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Assessing Homeowners' Lawn Management Practices and Preferred Sources of Educational Information

Candace J. Schaible
Utah State University

ASSESSING HOMEOWNERS' LAWN MANAGEMENT PRACTICES AND PREFERRED SOURCES OF EDUCATIONAL INFORMATION

by

Candace J. Schaible

A thesis submitted in partial fulfillment
of the requirements for the degree

of

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Approved:

_____	_____
Rhonda Miller, Ph.D. Major Professor	Kelly Kopp, Ph.D. Committee Member
_____	_____
Chad Reid, M.S. Committee Member	Mark R. McLellan, Ph.D. Vice President for Research and Dean of the School of Graduate Studies

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ABSTRACT

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Candace J. Schaible, Master of Science

Utah State University, 2018

Major Professor: Rhonda Miller, Ph.D.
Department: School of Applied Sciences, Technology and Education

Prior to the development of programing and outreach materials it is important for Extension outreach and education professionals to assess the educational needs and preference of the communities they serve. Survey data was gathered from 198 residents of Cedar City, UT, in an effort to gain an understanding of current lawn management practices and the resources homeowners utilize when making management decisions. In addition, soil samples were collected from a subset of participants (n=74) to compare nutrient levels to management practices.

Fourteen of forty-one survey questions gathered insight on the resources homeowners use when making management decisions. Results found that homeowners accessed multiple sources, with preferences leaning towards the use of friends and family members, the internet, and the point of purchase. Few homeowners, with the exception of Extension Master Gardeners (EMG), are aware of and utilize educational resources

and services provided by Extension. This is especially true for those under the age of 50, which poses a challenge to Extension professionals to find effective ways to reach younger generations. Once exposed to Extension's resources, through community classes and programing, homeowners tended to have a high opinion of the service and preferred it as an educational source over other options.

Twenty-three questions addressed lawn management practices, specifically water and nutrient management. The majority (96%) of respondents had a lawn. Of those that self-manage their lawn (n=182), 93% used fertilizer, with a preference towards synthetics (82%). When looking at irrigation practices, the majority of homeowners had an automatic irrigation system (AIS) vs. a manual irrigation system (MIS) with a percentage ratio of 66:33. Those with a MIS watered less frequently (3.68 irrigations/week in July) than those with an AIS (4.39 irrigations/week in July).

It was difficult to form associations between high soil nitrogen (NO_3^-), and phosphorus (P) concentrations and management practices. Although, there was a strong association between those with excessive P concentration (P>50ppm) and the application of biosolids. More research needs to be done to examine the distribution and end use of biosolids. The information obtained in this study will contribute to the improvement of educational efforts by USUE.

PUBLIC ABSTRACT

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Prior to the development of programing and outreach materials it is important for Extension outreach and education professionals to assess the educational needs and preference of the communities they serve. Survey data was gathered from residents of Cedar City, UT, in an effort to gain an understanding of current lawn management practices and the resources homeowners utilize when making management decisions. In addition, soil samples were collected from a subset of participants to compare nutrient levels to management practices.

Survey results found that homeowners accessed multiple sources, with preferences leaning towards the use of friends and family members, the internet, and the point of purchase. Few homeowners are aware of and utilize educational resources and services provided by Extension. This is especially true for those under the age of 50, which poses a challenge to Extension professionals to find effective ways to reach younger generations.

It was difficult to form associations between nutrient levels and management practices Although, there was a strong association between those with excessive phosphorus concentration and the application of biosolids. More research needs to be done to examine the distribution and end use of biosolids.

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CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

INTRODUCTION

Background and Setting

Research is needed to determine the resources homeowners are using to make lawn management decisions and whether these resources have a positive impact on their management practices. This research project examined the resources used when making lawn management decisions, preferred learning styles, and basic nutrient and water management practices of homeowners surveyed in Cedar City, UT. In addition, soil samples were collected from a subsample of those surveyed to compare measured nutrient levels to management practices. A better understanding of the homeowners' water and nutrient management practices is needed prior to developing outreach materials and educational programming. Research findings could increase effectiveness and impacts of educational efforts by Utah State University Extension (USUE).

Problem Statement

The American lawn has been a main feature in the home landscape since the development of suburbs after World War II (Jackson, 1985), and has continued to expand making it our nation's single largest irrigated crop (Lindsey, 2005). As the American lawn has expanded, so has the overall input to maintain the space. This expansion has led to an increased interest in homeowners' lawn management practices due to the rise in nutrients entering our watershed caused by the over-application of fertilizers and excessive irrigation (Law, Band & Grove, 2004). Although nutrients are needed for plant

growth, excessive nutrients in surface and ground water can be problematic. Nutrients in surface waters lead to excess algae growth which depletes oxygen, killing aquatic life. Nutrients that leach past the root zone contaminate groundwater which can result in health problems for both humans and livestock. While multiple irrigation studies have been conducted in Utah, there is much uncertainty about the nutrient management practices of home lawns. Proper use of nutrients is imperative in maintaining our natural resources and protecting our water quality.

