21.25	63	78.75
Farm Stand	33	41.25	47	58.75
Other	5	6.25	75	93.75

Note. n = 79

Insects

Respondents were asked to rate the severity of insects and mites using a Likert scale, ranging from 1 = Never a Problem, 2 = Rarely a Problem, 3 = Occasional Problem, and 4 = Annual Problem. Blueberry blossom weevil was reported to never be a problem by 41 (68.33%) of the respondents. It was reported to rarely be a problem by 17 (28.33%) respondents. One (1.67%) of the respondents reported it to be an occasional problem. While one (1.67%) reported it to be an annual problem. Forty-one (68.33%) of the respondents reported blueberry bud mite to never be a problem. Seventeen (28.33%) respondents reported it to rarely be a problem. Two (3.33%) of the respondents reported it as being an occasional problem. No respondents reported it to be an annual problem. Blueberry gall midge had 37 (61.67%) responses to never being a problem, 17 (28.33%)

responses to rarely being a problem, five (8.33%) responses to being an occasional problem, and only one (1.67%) response to it being an annual problem (see Table 9).

Blueberry maggot was reported to never be a problem by ten (15.63%) of the respondents. It was reported to rarely be a problem by 25 (36.09%). Seventeen (26.56%) of the respondents reported it to be an occasional problem. While 12 (18.75%) reported it to be an annual problem. Thirty (48.39%) of the respondents reported blueberry stem borer to never be a problem. Twenty-one (33.87%) respondents reported blueberry stem borer to rarely be a problem, while 11 (17.74%) of the respondents reported it as being an occasional problem. No respondents reported blueberry stem borer to be an annual problem. Blueberry tip borer had 35 (58.33%) responses to never being a problem, 20 (33.33%) responses to rarely being a problem, five (8.33%) responses to being an occasional problem, and no responses to it being an annual problem (see Table 9).

Cherry fruitworm was reported to never be a problem by 37 (59.68%) of the respondents. It was reported to rarely be a problem by ten (16.13%). Nine (14.52%) of the respondents reported it to be an occasional problem. While six (9.68%) reported it to be an annual problem. Thirty-eight (63.33%) of the respondents reported cranberry fruitworm to never be a problem. Eight (13.33%) respondents reported it to rarely be a problem. Nine (15%) of the respondents reported it as being an occasional problem. Five (8.33%) respondents reported it as being an annual problem. Japanese beetle had five (7.46%) responses to never being a problem, 17 (25.37%) responses to rarely being a problem, 17 (25.37%) responses to being an occasional problem, and 28 (41.79%) responses to it being an annual problem (see Table 9).

Oblique banded leaf roller was reported to never be a problem by 36 (60%) of the respondents. It was reported to rarely be a problem by 17 (28.33%). Six (10%) of the respondents reported it to be an occasional problem. While one (1.67%) respondent reported it to be an annual problem. Thirty-eight (66.67%) of the respondents reported oriental beetle to never be a problem. Thirteen (22.81%) respondents reported it to rarely be a problem. Five (8.77%) of the respondents reported it as being an occasional problem. One (1.75%) respondents reported it as being an annual problem. Plum curculio had 35 (58.33%) responses to never being a problem, 16 (26.67%) responses to rarely being a problem, six (10%) responses to being an occasional problem, and three (5%) responses to it being an annual problem (see Table 9).

Red banded leafroller was reported to never be a problem by 41 (70.69%) of the respondents. It was reported to rarely be a problem by 12 (20.69%). Four (6.90%) of the respondents reported it to be an occasional problem. While one (1.72%) reported it to be an annual problem. Twenty-eight (45.96%) of the respondents reported scale insects to never be a problem. Twenty-two (36.07%) respondents reported it to rarely be a problem. Ten (16.39%) of the respondents reported it as being an occasional problem. One (1.64%) respondent reported it as being an annual problem. Sharp-nosed leafhopper had 41 (70.69%) responses to never being a problem, ten (17.24%) responses to rarely being a problem, four (6.90%) responses to being an occasional problem, and three (5.17%) responses to it being an annual problem (see Table 9).

Thrips were reported to never be a problem by 39 (68.42%) of the respondents. It was reported to rarely be a problem by 14 (24.56%). Four (7.02%) of the respondents reported it to be an occasional problem. While no respondents reported it to be an annual

problem. Thirty-eight (66.67%) of the respondents reported white grubs to never be a problem. Fifteen (26.32%) respondents reported it to rarely be a problem. Four (7.02%) of the respondents reported it as being an occasional problem. No respondents reported it as being an annual problem. The Other response signifying an insect or mite other than what was listed, had one (3.85%) response to never being a problem, two (7.69%) responses to rarely being a problem, seven (26.92%) responses to being an occasional problem, and 16 (61.54%) responses to it being an annual problem (see Table 9). A majority of 18 respondents listed Spotted wing drosophila as the response to the Other category, with Winter moth and Gypsy moth also being identified (see Appendix D).

Diseases

Respondents were asked to rate the severity of diseases using a Likert scale, ranging from 1 = Never a Problem, 2 = Rarely a Problem, 3 = Occasional Problem, and 4 = Annual Problem. Anthracnose had 22 (37.29%) responses to never being a problem, 11 (18.64%) responses to rarely being a problem, 15 (25.42%) responses to being an occasional problem, and 11 (18.64%) responses to it being an annual problem. Forty-one (78.85%) of the respondents reported armillaria root rot to never be a problem. Ten (19.23%) respondents reported it rarely to be a problem. One (1.92%) of the respondents reported it as being an occasional problem. No respondents reported it as being an annual problem. Blueberry scorch virus was reported to never be a problem by 38 (71.70%) of the respondents. It was reported rarely to be a problem by nine (16.98%). Five (9.43%) of the respondents reported it to be an occasional problem. One (1.89%) respondent reported it to be an annual problem (see Table 10).

Table 9

Pick-Your-Own Operation Insect and Mite Severity

Insects and Mites	Never a Problem		Rarely a Problem		Occasional Problem		Annual Problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Blueberry blossom weevil	41	68.33	17	28.33	1	1.67	1	1.67
Blueberry bud mite	41	68.33	17	28.33	2	3.33	0	0.00
Blueberry gall midge	37	61.67	17	28.33	5	8.33	1	1.67
Blueberry maggot	10	15.63	25	39.06	17	26.56	12	18.75
Blueberry stem borer	30	48.39	21	33.87	11	17.74	0	0.00
Blueberry tip borer	35	58.33	20	33.33	5	8.33	0	0.00
Cherry fruitworm	37	59.68	10	16.13	9	14.52	6	9.68
Cranberry fruitworm	38	63.33	8	13.33	9	15.00	5	8.33
Japanese beetle	5	7.46	17	25.37	17	25.37	28	41.79
Oblique banded leafroller	36	60.00	17	28.33	6	10.00	1	1.67
Oriental beetle	38	66.67	13	22.81	5	8.77	1	1.75
Plum Curculio	35	58.33	16	26.67	6	10.00	3	5.00

Table 9 (continued)

Pick-Your-Own Operation Insect and Mite Severity

Insects and Mites	Never a Problem		Rarely a Problem		Occasional Problem		Annual Problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Red banded leafroller	41	70.69	12	20.69	4	6.90	1	1.72
Scale insects	28	45.90	22	36.07	10	16.39	1	1.64
Sharp-nosed leafhopper	41	70.69	10	17.24	4	6.90	3	5.17
Thrips	39	68.42	14	24.56	4	7.02	0.00	0.00
White grubs	38	66.67	15	26.32	4	7.02	0.00	0.00
Other	1	3.85	2	7.69	7	26.92	16	61.54

Note. n = 79

Blueberry shoestring disease had two (79.25%) responses to never being a problem, nine (16.98%) responses to rarely being a problem, two (3.77%) responses to being an occasional problem, and no responses to it being an annual problem. Thirty-eight (70.37%) of the respondents reported blueberry stunt to never be a problem. Eleven (20.37%) respondents reported it to rarely be a problem. Four (7.41%) of the respondents reported it as being an occasional problem. One (1.89%) respondent reported it as being an annual problem. Botryosphaeria stem blight was reported to never be a problem by 33 (63.46%) of the respondents. It was reported to rarely be a problem by 16 (30.77%). Three (5.77%) of the respondents reported it to be an occasional problem. While no respondents reported it to be an annual problem (see Table 10).

Botryosphaeria stem canker had 35 (68.63%) reports of never being a problem, 12 (23.53%) responses to rarely being a problem, four (7.84%) responses to being an occasional problem, and no responses to it being an annual problem. Twenty-six (44.07%) of the respondents reported botrytis blight to never be a problem. Nineteen (32.20%) respondents reported it to rarely be a problem. Eleven (18.64%) of the respondents reported it as being an occasional problem. Three (5.08%) respondents reported it as being an annual problem. Coryneum canker was reported to never be a problem by 41 (77.36%) of the respondents. It was reported to rarely be a problem by 11 (20.75%). One (1.89%) of the respondents reported it to be an occasional problem. While no respondents reported it to be an annual problem (see Table 10)

Crown gall had 38 (74.51%) reports of never being a problem, nine (17.65%) responses to rarely being a problem, four (7.84%) responses to being an occasional problem, and no responses to it being an annual problem. Thirty-three (62.26%) of the

respondents reported frusicoccum canker to never be a problem. Fourteen (26.42%) respondents reported it to rarely be a problem. Four (7.55%) of the respondents reported it as being an occasional problem. Two (3.77%) respondent reported it as being an annual problem. Mosaic was reported to never be a problem by 34 (65.38%) of the respondents. It was reported to rarely be a problem by 17 (32.69%). One (1.92%) of the respondents reported it to be an occasional problem. While no respondents reported it to be an annual problem (see Table 10).

Mummy berry had 15 (23.44%) reports of never being a problem, 18 (28.13%) responses to rarely being a problem, 13 (20.31%) responses to being an occasional problem, and 18 (28.13%) responses to it being an annual problem. Nineteen (33.93%) of the respondents reported phomopsis twig blight canker to never be a problem. Eleven (19.64%) respondents reported it to rarely be a problem. Fifteen (26.79%) of the respondents reported it as being an occasional problem. Eleven (19.64%) respondents reported it as being an annual problem. Phytophthora root rot was reported to never be a problem by 33 (62.26%) of the respondents. It was reported to rarely be a problem by 15 (28.30%). Four (7.55%) of the respondents reported it to be an occasional problem. While one (1.89%) respondent reported it to be an annual problem (see Table 10).

Powdery mildew had 17 (32.08%) reports of never being a problem, 21 (39.62%) responses to rarely being a problem, 13 (24.53%) responses to being an occasional problem, and two (3.77%) responses to it being an annual problem. Thirty-four (64.15%) of the respondents reported red ringspot to never be a problem. Sixteen (30.19%) respondents reported it to rarely be a problem. Two (3.77%) of the respondents reported it as being an occasional problem. One (1.89%) respondent reported it as being an annual

problem. Witches' broom was reported to never be a problem by 29 (50.88%) of the respondents. It was reported to rarely be a problem by 11 (19.30%). Three (5.26%) of the respondents reported it to be an occasional problem. While 14 (24.56%) respondents reported it to be an annual problem (see Table 10).

Table 10

Pick-Your-Own Highbush Blueberry Disease Severity in Northeast

Diseases	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Anthrachnose	22	37.29	11	18.64	15	25.42	11	18.64
Armillaria root rot	41	78.85	10	19.23	1	1.92	0	0.00
Blueberry scorch virus	38	71.70	9	16.98	5	9.43	1	1.89
Blueberry shoestring disease	42	79.25	9	16.98	2	3.77	0	0.00
Blueberry stunt	38	70.37	11	20.37	4	7.41	1	1.85
Botryosphaeria stem blight	33	63.46	16	30.77	3	5.77	0	0.00
Botryosphaeria stem canker	35	68.63	12	23.53	4	7.84	0	0.00
Botrytis blight	26	44.07	19	32.20	11	18.64	3	5.08
Coryneum canker	41	77.36	11	20.75	1	1.89	0	0.00
Crown gall	38	74.51	9	17.65	4	7.84	0	0.00
Frusicoccum canker	33	62.26	14	26.42	4	7.55	2	3.77
Mosaic	34	65.38	17	32.69	1	1.92	0	0.00

Table 10 (continued)

Pick-Your-Own Highbush Blueberry Disease Severity in Northeast

Diseases	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Mummy berry	15	23.44	18	28.13	13	20.31	18	28.13
Phomopsis twig blight	19	33.93	11	19.64	15	26.79	11	19.64
Phytophthora root rot	33	62.26	15	28.30	4	7.55	1	1.89
Powdery mildew	17	32.08	21	39.62	13	24.53	2	3.77
Red ringspot	34	64.15	16	30.19	2	3.77	1	1.89
Witches' broom	29	50.88	11	19.30	3	5.26	14	24.56

Note. n = 79

Weeds

Respondents were asked to rate the severity of various weeds using a Likert scale, ranging from 1 = Never a Problem, 2 = Rarely a Problem, 3 = Occasional Problem, and 4 = Annual Problem. Annual broadleaf weeds were reported to never be a problem by two (3.03%) of the respondents. It was reported to rarely be a problem by ten (15.15%). Nineteen (28.79%) of the respondents reported it to be an occasional problem. While 35 (53.03%) reported it to be an annual problem. Two (2.94%) of the respondents reported Annual grasses to never be a problem. Six (8.82%) respondents reported it to rarely be a problem. Seventeen (25%) of the respondents reported it as being an occasional problem. Forty-three (63.24%) respondents reported it to be an annual problem. Perennial broadleaf grasses had three (4.23%) responses to never being a problem, nine (12.68%) responses to rarely being a problem, 13 (18.31%) responses to being an occasional problem, and 46 (64.79%) responses to it being an annual problem. Two (2.74%) of the respondents reported Perennial grasses to never be a problem. Seven (9.59%) respondents reported it to rarely be a problem. Fourteen (19.18%) of the respondents reported it as being an occasional problem. Fifty (68.49%) respondents reported it to be an annual problem. No respondents reported the Other category as never being a problem. Rarely a problem was not reported by any respondents. Other was marked as occasionally being a problem by two (40%) respondents. Three (60%) respondents said Other was an annual problem (see Table 11). Bitter sweet and Virginia creeper were listed by respondents as problem weeds in the Other category (see Appendix D).

Respondents were asked an open-ended type question regarding what type of weed control pick-your-own producers use on their farms. Thirty-two respondents

identified herbicides as a source of weed control. Mulch was identified by 24 respondents as a source of weed control. Hand weeding was identified by 22 respondents, and mowing was identified by 20 respondents, as types of weed control. A small portion of respondents also identified Round-up as a direct form of weed control (see Appendix D).

Management

Respondents were asked to rate the severity of wildlife and nutrient management issues using a Likert scale, ranging from 1 = Never a Problem, 2 = Rarely a Problem, 3 = Occasional Problem, and 4 = Annual Problem. Birds were reported to never be a problem by two (2.56%) of the respondents. Birds were reported to rarely be a problem by 14 (17.95%) producers, while 18 (23.08%) of the respondents reported it to be an occasional problem. However, 44 (56.41%) reported it to be an annual problem. Twenty-four (32.88%) of the respondents reported deer to never be a problem. Twenty-two (30.14%) respondents reported it rarely to be a problem. Eighteen (24.66%) of the respondents reported it as being an occasional problem. Nine (12.33%) respondents reported it to be an annual problem. Frost had seven (9.59%) responses to never being a problem, 31 (42.47%) reported to rarely being a problem, 31 (42.47%) indicated it as an occasional problem, and four (5.48%) reported it as an annual problem. Twenty (27.40%) of the respondents reported plant fertility to never be a problem, 27 (36.99%) reported it to rarely be a problem, 17 (23.29%) of the respondents reported it as being an occasional problem, while nine (12.33%) respondents reported it to be an annual problem (see Table 12).

Table 11

Pick-Your-Own Highbush Blueberry Operation Weed Severity in Northeast

Weeds	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Annual broadleaf weeds	2	3.03	10	15.15	19	28.79	35	53.03
Annual grasses	2	2.94	6	8.82	17	25.00	43	63.24
Perennial broadleaf grasses	3	4.23	9	12.68	13	18.31	46	64.79
Perennial grasses	2	2.74	7	9.59	14	19.18	50	68.49
Other	0	0.00	0	0.00	2	40.00	3	60.00

Note. n = 79

Pollination was reported to never be a problem by 34 (46.58%) of the respondents. Pollination was reported to rarely be a problem by 32 (43.84%), five (6.85%) reported it to be an occasional problem, while two (2.74%) reported it to be an annual problem. Twenty-one (28.38%) of the respondents reported soil pH to never be a problem. 29 (39.19%) reported it to rarely be a problem. Eighteen (24.32%) of the respondents reported it as being an occasional problem, while six (8.11%) reported it to be an annual problem. Voles had 22 (31.43%) reports of never being a problem from respondents, 28 (40%) reports of rarely being a problem, 12 (17.14%) respondents reported voles as being an occasional problem, and eight (11.43%) reported voles as being an annual problem. Thirty-six (50%) of the respondents reported woodchucks to never be a problem, and 25 (34.72%) respondents reported them to rarely be a problem. Five (6.94%) of the respondents reported woodchucks as being an occasional problem six (8.33%) reported them to be an annual problem. One (8.33%) respondent selected other to be rarely a problem. Four (33.33%) respondents selected other as being an occasional problem. Seven (58.33%) respondents selected other as being an annual problem, while respondents selected Other to never be a problem (see Table 12). Three respondents listed bears and two listed rabbits as being responses to the Other category, with spotted wing drosophila, turkeys, and squirrels also being listed (see Appendix D).

Respondents were asked open-ended questions regarding what type of bird, deer, and rodent controls they use for their operation. Netting was identified by 29 respondents as being a source of bird control. Followed by 17 respondents identifying bird guard noise systems as a source of bird control. Respondents also utilized reflective ribbons, and balloons as bird control techniques (see Appendix D). A majority of 15 respondents

identified 8'ft. deer fencing as being a source of deer control. Electric fencing and hunting were also identified as sources of deer control (see Appendix D). Poison bait was identified by a majority of nine respondents as a source of rodent control. Trapping and general weed control were also identified as being utilized as forms of rodent control by respondents (see Appendix D).

Extension

Respondents were asked how often they have contact with their extension agent/specialist. Seventeen (22.37%) respondents stated they never receive information from their extension agent. Eight (10.53%) respondents stated they have contact with their extension agent once a week. Eighteen (23.68%) stated they have contact at least once a month. Thirty-three (43.42%) stated that they only have contact with their extension agent once every six months (see Table 13).

Table 12

Pick-Your-Own Highbush Blueberry Management Problems in Northeast

Wildlife and Nutrients	Never a Problem		Rarely a Problem		Occasional Problem		Annual Problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Birds	2	2.56	14	17.95	18	23.08	44	56.41
Deer	24	32.88	22	30.14	18	24.66	9	12.33
Frost	7	9.59	31	42.47	31	42.47	4	5.48
Plant fertility	20	27.40	27	36.99	17	23.29	9	12.33
Pollination	34	46.58	32	43.84	5	6.85	2	2.74
Soil pH	21	28.38	29	39.19	18	24.32	6	8.11
Voles	22	31.43	28	40.00	12	17.14	8	11.43
Woodchucks	36	50.00	25	34.72	5	6.94	6	8.33
Other	0.00	0.00	1	8.33	4	33.33	7	58.33

Note. n = 79

Table 13

*Frequency of Pick-Your-Own Highbush Blueberry Producer Contact with Extension**Agent in Northeast*

Contact Frequency	<i>f</i>	%
Never	17	22.37
Once a week	8	10.53
Once a month	18	23.68
Once every six months	33	43.42

Note. n = 79

Respondents were asked what year they last received information, services, etc. from the extension service. One (1.41%) respondent said the last year they received information was 2009 and another received information in 2014. Two (2.82) respondents stated they last received information in 2013. Three respondents indicated 2015 as the last year they received information. Thirty-eight (53.52%) respondents identified 2016 as the last year they received information. At the time this survey was conducted in April 2017, 26 (36.62%) respondents had identified 2017 as the last year they had received information (see Table 14).

Table 14

Last Year Information Received from Extension Service

Year	<i>f</i>	%
2009	1	1.41
2013	2	2.82
2014	1	1.41
2015	3	4.23
2016	38	53.52
2017	26	36.62

Note. n = 79

Respondents were asked to identify in what form was the last information they received from their extension agent/specialist. Forty-four (55.70%) respondents identified newsletters as the last form of information they received. Five (6.33%) respondents reported receiving their last information in a newspaper article format. Eighteen (22.78%) respondents said they had received information in the form of a fact sheet last. Phone calls were identified by 20 (25.32%) respondents as the form in which they last received information. Thirty-five (44.30%) respondents said they last received information in the form of a farm visit. Thirty-one (39.24%) respondents identified receiving their last information in the form of a workshop. Four (5.06%) respondents identified receiving their last information in the form of an online course. Websites were identified by 11 (13.92%) respondents as the form in which they last received information. Forty (50.63%) respondents identified email as the last form in which they received information. Six (7.59%) selected other as the last form by which they had received information from extension (see Table 15). Respondents identified mail, plant testings'

and extension office visits as being other forms in which they last received information (see Appendix D).