While some may argue that efforts to reduce chemical inputs would be better focused within the agriculture community it is important to note that on a per-hectare basis, more chemical inputs are added to the lawn than are used for food production (Robbins & Sharp, 2003). According to the 2016 National Gardening Survey, the do-it-yourself yard and garden sector is a $36.9-billion-dollar industry (Garden Research, n.d.). In addition, unlike agriculture and landscape professionals, homeowners rarely receive training on appropriate fertilizer application rates, frequency, storage, and disposal; nor do they understand the environmental impacts of its use. Results of an Oregon watershed study reports that only 15% of residents could correctly report where storm water goes after it runs off their landscape (Nielson & Smith, 2005).

In an effort to protect water quality and water availability, USUE has developed many educational resources and services, including the USU Soil Analytical Laboratories, which provide educational information on appropriate lawn management practices; but, the percent of homeowners accessing this information is unclear. It is also uncertain whether homeowners that are accessing this information are implementing the practices properly. Previous studies report that few homeowners are aware of and utilize

lawn management information provided by Cooperative Extension (Varlamoff et al., 2002), and even fewer are utilizing soil testing as a means for determining nutrient application (Morris & Traxler; 1992; Swann, 1999; Varlamoff et al., 2001; Law et al., 2004; Osmond & Hardy, 2004; Sewell et al., 2010). Past research has shown that product labels, store attendants, and lawn care companies serve as the primary sources of information for homeowners that do their own lawn care maintenance (Aveni, 1994; Swann, 1999).

In order to encourage proper landscape management practices, educational information and programing needs to be disseminated through widely used and preferred sources. As education and outreach professionals it is important to frequently assess and modify efforts to meet the needs of our clientele.

Objectives

Considering the multiple means of accessing information today, it is important to understand the preferred sources of information and current management practices prior to planning effective educational programming. The objectives of this research project were to assess homeowners' lawn management practices and their current and preferred sources of management information by conducting a survey of residents of Cedar City, Utah; and collect soil samples from a subset of those surveyed to compare nutrient need to management practices. The findings of this project will assist in the development and dissemination of educational programing and resources based on community need and preference.

CHAPTER II

REVIEW OF LITERATURE

Review Objectives

This review of the literature focused on answering the research questions and support the need for the assessment of homeowners' lawn management practices and their currently used and preferred sources of educational information, in relation to lawn management. Articles were included in this systematic review if they represented a study published in a peer-reviewed journal, and were relevant to the research objectives:

1. Describe current research that has been conducted on the lawn management practices of homeowners.
2. Describe current research evaluating the educational resources homeowners are accessing for lawn management information.
3. Discuss the issues, strengths, and weaknesses in the previous studies.
4. Draw conclusions based on this information from which the research questions and strategies for this study were formulated.

Research Design Characteristics

Measures

Preference was given to studies that surveyed homeowners' lawn management practices and/or the resources homeowners use when making lawn management decisions. Projects reviewed were a mix of phone interviews and mailed surveys. All information collected in reviewed articles was self-reported by the participant. Surveys

focusing on assessing homeowners' lawn management practices addressed the following questions:

- How often and at what frequency are fertilizers being applied to home lawns?
- What resources are homeowners using to determine appropriate lawn management practices?
- What percentages of lawns are managed by landscape professionals?
- Are soil tests conducted prior to fertilizer applications?
- What are the irrigation practices?

Surveys focusing on measuring homeowners' preferred sources of educational information focused on answering the following questions:

- How do homeowners acquire new information?
- What educational methods are preferred?

Validity Threats

Studies included a control group, and randomly selected participants. Validity threats include: 1) potential for the presence of the interviewer inducing socially desired answers (or other biases) during the phone survey process; 2) bias from answers being self-reported on a survey; 3) low response rate.

Review Outcomes

Cedar City is located within the Central Iron County Water Conservancy District's service area. Iron County's most recent economic and fiscal analysis of water resource in the valley indicates that groundwater levels have been depleting for the past

50 years, and the resource will not meet projected future demands, potentially causing significant economic and ecological implications (Applied Analysis, 2017).

Based on state-wide average annual precipitation, Utah is ranked as the second driest state in the nation (Osborn, 2017). Cedar City averages 10.85" of precipitation per year, with only 5.32" occurring during the six month (May-October) growing season (USU Climate Center, 2017).