Table 15

Form Information was Last Received from Extension

Information Forms	Yes		No	
	<i>f</i>	%	<i>f</i>	%
Newsletter	44	55.70	35	44.30
Newspaper article	5	6.33	74	93.67
Fact sheet	18	22.78	61	77.22
Phone call	20	25.32	59	74.68
Farm visit	35	44.30	44	55.70
Workshop	31	39.24	48	60.76
Online course	4	5.06	75	94.94
Website	11	13.92	68	86.08
Email	40	50.63	39	49.37
Other	6	7.59	73	92.41

Note. n = 79

Respondents were asked to identify in what form they most like receiving information. Forty-four (55.70%) respondents selected newsletter to be their favorite format for receiving information. Seven (8.86%) respondents identified newspaper articles as their favorite form, while, factsheets were identified by 26 (32.91%) respondents as their favorite form of information. Eighteen (22.78%) respondents identified phone calls as being their favorite form of receiving information. Forty (50.63%) of respondents identified farm visits as being their favorite form of receiving

information. Online courses were identified by five (6.33%) respondents as being their most liked form of receiving information. Twenty-four (30.38 %) respondents identified websites as being their most liked form of receiving information. Emails were identified by 51 (64.56%) respondents as their most like form of receiving information. Three (3.80%) respondents identified the category of other, as being their favorite form to receive information (see Table 16). Office visits and twilight meetings were identified as other forms respondents liked receiving information (see Appendix D).

Table 16

Form Pick-Your-Own Highbush Blueberry Producers Like Receiving Information

Information Forms	Yes		No	
	<i>f</i>	%	<i>f</i>	%
Newsletter	44	55.70	35	44.30
Newspaper article	7	8.86	72	91.14
Fact sheet	26	32.91	53	67.09
Phone call	18	22.78	61	77.22
Farm visit	40	50.63	39	49.37
Workshop	29	36.71	50	63.29
Online course	5	6.33	74	93.67
Website	24	30.38	55	69.62
Email	51	64.56	28	35.44
Other	3	3.80	76	96.20

Note. n = 79

Respondents were asked to identify their best source of information on blueberries. Newspapers garnered one (1.27%) response as being their best source of

information. Fourteen (17.72%) respondents identified magazines as being their best source of information for blueberries, while 36 (45.57%) respondents identified websites as their best source of information on blueberries. Email was identified by seventeen (21.52%) respondents to be their best source of information on blueberries. Seventeen (21.52%) respondents selected trade journals as being their best source of information on blueberries. Other producers were identified by 23 (29.11%) respondents as being their best source of blueberry information30 (37.97%) respondents reported research publications as being their best source of information pertaining to blueberries. Other sources of information were selected by 17 (21.52%) respondents as being their best source of blueberry information (see Table 17). Sources noted under other included the Extension Service, Cornell University, and personal consultants (see Appendix D).

Table 17

Pick-Your-Own Producer Best Source of Blueberry Information

Information Sources	Yes		No	
	<i>f</i>	%	<i>f</i>	%
Newspaper	1	1.27	78	98.73
Magazine	14	17.72	65	82.28
Website	36	45.57	43	54.43
Email	17	21.52	62	78.48
Trade Journal	17	21.52	62	78.48
Other Producers	23	29.11	56	70.89
Research Publications	30	37.97	49	62.03
Other	17	21.52	62	78.48

Note. n = 79

Respondents were asked in an open-ended question type format, what are the top five problems their farm is currently facing. The top five current problems respondents reported in ranked order from most identified problem to least are: weed control (N = 29), labor/labor costs (N = 25), weather (N = 17), birds (N = 15), and government regulations (N = 13). Respondents also identified several other current issues they are facing through open-ended questions. These issues included spotted winged drosophila, operational cost/profit, marketing, age of owner, Japanese beetle, witches broom, mummy berry, and plant pollination/fertilization (see Appendix D).

CHAPTER V

Summary, Conclusions, and Recommendations

Purpose

The purpose of this study is to identify current issues faced by pick-your-own blueberry producers in the Northeastern states. This study sought to determine operation related demographics, blueberry producers' preferred methods for obtaining information related to blueberries, and how much interaction and assistance they get from their Extension Service. In addition, the research study will determine current issues producers in the Northeast are experiencing in pick-your-own blueberry production.

Objectives

The objectives of the research study were:

1. Identify the demographics related to farm size, age, and size of blueberry operations including types of blueberries grown and plants per acre.
2. Identify current issues producers are experiencing with insects and mites.
3. Identify current issues producers are experiencing with blueberry diseases.
4. Identify current issues and management practices for wildlife and pest weeds.
5. Identify how often producers have contact with and receive information from their local Extension Service/Agent.
6. Identify what form producers prefer receiving information and what format they consider to be their best source of blueberry information.

Summary

The following summary and recommendations are based on the findings of this study. The demographic findings in this data provide a level of understanding for the operating size of Northeastern pick-your-own highbush blueberry operations targeted in this study. Out of the 93 total respondents, 79 stated that they are currently involved in a commercial blueberry operation. Average overall farm size operated by pick-your-own producers was found to be 142.56 acres, with an average overall age of 76.2 years old. Producers maintained an average of 8.26 acres of Highbush blueberries. Producers maintained an average of 715 blueberry plants per acre, and the operations had been growing blueberries for an average of 29.99 years.

Findings identified that nearly one quarter of the producers had conducted their last blueberry planting prior to 2000. A majority of the producers had conducted plantings after 2000, with the majority of the plantings having occurred in 2016 followed by 2012, and 2010. A majority of the respondents, stated that they did not plan on expanding their blueberry operations within the next five years. Only 17.5% of the respondent blueberry producers planned to expand their operation within the next five years.

With so many different farm classification labels on the market today, the study found that a large majority of Northeastern highbush blueberry producers identified their farm classification as local, followed by natural farm, and then as an organic farm. The study found that a large majority of the respondents, sell their produce in a pick-your-own or U-Pick style marketplace. Producers also stated they sell their produce in farm stands and wholesale markets.

Northeast highbush blueberry producers identified Japanese beetles, blueberry maggots and cherry fruitworms to be annual insect and mite issues. Annual disease issues were found to be mummy berry, witches broom, anthracnose and phomopsis twig blight.

Annual weed issues were reported to be from all of the listed plant types. While annual broadleaf weeds, annual grasses, perennial broadleaf grasses, and perennial grasses were all reported by a majority of the producers to be annual problems.

Annual management issues were reported by a majority of respondents to occur with birds, deer, and plant fertilization. Open-ended responses identified several means of control that producers are currently utilizing with netting as the top bird control identified. Respondents also identified 8ft. deer fencing as the top form of deer control, and poison bait as the top means of rodent control. Herbicides were identified as being the top form of weed control for highbush blueberries.

Five of the top issues currently facing Northeastern blueberry producers were identified through an open-ended type question. The top five current issues are ranked in order from most identified problem to least as follows: weed control, labor/labor costs, weather, birds, and government regulations.

The study found that a large proportion of Northeastern blueberry producers were only in contact with their extension agent/specialist once every six months. The most recent information or services from the Extension Service was received by pick-your-own producers in 2016 and 2017. Newsletters, emails, farm visits, and workshops were reported to have been the methods by which they last received information. The study found that producers prefer receiving information in the form of emails, newsletters, and

farm visits. Producers also felt that their best sources of blueberry information were websites, research publications, and other producers.

Conclusions

Research findings of this study were successful at meeting the purpose and objectives established by the researchers. Results of this study focused on highbush blueberry producers. Although data for lowbush blueberries was collected during this study, only a small response was received for the lowbush blueberry production questions, with a total of only 3 producers indicating they maintained lowbush blueberries. Demographic findings from this study determined the average size and number of blueberries produced per acre for Northeastern pick-your-own highbush blueberry producers.

The study was successful in identifying the current issues facing blueberry producers, in several areas. Japanese beetles were identified as being the top insect and mite problem which was reported by nearly half of the respondents as being an annual problem. Although it was not listed in the survey, it is interesting to note that nearly a quarter of the respondents identified the spotted wing drosophila insect as being an annual problem and major issue and noted the severity of this insect, that previously had not been reported in other reports for the northeast.

Two diseases were found to be current issues faced by highbush blueberry producers. Mummy berry was identified by 28.13% of the respondents as the largest current annual disease problem. However, 24.56% of the respondents identified witches' broom as a major annual disease problem as well.

Weeds were identified by more than 50% of the respondents in all categories to be annual problems. This corresponds to the fact that weed control was identified as the number one top farm issue by the respondents. Although a majority of respondents identified herbicides as the top form of weed control, it continues to be an annual problem for Northeastern blueberry producers.

Birds were identified to be the top annual management problem. Respondents identified several forms of bird control, with most respondents commenting that they used a combination of controls to increase bird deterrents. Controls were identified to be netting, bird guard noise systems, balloons, and reflective ribbon. Regardless of multiple controls being implemented in conjunction together, 56.41% of the respondents identified birds as being the top management issue.

Labor/labor costs and government regulations were reported by the respondents as being two of the top five overall farm issues. Respondents tended to group these two issues together with various comments about the severity of each. A lack of quality workers willing to do manual labor, coupled with the rise of the minimum wage, was reported to have taken a heavy toll on the profit of pick-your-own blueberry producers.

Blueberry producers reported websites and research publications as being their best sources for blueberry information. Online access seems to be pivotal with Northeastern blueberry producers, as nearly two-thirds of the respondents (64.56%) identified email as being their most preferred way of receiving information. Email, was followed closely by newsletters and farm visits as preferred methods of receiving information from sources. However, 44 respondents identified newsletters as being the last form in which they received information from the Extension Service. This

corresponds to the fact that 43.42% of the survey respondents, responded as only having contact with their extension agent/specialist once every six months.

Recommendations

Based on the study's findings and prior research, the following recommendations can be presented.

Integrated pest management as discussed by Szendrei and Isaacs (2006) pertaining to clean cultivation in crop fields, would help reduce the infestation of Japanese beetles. Japanese beetles lay their larva in dead plant matter, located between uncultivated permanent sod based rows. Although clean cultivation increases the amount of dust and mud between blueberry rows, it drastically reduces the Japanese beetle infestations by removing their ability to reproduce (Szendrei, and Isaacs, 2006). Clean cultivation is a low cost, high reward form of integrated pest management that would benefit pick-your-own blueberry producers.

With significant advances in genetic manipulation in the last 20 years, cultivar selection can play a huge role in a plants hardiness to not only the environment, but also insects, and disease. Ehlenfeldt, Polashock, and Stretch (2010) conducted research that identified cultivars of blueberry plants that are least susceptible to the disease Mummy berry. Mummy berry was identified by 28.13% of the respondents as being the top annually occurring disease. With a nearly a quarter of the respondent producers not having conducted a new planting since 1999, selection and implementation of a new cultivar, could have a tremendously positive impact on their production success.

Extension Service efforts to reach Northeastern blueberry producers could be improved, if they adjusted the form and frequency in which they present producers with

information. Sixty-four percent of producers identified email as their most preferred form of receiving information, and a majority of respondents identified websites as their best source of information. However, producers reported to only have contact with their extension agent/specialist once every six months, and to have received the last information in the form of newsletters and farm visits. The Extension Service could compile a comprehensive list of online contact information for blueberry producers in each state. This would allow the agency to switch to online forms of communication, such as email, websites, and online courses. Online communication would also allow the extension service to increase the frequency of contact between agents and producers. Extension agents could then send informative newsletters via email to producers once a month increasing contact frequency and information availability.

With respondents indicating their preference for using technology to receive information, the Extension Service could utilize the use of on-line resources and short courses to increase producer knowledge on various topics (see Table 14). Although nearly half of the respondents identified herbicide use as a form of weed control, weed management was still one of the largest annual issues and was reported in multiple categories. The availability of online information or courses focused on herbicide selection and use could be of great benefit to producers that may not be able to participate in face-to-face pesticide certification courses. This informational or training course could also be used to present producers with the most recent form of farm management practices and cultivar selections. With a large majority of producers using email and online websites to garner information already, an online course would have a high probability of being successful.

Recommendations for Further Research

Spotted wing drosophila was first discovered in the United States in California in 2008, and is an invasive species from Asia (Beers, Smith, & Walsh, 2010). By the fall of 2010 it was detected in Michigan, Utah, North Carolina, and South Carolina (Beers, et al., 2010). The researcher did not find any research studies that clearly supported the detection or severity of spotted wing drosophila in the Northeastern United States. Findings from this study suggest that spotted wing drosophila has spread to the Northeast and has become an annual issue for pick-your-own highbush blueberry producers. Further research is needed in order to firmly establish the detection of regional infestations and severity of the spotted winged drosophila invasive species in the Northeast.

REFERENCES

- Avery, M. L., Nelson, L., John, W., & Cone, M. A. (1991). Survey of bird damage to blueberries in North America. *Fifth Eastern Wildlife Damage Control Conference*, Paper 2.
http://digitalcommons.unl.edu/ewdcc5/2/?utm_source=digitalcommons.unl.edu%2Fewdcc5%2F2&utm_medium=PDF&utm_campaign=PDFCoverPages
- Barry, D. J., Rodriguez-Saona, R. C., Polk, F. D., & Zhang, A. (2010). Seasonal abundance, life history, and parasitism of *Caloptilia porphyretica* (Lepidoptera: Gracillariidae): A Leafminer of highbush blueberry. *Journal of Economic Entomology*, 103, 184-291. doi: <http://dx.doi.org/10.1603/EC09104>
- Beers, H. E., Smith, J. T., & Walsh, D. (2010). Spotted Wing Drosophila. *Washington State University Tree Fruit Research and Extension Center*.
<http://jenny.tfrec.wsu.edu/opm/displayspecies.php?pn=165>
- Cook, R., Peacock, D., Malensky, J., & Granatstein, D. (2015). OSU blueberry school: Marketing- What's the future for fresh, processed, and organic markets?
http://oregonstate.edu/dept/NWREC/sites/default/files/pg_programs/berry/documents/009-0014-marketing-whats_the_future.pdf
- Demchak, K., Harper, K. J., & Kime, F. L., (2017). Highbush blueberry production. *Penn State Extension*. <http://extension.psu.edu/business/ag-alternatives/horticulture/fruits/highbush-blueberry-production>
- Dillman, D. A. (2000). *Mail and internet surveys: The tailored design method*. (2nd ed.) New York: John Wiley & Sons, Inc.
- Ehlenfeldt, K. M., Polashock, J. J., & Stretch, W. A. (2010A). Ranking cultivated blueberry for mummy berry blight and fruit infection incidence using resampling and principal components analysis. *HortScience*, 45, 1205-1210. Retrieved from <http://hortsci.ashspublications.org.www.libproxy.wvu.edu/content/45/8/1205.full.pdf+html>
- Ehlenfeldt, K. M., Polashock, J. J., & Stretch, W. A. (2010B). Mummy berry fruit rot and shoot blight incidence in blueberry: Prediction, ranking, and stability in a long-term study. *HortScience*, 45, 92-97. Retrieved from <http://hortsci.ashspublications.org.www.libproxy.wvu.edu/content/45/1/92.full.pdf+html>

- Gough, E. R. (1994). *The highbush blueberry and its management*. New York: Food Products Press.
- Jez, J. M., Lee, S. G., & Sherp, M. A. (2016). The next green movement: Plant biology for the environment and sustainability. *Science* 353, 1241-1244.
<http://science.sciencemag.org/>
- Krejcie, R., & Morgan, D. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30, 607-610.
- Miller, L. E. & Smith, K. S. (1983). Handling nonresponse issues. *Journal of Extension*, 21(6), 45-50.
- Robinson, J. P., Shaver, P. R., & Wrightsman, L. S. (1991). Criteria for scale selection and evaluation. *New York: Academic Press*, 1-16.
- Schilder, A. (n.d). *Overview of blueberry diseases*.
http://extension.missouri.edu/blueberry/documents/Shared_Documents/MOBBSchool/MOBBSchoolConf12/SchilderOverviewBlueberryDisease10_19_12.pdf
- Szendrei, Z. & Isaacs, R. (2006). Survey of Japanese beetle management practices in Michigan highbush blueberry production. *HortTechnology*, 16, 83-88. Retrieved from
<http://horttech.ashspublications.org.www.libproxy.wvu.edu/content/16/1/83.full.pdf+html>
- US Highbush Blueberry Council, (2008). *Blueberry trends and market challenges*
<http://sfp.ucdavis.edu/files/144723.pdf>
- Van Timmerman, S. & Isaacs, R. (2009). Susceptibility of highbush blueberry cultivars to cranberry fruitworm and Japanese beetle. *International Journal of Fruit Science*, 9, 23-34. doi: 10.1080/15538360902801288
<http://web.a.ebscohost.com.www.libproxy.wvu.edu/ehost/detail/detail?sid=e0ba3cc9-2a58-4d5e-9477-5c869be2bf0e%40sessionmgr4009&vid=0&hid=4114&bdata=JnNpdGU9ZW9vc3QtbGl2ZQ%3d%3d#AN=38217848&db=a9h>

Vercauteren, K., Lavelle, M., & Hygnstrom, S. (2006). Fences and deer-management: A review of design and efficacy. *Wildlife Society Bulletin*, 34, 191-200.
<http://www.jstor.org.www.libproxy.wvu.edu/stable/pdf/3784954.pdf?refreqid=excelsior%3Aa3aa653233d0b045cd230f9c2ffcc3b4>

APPENDICES

APPENDIX A

Initial Cover Letter

John Doe
123 Main Street
Anytown, USA 12345

Dear Blueberry Producer:

Northern highbush blueberry cultivars account for 99% of blueberry production in the Northeastern region of the United States. The global demand for blueberries has added new pressure to the supply chain and as a blueberry producer your perspectives and experiences with the current industry is important in helping universities and Extension Services understand the problems producers' face so that research and outreach can be directed accordingly.

My name is Brian T. Gould, and I am a graduate student in at West Virginia University. I am working with my advisor, Dr. Deborah Boone, to conduct a research study to determine current production issues faced by randomly selected Northeastern Blueberry farmers. The results of this study will be used to prepare a thesis to partially fulfill the requirements for a Master of Science Degree in Agricultural and Extension Education. The Institutional Review Board (IRB) at West Virginia University has an acknowledgement of this research is on file.

Participation in this research study is completely voluntary, participants must be at least 18 years of age and all information you provide will be held as confidential as possible. Your response to the survey is appreciated, and will only take about 10 -15 minutes of your time to complete. You may skip any question you are not comfortable answering. You will notice a code number at the top left of the return envelope. This code will be used to identify non-respondents for follow-up and will be destroyed before the data are analyzed. Survey results will be reported in a summary format and individual responses will not be identifiable.

Place the completed questionnaire in the enclosed postage-paid self-addressed return envelope and drop in the mail. **Please return your completed questionnaire before April 14 2017.** If you have any questions or concerns about completing the questionnaire or about being a part of this study, you may contact me at bgould1@mix.wvu.edu or my advisor Dr. Deborah Boone at debby.boone@mail.wvu.edu or call 304-293-5450. Thank you in advance for your participation in this study. We sincerely appreciate your time and effort.

Sincerely,

Brian T. Gould
WVU Graduate Student

Deborah A. Boone, Ph.D.
Professor

APPENDIX B

Questionnaire

Current Issues Facing Northeast Blueberry Producers

Brian Gould
Graduate Student
Agriculture and Extension Education
Davis College of Agriculture, Natural Resources, and Design
West Virginia University
Morgantown, WV 26506

Instructions: Please answer all questions with as much accuracy as possible. The answers should be based on the most current information available for your blueberry operation. Please enter your answers in the space provided.

Farm operation

1. Are you are currently involved in a commercial blueberry operation (ie. Wholesale, CSA, U-pick, Farm stand or for Farmers Markets)? (Mark (X) correct response)
_____ *Yes, if so, please continue with the survey.*
_____ *No, if not, please stop and return the survey to WVU in the postage paid return envelope provided. Thank you for your time.*
2. How many years have you been growing blueberries? _____
3. What is the size of your farm in acres? _____
4. How many acres of blueberries do you maintain? _____
5. How many acres are Highbush Blueberry types? _____
6. How many acres are Lowbush Blueberry types? _____
7. On average how many blueberry plants do you have per acre? _____ (Number plants per acre-approximately)
8. What percent (%) of the total blueberries you produce are **Highbush**? _____
9. What percent (%) of the total blueberries produced are **Lowbush**? _____
10. In what year did you do your last blueberry planting? (i.e. 2010, 2016, etc.)
_____

11. Do you plan to expand your blueberry operation in the next 5 years?

_____ Yes

_____ No

_____ Maybe

12. How do you classify your farm? Mark (X) appropriate response

_____ Organic

_____ Natural

_____ Local

_____ Certified Organic

_____ Not Certified

_____ Other (please list) _____

13. What is the current age of the farm? _____

14. How many years has the farm been growing blueberries? _____

15. In what type of market(s) does the farm sell Blueberries? (check all that apply)

_____ You Pick

_____ CSA

_____ Farmers Market

_____ Wholesale

_____ Farm Stand

_____ Other, please list _____

16. What is your current job title on the farm? _____

Management

17. What type of bird control do you use for your blueberries?

---

18. What type of deer control do you use for your blueberries?

---

19. What type of rodent control do you use for your blueberries?

---

20. What type of weed control do you use for your blueberries?

Insects and Mites

Please rate the degree the following insects and mites are a problem on your farm for both highbush and lowbush plants using the following scale: 4 = annual problem, 3 = occasional problem, 2 = rarely a problem, or 1 = never a problem. Please circle the number that corresponds to your rating for both Highbush and Lowbush.