Large inputs of water and nutrients are needed to establish and maintain lawns in arid environments. In excess, these inputs represent a potential source of non-point pollution that may contribute to water quality impairment and availability. Of the 10 non-point pollution source categories listed in the National Water Quality Inventory: 2000 Report to Congress, "urban runoff/storm sewers" was ranked as the tenth leading source of impairment in rivers, sixth in lakes, and eighth in estuaries (USEPA, 2009). In an effort to reduce these impacts and improve water quality, several states such as Washington, Florida, Maryland, California, Illinois, and several Great Lake states have implemented fertilizer regulations. For example, in Maryland, the Fertilizer Use Act of 2011 requires that anyone applying nutrients to a lawn area needs to be certified and licensed by Maryland Department of Agriculture (Maryland Department of Agriculture, n.d.). Eleven states prohibit the sale of turf fertilizers that contain phosphorus: Illinois, Maine, Maryland, Michigan, Minnesota, New Jersey, New York, Vermont, Virginia, Washington, and Wisconsin (Miller, 2012).

Although fertilizers have been a main focus in watershed management programs, the link between use and water quality impairment is complex. Management practices and overall turf quality play a role in nutrient leaching and surface loss. A recent

comparative assessment of runoff nitrogen from mixed landscape watersheds with mixed management intensities found that a moderately managed turf watershed (weekly mowing, 60.9 kg N/ha/yr, late fall fertilizer application) produced lower base flow nitrate and total nitrogen concentration than both the low and high management sites (Bachman et al., 2016). This is consistent with earlier studies which suggest that a well-managed, high density turf retains nutrients and minimizes leaching and surface loss (Miltner et al., 1996; Petrovic & Easton, 2005), and suggest that overall plant growth, shoot density, and established root system are related to the turf's ability to reduce nutrient leachate and runoff (Easton & Petrovic, 2004).

The percent of homeowners applying fertilizer to the landscape varies by region, with soil testing not being a predominate resource when making management decisions (Table 1). A Nebraska study found that 91% of residents surveyed reported applying fertilizers to their lawn at least once a year. In addition, only 3% of those surveyed had ever had their soil tested and only 52% followed the directions given on the product label (Sewell et al., 2010). Homeowners applying fertilizer regardless of actual nutrient need is cause for concern. Osmond and Hardy (2004) found similar results in their study of five North Carolina communities. Varlamoff et al., (2001) reported that 76% of Georgia homeowners applied fertilizers to their landscape, with 79% of those respondents applying them to their lawns. Table 1 summarizes results from six lawn management surveys completed in various locations. While these studies suggest the majority of homeowners apply fertilizers, none of these studies compared fertilizer practice to soil nutrient levels, or determined whether soil testing had a positive impact on fertilizer practice.

Table 1

Summary of Six Lawn Management Surveys

Study Location	# of Respondents	% Fertilizing	% Soil Testing
Glydon, MD (Law et al., 2004)	60	68%	19%
Baisman Run, MD (Law et al., 2004)	40	56%	13%
Nebraska (Sewell et al., 2010)	68	91%	3%
Chesapeake Bay (Swann, 1999)	656	50%	16%
Minnesota (Morris & Traxler, 1992)	981	75%	12%
Georgia (Varlamoff et al., 2001)	124	60%	na
Kinston, NC (Osmond & Hardy, 2004)	130	54%	16%
Cary, NC (Osmond & Hardy, 2004)	300	83%	23%

CHAPTER III

METHODOLOGY

Study Area

The state of Utah falls within four hydrological regions, including: The Great Basin Region, the Upper Colorado Region, the Lower Colorado Region, and the Pacific Northwest Region. Surveys were mailed and administered to residents in Cedar City, Utah which is located within the Great Basin Region. More specifically, in the Cedar/Beaver River Watershed Management Unit, within the Escalante Desert-Sevier Lake sub-region. The major streams within this unit are the Beaver River, Coal Creek, Shoal Creek and Pinto Creek (Ramsey, Banner & McGinty, 2006).

Cedar City sits at 5,840 feet above sea level and averages 10.85" of precipitation per year, with only 5.32" occurring during the six month (May-October) growing season (USU Climate Center, 2017). Cool-season turf varieties are the predominate turf type.

The following is the most recent demographic data available from the Census Bureau summarized by Town Charts (n.d.):

- 2016 population, 31,223
- Ethnicity
    - White, 89%
    - Hispanic or Latino, 7%
    - American Indian, 2%
    - Asian, Black or African American, <1%

- 1:1 ratio of male to female
- Median age, 24 years
- Median household income, $43,130
- Median home value, $185,920
- Highest level of education
    - High school or GED, 21%
    - Associates degree, 20%
    - Bachelor's degree, 53%
    - Master's degree, 20%
    - Post graduate degree, 4%

Survey Development

A 41-question survey of Cedar City homeowners was conducted by USUE, using a set of questions developed by Extension horticulturists and agronomists. Fourteen of these questions had an education or awareness component, allowing for the analysis of preferred sources of information, and gauging the awareness, utilization, and value of Extension programing and services. Twenty-three questions evaluated water and nutrient management practices. The remaining four questions requested demographic information. The survey was reviewed by a panel of experts to ensure validity, and the research protocol was approved by USU's Institutional Review Board. An online version of the survey was created using Qualtrics, a secure web-based survey system. In addition, soil samples were collected from a subsample of survey participants to compare nutrient levels to management practices. Surveys were distributed during 2014 and 2015.