	Highbush				Lowbush			
	Annual problem	Occasional problem	Rarely a problem	Never a problem	Annual problem	Occasional problem	Rarely a problem	Never a problem
21. Aphids	4	3	2	1	4	3	2	1
22. Blueberry blossom weevil	4	3	2	1	4	3	2	1
23. Blueberry bud mite	4	3	2	1	4	3	2	1
24. Blueberry gall midge	4	3	2	1	4	3	2	1
25. Blueberry maggot	4	3	2	1	4	3	2	1
26. Blueberry stem borer	4	3	2	1	4	3	2	1
27. Blueberry tip borer	4	3	2	1	4	3	2	1
28. Cherry fruitworm	4	3	2	1	4	3	2	1
29. Cranberry fruitworm	4	3	2	1	4	3	2	1
30. Cranberry fruitworm	4	3	2	1	4	3	2	1
31. Japanese beetle	4	3	2	1	4	3	2	1
32. Obliquebanded leafroller	4	3	2	1	4	3	2	1
33. Oriental beetle	4	3	2	1	4	3	2	1
34. Plum curculio	4	3	2	1	4	3	2	1

	Highbush				Lowbush			
	Annual problem	Occasional problem	Rarely a problem	Never a problem	Annual problem	Occasional problem	Rarely a problem	Never a problem
35. Redbanded leafroller	4	3	2	1	4	3	2	1
36. Scale insects	4	3	2	1	4	3	2	1
37. Sharp-nosed leafhopper	4	3	2	1	4	3	2	1
38. Thrips	4	3	2	1	4	3	2	1
39. White grubs	4	3	2	1	4	3	2	1
40. Other	4	3	2	1	4	3	2	1
41. Other	4	3	2	1	4	3	2	1
42. Other	4	3	2	1	4	3	2	1

Comments:

Diseases

Please rate the degree the following diseases are a problem on your farm for both highbush and lowbush plants using the following scale: 4 = annual problem, 3 = occasional problem, 2 = rarely a problem, or 1 = never a problem. Please circle the number that corresponds to your rating for both Highbush and Lowbush.

	Highbush				Lowbush			
	Annual problem	Occasional problem	Rarely a problem	Never a problem	Annual problem	Occasional problem	Rarely a problem	Never a problem
43. Anthracnose	4	3	2	1	4	3	2	1
44. Armillaria root rot	4	3	2	1	4	3	2	1
45. Blueberry scorch virus	4	3	2	1	4	3	2	1
46. Blueberry shoestring disease	4	3	2	1	4	3	2	1
47. Blueberry stunt	4	3	2	1	4	3	2	1
48. Botryosphaeria stem blight	4	3	2	1	4	3	2	1
49. Botryosphaeria stem canker	4	3	2	1	4	3	2	1
50. Botrytis blight	4	3	2	1	4	3	2	1
51. Coryneum canker	4	3	2	1	4	3	2	1
52. Crown gall	4	3	2	1	4	3	2	1
53. Fusicoccum canker	4	3	2	1	4	3	2	1
54. Mosaic	4	3	2	1	4	3	2	1
55. Mummy berry	4	3	2	1	4	3	2	1
56. Phomopsis twig blight	4	3	2	1	4	3	2	1
57. Phytophthora root rot	4	3	2	1	4	3	2	1

	Highbush				Lowbush			
	Annual problem	Occasional problem	Rarely a problem	Never a problem	Annual problem	Occasional problem	Rarely a problem	Never a problem
58. Powdery mildew	4	3	2	1	4	3	2	1
59. Red ringspot	4	3	2	1	4	3	2	1
60. Witches' broom	4	3	2	1	4	3	2	1
61. Other	4	3	2	1	4	3	2	1
62. Other	4	3	2	1	4	3	2	1

Comments:

Weeds

Please rate the degree the following weeds are a problem on your farm for both highbush and lowbush plants using the following scale: 4 = annual problem, 3 = occasional problem, 2 = rarely a problem, or 1 = never a problem. Please circle the number that corresponds to your rating for both Highbush and Lowbush.

	Highbush				Lowbush			
	Annual problem	Occasional problem	Rarely a problem	Never a problem	Annual problem	Occasional problem	Rarely a problem	Never a problem
63. Annual broadleaf weeds	4	3	2	1	4	3	2	1
64. Annual grasses	4	3	2	1	4	3	2	1
65. Perennial broadleaf weeds	4	3	2	1	4	3	2	1
66. Perennial grasses	4	3	2	1	4	3	2	1
67. Other	4	3	2	1	4	3	2	1
68. Other	4	3	2	1	4	3	2	1
69. Other	4	3	2	1	4	3	2	1

Management

Please rate the degree the following management issues are a problem on your farm for both highbush and lowbush plants using the following scale: 4 = annual problem, 3 = occasional problem, 2 = rarely a problem, or 1 = never a problem. Please circle the number that corresponds to your rating for both Highbush and Lowbush.

	Highbush				Lowbush			
	Annual problem	Occasional problem	Rarely a problem	Never a problem	Annual problem	Occasional problem	Rarely a problem	Never a problem
70. Birds	4	3	2	1	4	3	2	1
71. Deer	4	3	2	1	4	3	2	1
72. Frost	4	3	2	1	4	3	2	1
73. Plant fertility	4	3	2	1	4	3	2	1
74. Pollination	4	3	2	1	4	3	2	1
75. Soil pH	4	3	2	1	4	3	2	1
76. Voles	4	3	2	1	4	3	2	1
77. Woodchucks	4	3	2	1	4	3	2	1
78. Other _____	4	3	2	1	4	3	2	1
79. Other _____	4	3	2	1	4	3	2	1
80. Other _____	4	3	2	1	4	3	2	1

81. Please list in order the top 5 problems that your farm is currently facing.

1. _____
2. _____
3. _____
4. _____
5. _____

82. How often do you have contact with your Extension Agent/Specialist?
(Please check one)

- _____ Never
- _____ Once a week
- _____ Once a month
- _____ Once every six months

83. In what year did you last receive information, services, etc. from the extension service? (i.e. 2016) _____

84. In what form(s) did you last receive information from the Extension Agent/Specialist? (check all that apply)

- _____ Newsletter
- _____ Newspaper Article
- _____ Fact Sheet
- _____ Phone call
- _____ Farm Visit
- _____ Workshop
- _____ Online course
- _____ Web-site
- _____ Email
- _____ Other: Please list _____

85. In what form(s) do you most like receiving information? (check all that apply)

- ☐ Newsletter
- ☐ Newspaper Article
- ☐ Fact Sheet
- ☐ Phone call
- ☐ Farm Visit
- ☐ Workshop
- ☐ Online course
- ☐ Web-site
- ☐ Email
- ☐ Other: Please list _____

86. What do you consider your best source for information on blueberries?

- ☐ Newspaper
- ☐ Magazine
- ☐ Website
- ☐ Email
- ☐ Trade Journal
- ☐ Other Producers
- ☐ Research Publications
- ☐ Other: Please list _____

Thank you for taking time to assist us in conducting this research project.

We appreciate your time and input.

If you have questions about the survey, please contact me at:

bgould1@mix.wvu.edu or contact my advisor

Dr. Debby Boone at debby.boone@mail.wvu.edu or

call (304-293-5450)

Please return survey in enclosed postage paid envelope or mail to: Dr. Debby Boone, P.O. Box 6108, Morgantown, WV 26506

APPENDIX C

Follow-up Cover Letter

John Doe
123 Main Street
Anytown, USA 12345

Dear Producer:

In late March we mailed you a survey on blueberry production in the Northeastern states, as of today, we have not heard from you and are requesting your assistance. As a blueberry producer your perspectives and experiences with current blueberry production is important in helping universities and Extension Services understand the problems producers' face so that research and outreach can be directed accordingly.

My name is Brian T. Gould, and I am a graduate student in at West Virginia University. I am working with my advisor, Dr. Deborah Boone, to conduct a research study to determine current production issues faced by randomly selected Northeastern Blueberry farmers. The results of this study will be used to prepare a thesis to partially fulfill the requirements for a Master of Science Degree in Agricultural and Extension Education. The Institutional Review Board (IRB) at West Virginia University has an acknowledgement of this research is on file.

Participation in this research study is completely voluntary, participants must be at least 18 years of age and all information you provide will be held as confidential as possible. Your response to the survey is appreciated, and will only take about 10 -15 minutes of your time to complete. You may skip any question you are not comfortable answering. You will notice a code number at the top left of the return envelope. This code will be used to identify non-respondents for follow-up and will be destroyed before the data are analyzed. Survey results will be reported in a summary format and individual responses will not be identifiable.

Place the completed questionnaire in the enclosed postage-paid self-addressed return envelope and drop in the mail. **Please return your completed questionnaire before May 9, 2017.** If you have any questions or concerns about completing the questionnaire or about being a part of this study, you may contact me at bgould1@mix.wvu.edu or my advisor Dr. Deborah Boone at debby.boone@mail.wvu.edu or call 304-293-5450. Thank you in advance for your participation in this study. We sincerely appreciate your time and effort.

Sincerely,

Brian T. Gould
WVU Graduate Student

Deborah A. Boone, Ph.D.
Professor

APPENDIX D

Responses to Open Ended Questions

Comments that were Written on Survey

All comments were transcribed (and appear below) exactly as they were written on the survey instrument. The researchers did not attempt to correct spelling and grammatical errors.

Question 12: How do you classify your farm?

IPM -5

We use organic practices but not certified

questionable diversified

Conventional IPM

Mix of Organic and Comm. Sprays & Fert

Conventional

IPM for apples - non-spray natural for blueberries

in between organic and commercial

conventional - use pesticides

Low Spray IPM -2

Off Grid Solar, Penniculture

Registered Organic

MIXED - SOME ORGANIC BUT MOSTLY CONVENTIONAL

Question 15: in what type of market(s) does the farm sell blueberries?

Restaurants -2

craft events

ones not sold quickly are frozen & put in home make pies

We freeze most. We bake in pies, bread, etc.

Question 16: What is your current job title on the farm?

Owner

Owner

Manager

owner

Owner

Owner

Co-Owner

Manager

OWNER

owner

owner

DAN THE MAN

OWNER

Owner

owner

owner

Manager

DO IT ALL

Manager

Owner

Owner/Farmer

Owner/Manager

owner/operator

OWNER

OWNER, MAIN ONLY LABOROR

owner

Owner

owner

Manager

Owner/Manager

Owner

owner - Manage

Owner

Owner/operator

Owner

Owner

OWNER/Operater

Owner

co-owner

The farm has been sold.

CO-OWNER

Owner

owner

President

owner

OWNER

OWNER/MEMBER

orchard manager

owner

owner

Wholesale Manager

Co-Owner/ operatore

PRESIDENT

owner

Farmer

owner

Owner

owner

OWNER

OWNER/MANAGER JACK OF ALL TRADES

OWNER

owner, operator

OWNER

Owner

Farm Manager

Partner

owner

Farmer

Partner LLC

gen.ptr.

Owner

owner

FAMILY

assistant manager

Owner/grower

OWNER - SEMI-RETIRED

co-owner

co-owner

owner

Question 17: What type of bird control do you use for your blueberries?

Aircro

Netting

Over planting

None we do pick your own so people are in there all day. Seems to help minimize the problem

Netting

NETTING

Past Net

bird alarms

Net

RIBBONS

Smart net

Bird distress call useless

NONE

Netting

Nets

Shotgun

none- minimal impact

Video Balloons

NONE

None

Scare balloons

Scare Tactics

None

None - Not A Fly Zone, Low Damage

KITES

none

Bird Guard

foil, owl, fake snake.

electronic bird guard

None

Netting

Computer

Net

NONE

HAVE NETTED IN PAST/USED NILAN CONTROL PRODUCT

electronic bird guard

Netting

Balloons

netting

Had computer disc on poles

ELECTRONIC BIRD DISTRESS CALLS

None

netting

Net

Autrol

used to net now we used computer & cannon

NONE - TRIED 3 BIRD DISTRESS CALL

distress calls

hanging tape silver/holographic on rope over rows

Aircrow machines

Nothing

WE NET THE FIELD

Net

Smart Net

scare balloons

TRIED NETTING

dogs

Netting

NETTING

None

plastic netting over top of 3 patches.

electronic

None

Nothing at this point

Netty

bird banger

none

NONE

netting

None

NONE

Netting

Nets

SHOTGUN

sound device some seasons

Netting

birdguard pro

reduce surrounding trees

Current None

horse mulcess

Audio propane cannon

FLASH TAPE

ELECTRONIC CALLER

The only thing that works is when the coopers hawk lives nearby - or when people are picking

NOW DONT USE ANY CONTROLS

scare baloons

Propane

BIRD SCARE BALOONS

cracker shells

bird distress calls thru speakers

OWLS

netting - rarely

BIRD TRAPS - N.Y. STATE STARTLING TRAP - STARTLINGS, BLACKBIRDS

BUT MOSTLY HOUSE FINCHES.

air scarecrow some seasons

12 Ga Shotgun

AIRDANCERS

hard kill

Connon

balloons

BALLONS

SCARE DEVICES - NOT MUCH LUCK.

netting on portion

Question 18: What type of deer control do you use for your blueberries?

8' deer fence

Fencing

Over planting

None

8' fence

NONE -NOT A CONSISTET PROBLEM

None

none

8' Woven Wire Fence

NONE

fence

none

NONE

Nets

none

Fishing line barrier around earliest variety- 1 acre none around remainder

None

NONE

None

None To date

None

None, have Lots of Deer But Don't Seem To Like eating Bushes

NONE

none

None

None

Lead

None

Fence

None

none

NONE

DON'T HAVE Deer problem

NONE

Fence

SOLAR ELECT TAPE W/PEANUT BUTTER ON FLASHING

fences

Electric Fence Around The Field

NONE

None

netting

fence

coyotes

cracker shells

HIGH VOLTAGE, LOW AMP DEER TRAINING FENCE

Fence

None

None

Nothing - a little Hunting in the fall

NONE MECESSARY

None

10ft High Wire Mesh

n/a

NONE

none

Net

FENCING

None

None.

None

None

Nothing

None

soap bars tied around perimeters of all fields

none

NONE

none

None

NONE (dog)

None (none needed)

None - does not seem to be an issue as the adjoining farm grows strawberries.

NONE

electric fence

10'fence

None other than hunting

Hunting

Question 19: What type of rodent control do you use for your blueberries?

ramik

Poison Bait

weeding

None

none

NONE

None

none

Fall Mouse Bait

NONE

None

none

NONE

TRAPS

none

none

none- not a problem

None

NONE

Mouse Bait

None

None

None

None, Lots of Hawks etc

NONE

none

None

None

None

None

No Rodent Problem except occasional rabbit eating young stems.

None

none

NONE

DON'T HAVE problem

castor oil

Mow Grass

N/A

local cats

Kept Field Clean

NONE

None

none

mouse bait

coyotes

none

NON

Zinc Phosphate

None

Bait with Rozol in fall

Nothing

NONE NECESSARY

None

Mowing

n/a

NONE

none

None

NETTING

None

Try to keep orchards mowed & keep orchards clean.

None

None

Nothing

None

encouraging foxes & fox dens

none

NONE

none

none

NONE (dog)

Pro-Zap

None

WEED CONTROL

None

(wild) hawks

Herbicide

other bait rodenticide

mulching

Red-Tail Hawks

keep snow cover loose

Weed control

FENCING

MOWING

mouse bait

Zinc Phosphide Bait

TRAPPING

ROZOL & OTHER BAITs

Question 20: What type of weed control do you use for your blueberries?

mulch

Herbicides

wood chip mulch

Weed Whacker and mowing

hand weeding

HERBICIDE

Past Mowing

spray in spring & fall w/ herbicides

manual

MULTCH

chips

round up

MULCH

HERBICIDES

Chemical

velpus

hoeing

Chemical

PICKERS GET DISCOUNT IF THEY HELP WEED

Herbicides

Woodchips/Glysophate

mowing

mowing

Chemical in Row's. May Try Organic This YR. Middle of Row's, Mowed w/ Mulcher

WHAT IS LEAGUE FOR N.Y.S. AND CORNELL UNIV. RECOMMENDS

hand weeding - mow grass

Herbicides

hand weeding

Gramoxone

Multiple Herbicides

Mowing

Herbicides

herbicides

Mulch

RECOMMENDED HERBICIDES

hand weeding

Pre-emergent Herbicide

WEED WHACKERS- CASARON

hand weeding

Casarrow herbicide was used

PRE-EMERGENCE HERBICIDES

Postemergence Herbicides

mulch

mulch

spray

lots mulch

Round up

hand weeding

wood chip mulch

Spring application of suflur & simazine followed by full of chateau, callisto, Roundup.

Currently mowing, the field used to be burned & sprayed w/ herbicide

Registered herbicides

Post emergent with a little pre-emergent

Premergent + Contact Herbicides.

weed badger, or by hand

LIMITED ROUND- UP - BUT BURRIES

mowing

None

HERBACIDE (ROUND UP- GENERIC

we weed by hand

casaron early in spring

chemical

NOthing the last 4 years. Plan to adjust PH & spot burn

wood chip mulch

Spot Control

mowing

Hand Weeding

Combo of pre- emergence and Round- up

weed trimming

Mulch

mowing btn rows

HERBICIDE - ONLY

Paraquat FC

Chateau

MOWING

Mechanical - weedbadger

wood chips

herbicide

spot spray herbicides

mulch

mulch

HAND WEEDING

Round Up

mat

planing to use a premergent

HORSE MANURE

WOOD CHIPS

mulch

plowing

hand pulling

Hand weeding

organic mulch

spacing applications of lesiliars

chips

Spot Roundup

heavy mulch

SPOT SPRAY ROUND UP

herbicide

hand

some round-up

mowed sod between rows

Round Up

Will spot treat with paraquat, as well as hand weed.

Mowed Alleys.

Weed wack

hand weeding

Mulch

weed wacking

bark mulch

Salt Marsh

handweeding in rows

CHEMICALS

120 % vinegar solution for burn back

Mowing

banded herbicides

Weed whacking

Current Mowing

much cuttical

PULLWEEDS BY HAND

May try geese this year

hand weeding

some glyophate

Manual

HAND WEED

wood chips in rows

Mulch

weed pulling

Hay

hand pulling

occ. round up

Question 40: What other insects or mites are issues that are not listed?

WINTER MOTH

Gypsy Moth

spotted wing drosophyla

SWD

SWD

SPOTTED WING DROSOPHILA

spoted wing drosopola

Winter Moth

Asian Sptted-wing Fruit Fly

SWD

SWD

Spotted Wing Drosphilla

WINTER MOTH

SWD

Cicades

SW drosophila

SPOTTED WINGED DROSOPHILA

SWD

Spotted W Drosophila

Spotted Winged Drysophyla

SPOTTED WINGED DRYSPHOLIA

SWD

Yellow Caterpillar - Serious problem

SWD

S.W.D.

Question 61: What other diseases are issues that are not listed?

Tip-Die-Back

"die back" of tip blossoms on Weymouths

PHOMOPSIS CANKER

Question 67: What other weeds are issues that are not listed?

deciduous trees

grape vines

bitter sweet

Virginia Creeper

BITTER Sweet

PERSLAIN

Creeping thorny berry vines

Bittersweet

Question 67: What other wildlife and nutrient management problems may be issues

that are not listed?

Bears

spotted winged drosophyla

Rabbit

BEARS

wet sections

Rabbits

People

TURKEYS

pruning

SQUIRELS

Bears

FRUIT S.W.D.

plant vigor

Bears

SWD

Wild Turkeys

FRUIT WORMS

Nutrition

drip irrigation

Question 81: Please list in order top 5 problems that your farm is currently facing.

government regulations

Govt Regulations

Affordable labor

Labor costs are a huge problem

profitability

3 INVASIVE INSECTS

Strange weather in our winters & spring - losing part of crop

weather changes

WORKERS TO pick (LABOR)

Blueberry maggott

FINANCES, COSTS

AGE OF OWNER 74

SWD

Bird imported weeds even up grapevine

Limited income- insufficient for hired help

New Regulations - some are difficult, expensive, Time consuming unreasonable. Opens up lawsuits possibilities from workers and customers. Posted signs are ugly, will scare uppick customers away. Family members not as willing to take over if they have to compy none

wholesale market vicinity

Poor local economy for U-pick customers

Soil pH

Expenses

Asian spotted wing fruit fly

Available Mulch

MAINTAINING A GOOD BALLANCE IN FERTILITY

Birds

Birds and an unknown disease - plus the never ending weeds

We have a Variety Named Duke. They are Slowly dieing but we don't Know why!