Research Questions

1) What resources are homeowners using to determine lawn management practices?
2) Are homeowners utilizing programing and services offered by USUE, and do these resources have a positive effect on practices?
3) Which areas of lawn management are homeowners less informed or misinformed?
4) Do relationships exist between lawn management practice and measured soil nutrient levels?

Population

Five groups were selected to participate in the survey: 1) a random sample of 500 Cedar City homeowners (83 replies); 2) attendees of Cedar City's Downtown Farmers Market (28 replies); 3) Iron County Water Check program participants (36 replies); 4) individuals picking up free biosolids supplied by the waste water treatment plant (29 replies), and; 5) Extension Master Gardeners (37 replies), totaling 213 replies.

Mailed Surveys

Surveys were mailed to a random sample of 500 Cedar City homeowners, during the fall of 2014. Contact information and homeownership status was provided by the Iron County Recorder's office.

Procedures used for this survey were based on Dillman's guiding principles for mail and internet surveys (2009). The first mailing, an invitation postcard (Appendix A), was sent on September 15, 2014 and included information that introduced individuals to the project, announced the survey would be arriving, made them aware of a prize drawing they could enter, and thanked them for their participation.

The seconding mailing, sent on September, 23, 2014 included the following: 1) a cover letter (Appendix C) from the Agriculture Environmental Quality Extension specialist at USU and the USU Iron County Extension horticulturist, inviting participation in the survey and 2) a survey instrument (Appendix D).

The third mailing, consisting of a reminder postcard (Appendix B), was mailed to the nonrespondents on October 15, 2014. The postcard acted as a friendly reminder to complete the survey and included a link to the online version, which was created using Qualtrics.

Returned surveys were counted to track sample status and response rate. Peak survey response rate occurred the week following the mailing of the survey instrument (second mailing), with a response from forty-three individuals (52% of returned surveys) (Figure 1).

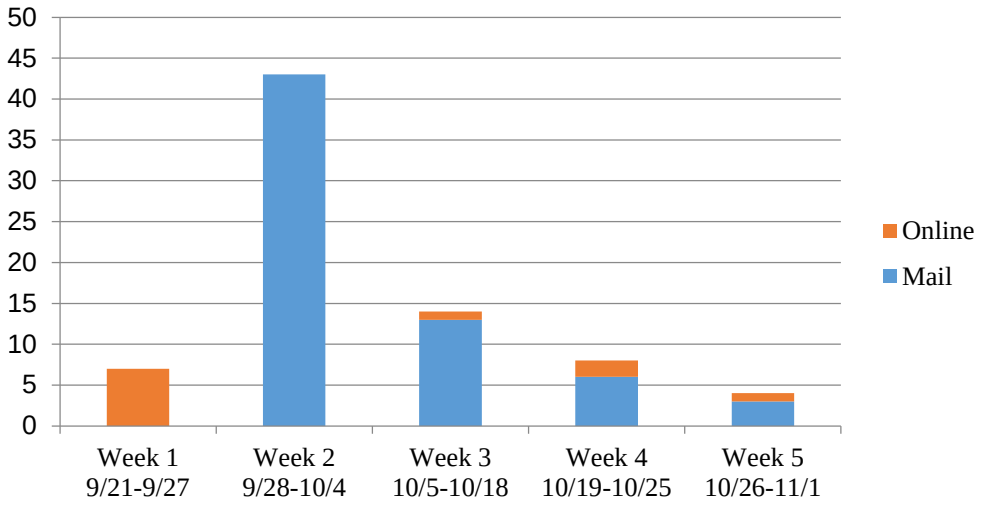

Figure 1. Survey Response Rate, 2014

Surveys were returned by 83 individuals, for an overall response rate of 17%. Twelve individuals choose to use the online survey. Four surveys were discarded due to incomplete responses or non-resident status.

Cedar City's Downtown Farmers Market

Patrons attending the weekly market during September, of 2014 were invited to participate and given a five-dollar market gift certificate upon survey completion. Surveys were filled out onsite by the participant and later entered into Qualtrics. Twenty-eight individuals completed the survey. The selection criteria for inclusions were 1) own a home in Cedar City, Utah and 2) had not previously completed the survey.

Biosolid Give Away

Biosolids, or treated sewage sludge, is annually distributed by Cedar City's Regional Wastewater Treatment Facility to the public as a soil amendment. Biosolids, as defined by the Environmental Protection Agency, are:

> "nutrient-rich organic materials resulting from the treatment of domestic sewage in a treatment facility. When treated and processed, these residuals can be recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth." ("Biosolids," n.d.).

During the March, 2015 give away, biosolid recipients were asked to complete the survey. Surveys were filled out onsite by the participant and later entered into Qualtrics. Twenty-nine individuals completed the survey. Three were discarded due to incomplete responses.

USU Water Check Program

The USU, Iron County Extension Service and the Central Iron County Water Conservancy District provide free irrigation audits to individuals in Iron County, UT. Those participating in the 2015 water check program were invited via email to complete the survey online using Qualtrics. Thirty-six individuals completed the survey. Two were discarded due to incomplete responses.

Extension Master Gardener Program

The program began in 2009, with the intent to educate Utahns about the art and science of growing and caring for plants. The program consists of 40 hours of course work, followed by 40 hours of horticulture-related volunteer service. Those that had previously completed the program (n=141) were invited to complete the online survey, via email, in August of 2014. Surveys were completed by 37 individuals. Six surveys were discarded due to incomplete responses.

Nutrient Analysis

Soil samples from 74 individuals were analyzed for nitrogen and phosphorus content to assess the soil nutrient levels. Twenty-four individuals were randomly selected from those participating in the water check program, 10 from the biosolids group, and 40 from the mail survey group. Soil pH and texture were not evaluated for each site. According to the USUE Iron County Agriculture Agent, based on previous soil analyses conducted by USU's Soil Analytical Laboratory, the predominate soil texture in Cedar City, UT is clay loam, with a pH range of 7.5-8.0 (personal communications, December 5, 2017).

Soil Sampling Procedures

Soil samples from the mailed survey group were collected in December of 2014 (30 collected) and May of 2015 (10 collected). Samples from the biosolids group were collected in May of 2015. Samples from the water check group were collected when the water check took place, during the summer of 2015 (June and July). Soil samples were collected by compositing 5-7 cores from the front yard of each of the 74 participants. All samples were air dried at room temperature, and then sealed in plastic bags until analysis.

Standard Fertility Soil Test

Soil samples were submitted to Dr. Rhonda Miller's lab in the Agriculture Systems Technology and Education building on the USU campus in Logan, UT for analysis. Soil phosphorus availability was determined using the "Olsen P" or sodium bicarbonate soil phosphorus method developed by Sterling R. Olsen and colleges (Olsen et al., 1954). Two grams of soil were extracted with 40 ml of 0.5 M $NaHCO_3$ solution and shaken for 30 minutes. Concentration of P in the extracts were measured on a Lachat

QuikChem 8500 Series 2 flow-injection autoanalyzer (Hach Company; QuikChem Method 12-115-01-1-Q for P). For nitrates, 5g of each soil sample were extracted with 40 mL of 2 M KCl and shaken in a horizontal shaker for 1 hour. Concentrations of NO_3^- in the extracts were measured on a Lachat QuikChem 8500 Series 2 flow-injection autoanalyzer (Hach Company; QuikChem Method 12-107-04-1-F for NO_3^-). Results are reported as parts per million (ppm) phosphorus (P) and parts per million (ppm) nitrate (NO_3^-) in the soil.

Data Analysis

Surveys with unclear or incomplete responses (15 replies) were discarded and not included in the analysis, resulting in a sample size of 198 participants. These responses were manually entered into Qualtrics by either the participant or the researcher. Next, the resulting Qualtrics file was exported to SPSS (IMB, version 24) for statistical analysis. Responses were analyzed to determine difference in responses between groups, demographics, and management practice. Since the survey targeted homeowners, the majority of respondents reported that they owned their home. Therefore, the variable for home ownership was excluded from analysis. A sizable portion of data consisted of a nominal variable and ranked variable. To analyze nominal and ranked variables, which did not meet the assumptions for normality, a Kruskal-Wallis H test was used to determine if statistical significant differences existed between two or more groups of independent variables by ordinal/continuous dependent variables (Statistics Solutions, 2013). For example, determining whether the surveyed groups acquire lawn management information differently, or utilize Extension services and resources at different rates.

When significant differences were revealed, post hoc comparisons were conducted using the Dunn-Bonferroni procedure. Resulting P values <.05 were considered significant.

Bivariate measures of association between continuous test variables were examined using Pearson's r correlation coefficient, for example, determining if soil P levels increased with the number of seasonal fertilizer applications. Descriptive statistics including, cross-tabulations, frequency, and percentages were performed to assess the relationship between variables and analyze categorical data.