Weeds

To much warm weather in 7 of last 10 winter

Cold damage - lost crop 2016 / 2015

SWD

Spotted wing Drosophila

INCREASED GOVERNMENT REGULATION

availability of PYO clients

Soil PH

Labor

aging farmers!

Labor

WINTER/SPRING COLD DAMAGE TO BUDS & CANES

witches broom

Government regulation

Labor

weather

climate change to wet to dry

AGE - MY

Food Safety

Weeds

AVAILABLE LABOR

Labor

Frost/Freeze due to more climate variability

weeds

Birds

we have just started farming so are not as aware of issues yet

SWD

INSECTS

Keeping the bushes trimmed properly.

Blight

Weeds

weeds - grasses

Labor Casts

weeds when establishing new bushes

Finding people to do hand picking

SWD

weed control

DROUGHT

Handweeding - help

WEATHER - TOO WINDY, RAINING, TOO DRY,

Cost of labor intensive pruning

Mummy berry

BIRDS

frost

labor (Lack)

rising labor costs / low labor quality

Infrastructure costs

Selling all we produce

succession- owner due to retire

SEE #40, 41, 42

spotted winged drosophyla

Labor

SWD

EQUIPMENT

WEED CONTROL

poison ivy

Maintenance

Taxes

Local competition from farms u- pick price down

Birds

Machinery

Japanese beetle

Mummy Bry - Need To Get A Spray For Big Trois. For PYO OPs

EVEN PLANT GROWER

SWD

Market Loss

Birds

flood

Fertility

Japanese Beetles

INCREASE TAXES

water supply during drought in drip irrigation

Cicadas

Rising Production Costs

otherwise OK

Pruning Time

WEED CONTROL

japanese beetles

Pruning

hail

LABOR - PICKERS

Generational transition

Pollination

GOV. REGULATIONS

Regulations

Invasive species of insect, weeds, + disease

pruning property

buckthorn is an invasive plant that took over the fields have spent most of our time

removing that

Good size

DISEASE

weather issues do to climate change.

Pollination

wind (high elevation)

Chemical Casts

mulch & organic chicken manure raise pH

Fighting bittersweet vines

Witches Broom

cost of labor

HAIL

Lucky tractor

TRIMMING/PRUNING

Shortage of dedicated help

Twig Blight

VOLES

bermuda grass

drought 2015 - 2016

weed control

Lack of knowledge

insects on plant's OTHER THAN blueberries

SOME PERSISTANT WEEDS

invasive weeds

EXPASION

VOLES

Virginia Creeper

Labor wages

New York Taxes on Property and Business

Help

Blue berry maggot

Witches Broom (Fast Growing To #1)

GETTING BETTER PRODUCTION

Winter Moth

Government Regulations (EPA, Etc)

labor

Labor

Lack of help to harvest

phomarsis from winter injury

Poison Ivy

Having Enough Time

CANKER DISEASES

weed control

WEATHER - SHORT SEASON DUE TO HEAT

H2A Labor Rules

Weather

Keeping current on regulatons

BIRDS

Water

Fields too wet when we have time to spread woodchips

Weed Management

deer feeding on bushes

BLUEBERRY MAGGOT

expense of wood ship & means of distributing them (see 1)

FERTILIZER

Inability to eradicate recurring vines

Grass

SWD

nutrition

weeds

inflation

Overgrown bushes

perennial (spreading) weeds

TAXES

MOLES

Help Seasonal

No one To Take over farm

theft of berries due to birds & humans

Annual Grass

High use fungicides to get a good crop

Virginia Creeper

Weather

Weed control

Cost of increased relocations

bird control

Keeping Bee Colonies Alive

SPOTTED WINGED PROSOPHILA

maggot

Climatic change

Increased labor costs.

WEEDS

SWD - (Berries)

limiting bird damage

Birds

front

HELP/LABORERS/PICKERS

IRRIGATION

Voles & Spotted Wing Drosophila

WEATHER

deer

market interference by gov't & NGO's, resulting in many inefficient producers continuing in business and oversaturating the market place with unsustainably low-priced product

witches broom

birds

WEATHER

EPA and Osha regulations

Wet areas

Bitter Sweet

SWD control

Getting Children Interested in Doing More.

VARIABLE SOIL CONDITIONS FOR BLUEBERRY GROWTH

Federal Regulation

Accessing markets as a small grower.

ANIMALS

Regulations

Fruit Production of older plants

bird

Unrealistic advertising expenses

Birds

Question 84: In what form(s) did you last receive information from the Extension Agent/Specialist?

Mail

plant testing

Office Visit

YEARLY PEST MANAGEMENT GUIDELINES

NY State Expo

Never

Question 85: In what form(s) do you most like receiving information?

twilight meetings

OFFICE Visit

SON (NAME) INTERNET FOR PROBLEM ALERTS ETC. BY MASS. CO-OP EXT.

Question 86: What do you consider your best source for information on blueberries?

The Extension Services

MEETINGS

from our consultant

Coop- Extension

Cornell

fruit grower mtg's

extension - other grower

University spray manuals

twilight meetings and visits to other farms

Extension Specialists Retiring and not being Replaced- A Problem for growers Have to

Rely on Making Conferences AS Much AS Possible

other local producers

extension specialist

High bush Blueberry prod guide, Northeast Reg Ag Eng Ser Coop Ext

NEWSLETTER

MOFGA

Expo

IN THE EARLIER YRS/ - MA. CO-OP AG. EXTENSION.

consultant

ext service

Miscellaneous Comments

We have made it a business for the last 25 years, family farm for the previous 100 + years
don't know- farm is organic I might not be able to do anything about them anyway!

42: BROWN MAR. STINKY BUG

→ our own paid farm consultant not Extension

We were foreclosed on.

not sure some 30 yr. sum are 15 yrs. approx on Both

NONE "YET"

We're slowly going out of business. Good luck on your research. New Hampshire

SWD is ALSO A CONCERN

Dumb Question?

Family Farm since 150

MANAGE WITCHES BROOM W CLEAN TECHNIQUES INCLUDING

CHLORINATING/ OR IODINE ON CUT STEM & DISINFECTING CUTTERS

BETWEEN CUTS FULL REMOVAL

ALL

Winter Moth is a very serious problem in R.I. & Massachusetts!

4/11/2017 Brian: Thank you for allowing me and my farm to be a part of our project. If
you would like to contact me- you may call: (***) ***-**** I am only at the farm from
the end of April to Labor Day. I actually live @ this address: (NAME) (ADDRESS)

Wishing you well with all your educational endeavors. Sincerely, (NAME)

Asian spotted-wing Fruit Fly is our biggest problem

(mixed yrs)

FARM VISITS- LITTLE TO NONE

Replacements only

1/2 A in blueberrys 100 A in all

Rabbiteye .25 Acre

We are hoping for a good crop this year - at the moment they look good tight buds

(almost)

replace a few anually

DEC.

all

You did Not Address irrigation. We used Trickle Irrigation is a very important part of

blueberry production

REPLANTED SOME ROWS TO DIFFERENT VARIETY

None

3x12

All

NONE

started 181

30 Acre apple, .3 Acre pears, 2 Acre cherries tart, 1 Acre pumpkin, rest bldgs, roads,

wood lot, swamp, or leased out to dairy farmer for crops - hay & corn

IN MY FORMER LIFE - SPENT MOST OF MY TIME AS A COUNTY AGENT ON

THE ROAD VISITING FARMS. NH. EXTENSION

Plum Corculio, Japanese Beetle, and Blueberry Maggot are Annual problems, but are

kept well under control using IBM Practices. Spotted Winged Drosophila has been a new

recent pest, but with IBM Practices and harder pruning practices to allow more air flow the problem is easier to handle.

Never planted any

Netted

we use no pesticides

not sure

All

Great survey! Good luck with your studies & research!

Sorry, not able to help. LLC has been dissolved - no longer living here or farming.

I am not sure. We purchase the farm in 12 & rented it to someoneed

at least 25 yrs. ago

No idea

Not alway sure Not major problem

Certain varieties just plain died out, like: Toro, Patriot, and Nelson. So, we just don't grow them.

No skilled enough to define

May 5, 2017 Dear Brian, We have recently leased our blueberry field to a new grower.

My husband passed away and I am only filling out a portion of the form as I do not have the information you asked for. I hope this small amount of info. will help. Good luck on your thesis! Sincerely, (NAME)

Spotted Wing Drosophila is now are largest problem forcing us to close a week to 10 days earlier in our season. Weno longer pick our late Blue blueberry plants because they decimate the crop.

NOT Sure

47 fields, woods, 5 A. cultivated

8' BETWEEN ROWS 4'BETWEEN PLANTS ON ROW.

N.B. Will gladly answer your questionnaire even though my field is currently leased to someone else. (INITIALS)

Does not seem to have blueberry knowledge

MYSELF - 1, SON - 8

all

Sent by email two weeks ago

Witches broom has been our biggest problem. we are surrounded by batgon!

Don't know- see previous comment

Don't Remember

years approx

NONE

Other than noted, the remainder have not been identified as being present

THIS IS IT

on the 1/4 acre

Do Not Have A Local One!

all

#60 - This Downplayed by UMASS & EXT. But For PYO Growers IT'S BAD, Makes Our Fields Look Like Something You See Under Power Lines. Because Customer is in field we Like To have Looking Neat. We Can't Cut Down Host Trees That Are Not Ours But Next to Our field. Also it cost us in Labor To Cute It Out.

HOW DID YOU GET MY NAME TO BE CONTACTED? (EMAIL ADDRESS)

All

Rabbiteye 20%

This is quite a factor on Lot blueberries after Aug 15th

What do these mean?

(Extension Agent) - PSU

ordered for the yr.

None

normal 7.0

DEPENDS ON WHETHER THEIR IS A PROBLEM

I am unformilliar with diseases & pests. I would not know what I was seeing if I found a problem. I do know our field was tested for maggot flies, & not enough were found to test the organic pesticide we were to test.

I put them all down as occasional because I'm sure going "natural" is bringing them in and out. Also, we are still learning what they all are so we might mis-identify.

1810

15 years Blueberries, 100 Apples

I am not really a blueberry farmer. My main fruit is apples. I just have some so I can open the store earlier. Sorry if the answers are not that great

at least 50 yrs.

Never, they are old

Bryan Sorry Debbie I do not know the diseseas to comment

Witches' broom is on the rise. could be increase in residential homes around the farm -
we suspect landscaping with fir trees.

1 cultivated; 5 Acres Native Highbush

- ONLY

P.S. Good luck on your reward project. (INITIALS)

I called my first year they were not helpful.

ALL - 8 -

None

-170

due to too high pit?

if you include e-lists

small amount

NONE

PUT UP ELECTRIC FENCE LAST YEAR

ALL

UMASS

unsure

- field mice

None

Blackberry probably te worst weed.

(purchase bumble bees)

since 88

during season (apple)

ONCE IN A BLUE MOON

There could be more, still learning as time goes & without pesticides/herbicide management.

not sure at least 50

wet

My husband died in 2014

I rated for the insects I know. I could not identify any of the others you listed all (8000 bushes)

1 + 5

Various universities

I DO NOT.

mummy berry not that Ive seen 20 years ago are farm was one of the first farms in NH.

To have it

NONE

EVERY YEAR OR TWO & READ VERN GRUBINGER'S EMAIL UPDATES

#40 - (2016) was the very 1st time I experienced tent caterpillars. I used a completely natural means of eradication. After poking a hole in the tent with a screwdriver, I put the nozzle of a spray bottle into the hole. The bottle was filled with Crisco oil - I let them have it! They breathe through their skin and the oil takes care of them - fast! No harm to the plants or self!

600 - but only 1/2 A so 300

Lost 80% in freeze of April 5 2007, Lost 50% in freeze of April 10 2016

coyotes chew irrigation in winter

? planted in 184 - 175

frequent news %scab mature etc

WHATS THAT

We use no weed controls except for removing them by machine or hand.

I try to keep the grass & weeds mowed & do not have a lot of problems.

I know nothing about diseases

1/2 Native

PURCHASED IN 177.

witch Broom Ive sean it a few times a few pieces

VERN GRUBINGER IS THE BEST!

I'm not sure I could tell one from another.

I've have had rabbiteyes for 25 years for 25 years & have had no no more frost damage from them than my northern highbush zone 56

ferilizer costs, pestocide costs

I sit on the ext. advisors comm @ UVM. Former Trustee UVM

EVERY 2 YRS. THE N.H. SMALL FRUIT/VEG. ASSOC. PROVIDES AN UP TO DATE GUIDE DEVELOPED BY THE 6 N.E. STATES AND USDA AND THE N.E. UTG. & BEARY GROUTERS ASSOC. FOR A PRICE.

Not familiar with many of these problems.

PH has not been tested yet

* MY SON, ROB IS RENTING THE MAIN BB. OPERATION FROM ME FOR APPROX. 5 YRS. I OPERATE & MAINTAIN 1 SEPARATE AC. ALONG W/ SOME VEG. CROPS. WE BOTH USE SIMILAR PRACTICES, BUT I DO NO P.Y.O.

ANYMORE. I GAVE HIM THE ORIGINAL FORM BUT SINCE HE DIDN'T GET TO IT, I DECIDED TO COMP. & SEND THIS ONE ALONG. GOOD LUCK, (NAME)

we have Bind weed a real pain premerge doesn't work on it we pull it and weed wack
TYPICAL

We have an excellent crop every year so if we have any of these it can't be too bad.
about sheep / not sure about blueberries

VIA WORKSHOPS

LATE 0'S

when in season

Not sure

(EXTENSION AGENT) - N.H.

most informative

I do have an occasional bush slowly die but no one has been able to tell me what it is. I
simply pull it out and replace it.

Had one that was unable to tell me what was killing my plants.

Dr. Boone:

We find it ironic that the University wasn't there when we needed it but didn't hesitate to ask for our assistance re: this survey. We are more than happy to share our experiences with high bush blueberries toward the compilation of data, but a recent, puzzling, interaction with the soil testing group gives us pause. While we recognize the possibility that they and you may have little interaction, to the degree that it helps, please advise the appropriate parties that we would appreciate them using our tax dollars a bit more efficiently. Here's the story.

In late winter 16/17, we sent five soil samples for analysis. Results were provided in a timely fashion, and we appreciate it. No recommendations were provided. We contacted both Raleigh and Mercer County Ag Agents for advice. We have had positive experiences with both and have nothing but good things to say about them. Both said it was the first analysis they had seen that did not include recommendations. They gave us a phone number which we tried, but the phone system did not even allow us to leave a message. They also suggested we try emailing the lab and apparently they did so too, on our behalf. Receipt of our email was never acknowledged and to this day we have never received recommendations for our field.

There could be a variety of reasons why the lab has not responded to our request for information all of which would be pure speculation on our part. Needless to say, it would have been nice to have at least received a courtesy response, even if the lab is not prepared to recommend soil amendments for our specialty crop.

As mentioned, we know it is possible that you and department have nothing to do with the lab. We share our unsatisfying experience in hopes that you will forward it to the appropriate parties.

With Regards,

(Name) & (Name)

(***_***_****)

(Email)

APPENDIX E

Lowbush Blueberry Data

Table 18

Lowbush Pick-Your-Own Operation Insect and Mite Severity

Insects and Mites	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Blueberry blossom weevil	1	50.00	1	50.00	0	0.00	0	0.00
Blueberry bud mite	1	50.00	1	50.00	0	0.00	0	0.00
Blueberry gall midge	1	50.00	1	50.00	0	0.00	0	0.00
Blueberry maggot	1	50.00	0	0.00	1	50.00	0	0.00
Blueberry stem borer	1	50.00	1	50.00	0	0.00	0	0.00
Blueberry tip borer	1	50.00	1	50.00	0	0.00	0	0.00
Cherry fruitworm	1	50.00	1	50.00	0	0.00	0	0.00
Cranberry fruitworm	1	50.00	1	50.00	0	0.00	0	0.00
Cranberry fruitworm	1	50.00	1	50.00	0	0.00	0	0.00
Japanese beetle	1	33.33	2	66.67	0	0.00	0	0.00
Oblique banded leafroller	1	50.00	1	50.00	0	0.00	0	0.00
Oriental beetle	1	50.00	1	50.00	0	0.00	0	0.00

Table 18 (continued)

Lowbush Pick-Your-Own Operation Insect and Mite Severity

Insects and Mites	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Plum Curculio	1	50.00	1	50.00	0	0.00	0	0.00
Red banded leafroller	2	100.00	0	0.00	0	0.00	0	0.00
Scale insects	2	100.00	0	0.00	0	0.00	0	0.00
Sharp-nosed leafhopper	2	100.00	0	0.00	0	0.00	0	0.00
Thrips	2	100.00	0	0.00	0	0.00	0	0.00
White grubs	2	100.00	0	0.00	0	0.00	0	0.00
Other	0	0.00	0	0.00	0	0.00	0	0.00

Note. n = 3

Table 19

Lowbush Pick-Your-Own Operation Disease Severity

Disease	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Anthracnose	2	100.00	0	0.00	0	0.00	0	0.00
Armillaria root rot	2	100.00	0	0.00	0	0.00	0	0.00
Blueberry scorch virus	2	100.00	0	0.00	0	0.00	0	0.00
Blueberry shoestring disease	2	100.00	0	0.00	0	0.00	0	0.00
Blueberry stunt	2	100.00	0	0.00	0	0.00	0	0.00
Botryosphaeria stem blight	2	100.00	0	0.00	0	0.00	0	0.00
Botryosphaeria stem canker	2	100.00	0	0.00	0	0.00	0	0.00
Botrytis blight	2	100.00	0	0.00	0	0.00	0	0.00
Coryneum canker	2	100.00	0	0.00	0	0.00	0	0.00
Crown gall	2	100.00	0	0.00	0	0.00	0	0.00
Frusicoccum canker	2	100.00	0	0.00	0	0.00	0	0.00
Mosaic	2	100.00	0	0.00	0	0.00	0	0.00

Table 19 (continued)

Lowbush Pick-Your-Own Operation Disease Severity

Disease	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Mummy berry	1	50.00	0	0.00	1	50.00	0	0.00
Phomopsis twig blight	2	100.00	0	0.00	0	0.00	0	0.00
Phytophthora root rot	2	100.00	0	0.00	0	0.00	0	0.00
Powdery mildew	2	100.00	0	0.00	0	0.00	0	0.00
Red ringspot	2	100.00	0	0.00	0	0.00	0	0.00
Witches' broom	1	33.33	1	33.33	0	0.00	0	0.00

Note. n = 3

Table 20

Lowbush Pick-Your-Own Operation Weed Severity

Weeds	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Annual broadleaf weeds	0	0.00	1	100.00	0	0.00	0	0.00
Annual grasses	0	0.00	1	100.00	0	0.00	0	0.00
Perennial broadleaf grasses	0	0.00	1	100.00	0	0.00	0	0.00
Perennial grasses	0	0.00	1	100.00	0	0.00	0	0.00
Other	0	0.00	0	0.00	0	0.00	0	0.00

Note. n = 3

Table 21

Lowbush Pick-Your-Own Operation Management Problems

Wildlife and Nutrients	Never a problem		Rarely a problem		Occasional problem		Annual problem	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Birds	0	0.00	1	100.00	0	0.00	0	0.00
Deer	0	0.00	1	100.00	0	0.00	0	0.00
Frost	1	100.00	0	0.00	0	0.00	0	0.00
Plant fertility	0	0.00	0	0.00	1	100.00	0	0.00
Pollination	0	0.00	0	0.00	1	100.00	0	0.00
Soil pH	0	0.00	1	100.00	0	0.00	0	0.00
Voles	1	100.00	0	0.00	0	0.00	0	0.00
Woodchucks	1	100.00	0	0.00	0	0.00	0	0.00
Other	1	100.00	0	0.00	0	0.00	0	0.00

Note. n = 3

VITA

Education: **West Virginia University**, Morgantown, WV 26505. *Masters of Science in Agricultural and Extension Education*. August 2017 – July 2017. Course work specializing in: Extension program development and evaluation, research, plant science, and agriculture mechanics.

West Virginia University, Morgantown, WV 26505. Recipient of *Bachelor of Science in Agricultural and Extension Education*. August 2011 – May 2016. Course work specializing in: Plant science, soil science, agriculture mechanics, teaching methods, and FFA/SAE.

Professional Experience: *Groundskeeper, West Virginia State Department of Agriculture*, Charleston, WV 25305. May 2013 – August 2013. Responsibilities included: Greenhouse management, vehicle maintenance, grounds upkeep, landscape design and building maintenance.

Forest Health Protection Specialist, West Virginia State Department of Agriculture, Charleston, WV 25043. May 2015 – August 2015, and May 2016 – August 2016. Responsibilities included: Pesticide management and application, Gypsy Moth monitoring, insect identification, deforestation monitoring, and WVDA market bulletin production formatting and assembly.