CHAPTER IV

RESULTS AND DISCUSSION

Survey

Surveys were completed by 213 individuals from the five groups: 1) a random sample of 500 Cedar City homeowners (83 replies); 2) attendees of Cedar City's Downtown Farmers Market (28 replies); 3) Iron County water check program participants (36 replies); 4) individuals picking up free biosolids supplied by the waste water treatment plant (29 replies), and 5) EMG (37 replies). Surveys with unclear or incomplete responses (15 replies) were discarded and not included in the analysis, resulting in a sample size of 198 participants.

Demographics

A series of questions requested socio-economic and demographic information from each respondent. This information enabled the comparison of responses with respect to age, gender, and education level.

Since the survey targeted homeowners, the majority of respondents reported that they owned their home (92%). Therefore, the variable for home ownership was excluded from analysis. Additional demographic characteristics are summarized in Table 2:

- The average age of participants was between 50-59 years of age.
- Slightly over half (52%) of the participants were male.
- Half of the participants had obtained a bachelor's degree or higher and 71.5% had obtained at least an associates or technical degree.

A Kruskal-Wallis H test determined that the distribution of age and education level was the same across the five groups. The distribution of gender was not, with the EMG survey respondents having a higher number of female participants, $x^2(4) = 10.368$, $p = .035$, when compared to the biosolids ($p = .003$) and the mailed survey groups ($p = .027$).

Table 2

Demographic Information

Characteristic	Water Check (%)	EMG (%)	Farmers Market (%)	Mailed Survey (%)	Biosolids (%)
Sample Size	34	31	28	79	26
Age					
<30	14.7	3.2	17.9	5.1	3.8
30-39	23.5	9.7	17.9	10.1	23.1
40-49	8.8	16.1	21.4	20.3	19.2
50-59	11.8	29.0	17.9	29.1	3.8
>60	41.2	41.9	25.0	35.4	46.2
Missing	0.0	0.0	0.0	1.3	3.8
Gender					
Male	55.9	32.3	42.9	55.0	69.2
Female	44.1	67.7	57.1	43.8	26.9
Missing	0.0	0.0	0.0	1.3	3.8
Education					
High school	26.5	16.1	25	31.3	19.2
Associates	17.6	25.8	32.1	16.3	23.1
Bachelors	29.4	16.1	25	26.3	26.9
Graduate	20.6	12.9	7.1	12.5	19.2
Post Graduate	0.0	29.0	7.1	12.5	7.7
Missing	5.5	0.0	3.6	1.3	3.8

Used and Preferred Sources of Educational Information

Survey participants were asked to indicate currently used and preferred sources of yard and garden information. Participants were given fourteen predetermined choices as well as an option to indicate additional resources not listed by the researcher.

Respondents were asked to select all options that apply from the provided list. The fourteen predetermined choices included; a) internet, b) friends or family members, c) local nursery, d) garden center employees, e) USU Extension website, f) County Extension Office, g) gardening magazines, h) YouTube, i) television, j) gardening books, k) newspaper, l) EMG, m) community classes, and n) radio. Participants were then asked to rank their top five preferred sources of information, from the same list of fourteen, with #1 being their favorite, #2 being their second favorite, etc.

Sources used. The distribution of the use of several resources was significantly different among groups, with EMG showing a higher usage of USUE resources. Due to this strong preference EMG were not included in the following analysis (Figure 2).

Seventy-three percent of participants indicated the use of the "internet" as resource when seeking yard and garden information. Internet use was followed by "friends or family members" (70%), and "local nurseries" (55%). The "internet" is being used by almost three quarters of the participants, but only a small portion are using "YouTube" (15%) and the "USUE Website" (20%). A third of the respondents indicated the use of "garden centers", like Home Depot or Walmart, which was far less than the 55% that utilize "local nurseries". A small portion of the population reported the use of USUE services such as the "County Extension Office" (22%), "USUE Website" (20%), "EMG volunteers" (9%), and "community classes" (5%). "Gardening magazines" (17%), "gardening books" (15%), "television" (16%), "newspaper" (13%), and the "radio" (4%) were also indicated as sources used by a small portion of participants. Fourteen individuals selected "other" (8%) listing the Cedar City Mayor's Newsletter, the Central Iron County Water Conservancy District, Spring Home and Garden Show, High

Country Garden's catalog and website, personal experience, and landscape maintenance companies, as other sources of information.

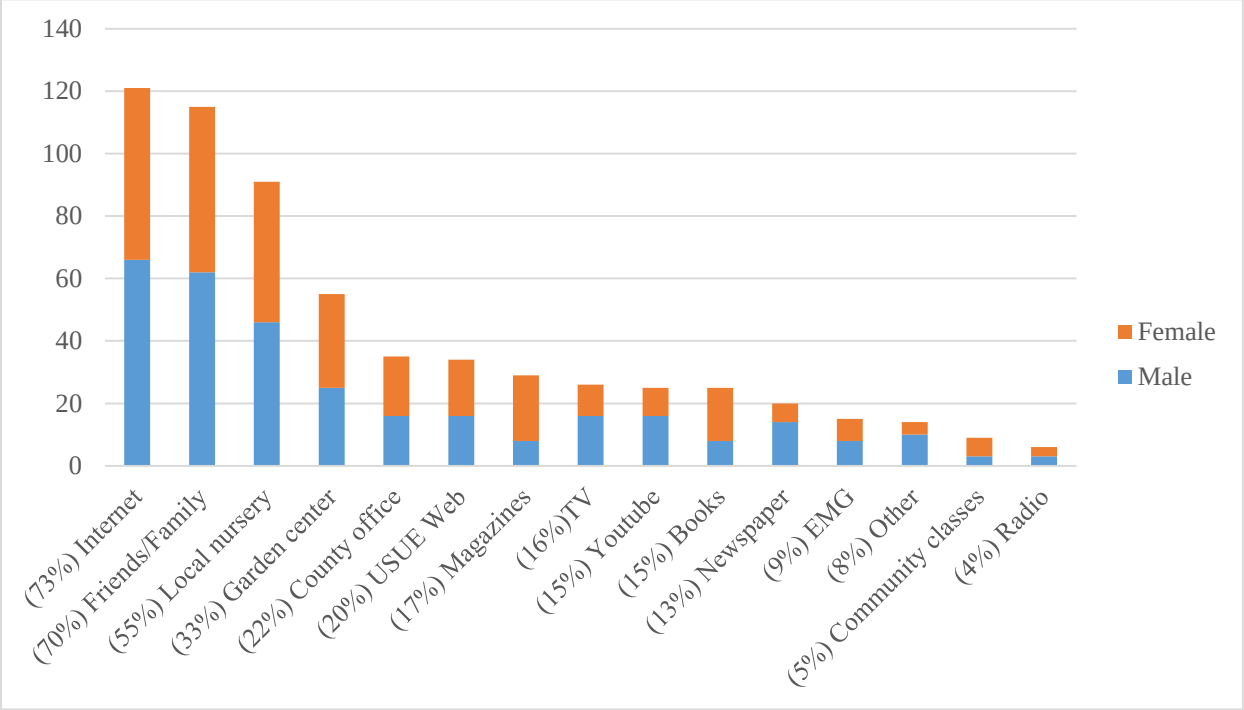

Figure 2. Educational resources Cedar City, UT residents used when seeking yard and garden information, gender preference, excluding EMG

Group preference. Multiple group differences occurred (Figure 3) in the reported usage of the "internet", $x^2(4) = 10.007$, $p = .040$, "USUE website", $x^2(4) = 58.877$, $p < .001$, "gardening magazines", $x^2(4) = 24.398$, $p < .001$, "gardening books", $x^2(4) = 44.766$, $p < .001$, "County Extension Office", $x^2(4) = 28.956$, $p < .001$, "EMG", $x^2(4) = 65.535$, $p < .001$, "community classes", $x^2(4) = 39.345$, $p < .001$, and the "local nursery", $x^2(4) = 15.534$, $p = .004$, as informational sources when seeking yard and garden information.

- EMG (97%) had the highest reported usage of the "internet" as an information source. This group's usage was significantly higher when compared to the mailed survey (69%, p=.002) and the farmers market groups (75%, p=.048).
- EMG had the highest reported usage of the following resources when compared to all other groups (p<.001):
    - "USUE website" (83.9%)
    - "County Extension Office" (64.5%)
    - "EMG" (71%)
    - "Community Classes" (45.2%)
    - "Gardening magazines" (58.1%)
    - "Gardening books" (67.7%)
- The water check group (41%) showed a significantly higher usage of the "USUE website" when compared to the farmers market (14%, p=.023) and the mailed survey groups (13%, p=.002).
- The farmers market group (32%) showed a significantly higher usage of "gardening books" when compared to the mailed survey group (11%, p=.025).
- EMG (81%) had the highest reported usage of "local nursery" employees as an information source. This group's usage was significantly higher when compared to the farmers market (46%, p= .008), mailed survey (56%, p=.019), and the biosolids group (39%, p= .001). The water check

group (74%) showed a significantly higher usage when compared to the biosolids (39%, p=.006) and the farmers market group (46%, p=.031).

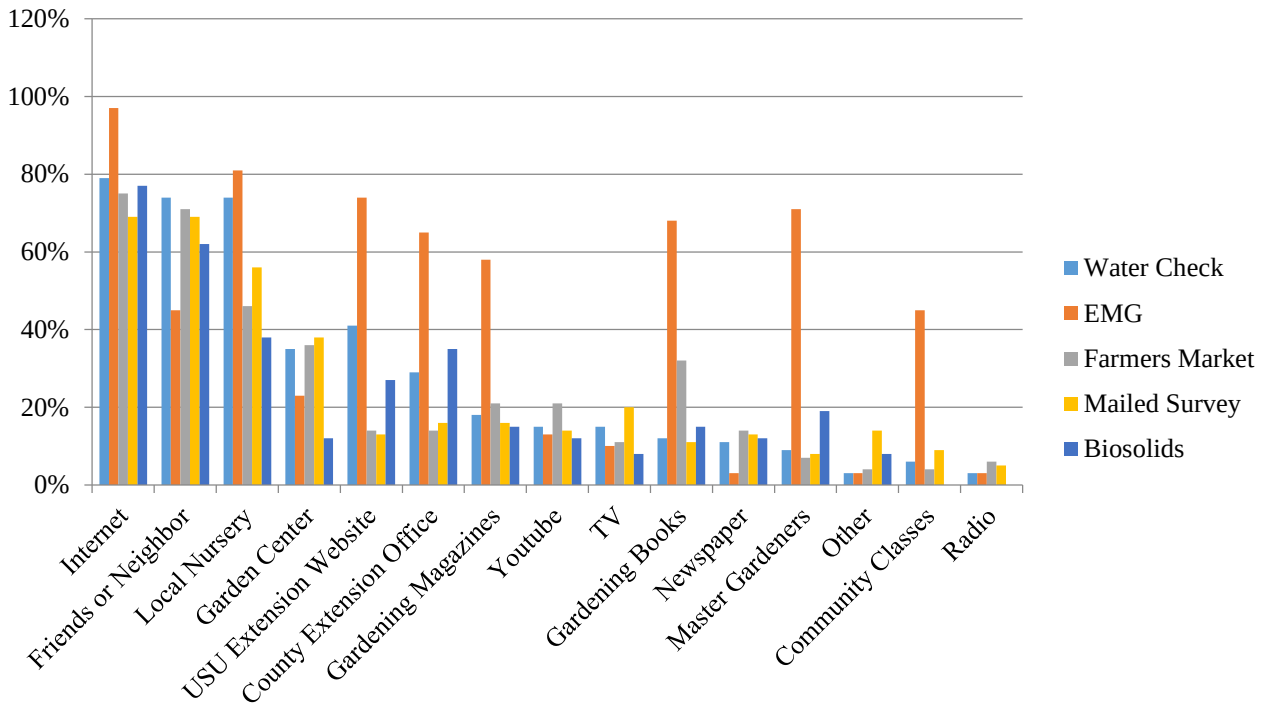

Figure 3. Educational sources Cedar City, UT residents used when seeking yard and garden information, group preference

Statistical differences among demographics. The distribution of "friends or family members", $x^2(5) = 15.788$, p=.007, and "community classes" $x^2(5) = 19.889$, p<.001 was not the same across all age categories.

- Those over the age of 60 (51%) were least likely to report the use of "friends or family members" as a resource when seeking yard and garden information. This was statically significant when compared to the under 30 age group (81%, p=.023), and those between the ages of 40-49 (86%, p < .001).

- Those between the ages of 50-59 (31%) were more likely to report the use of "community classes", which was statically significant when compared to those under 30 (0%, $p < .001$), those between 30-39 (10%, $p=.007$), 40-49 (3%, $p < .001$), and those over 60 (10%, $p=.001$).

The distribution of "gardening books", $x^2(2) = 10.907$, $p=.004$, and "magazines" $x^2(2) = 10.907$, $p=.004$, "County Extension Office", $x^2(2) = 6.498$, $p=.039$, and "community classes" $x^2(2) = 6.152$, $p=.046$, was not the same across all gender categories (Figure 2).

- Female respondents were more likely to report the use of "gardening books" (34%), "gardening magazines" (34%), "County Extension Office" (36%), and "community classes" (18%).

Preferred sources. The survey data also explored the participants' preferred educational sources when seeking yard and garden information. As shown in Table 3, "friends or family members", "internet", and the point of purchase were among the most preferred resources. The "County Extension Office", "USUE Website", "gardening books", and "magazines" were also ranked highly, but only among EMG.

Table 3

Ranking of Top Five Preferred Sources of Educational Information, 0=not used, 5=Most Used

Information Source	Overall (n=198) Mean	Excluding EMG (n=167) Mean	EMG (n=31) Mean
Friends and/or Family	2.73	3.05	1.00
Members	2.24	2.29	1.94
Local Nursery	2.25	2.20	2.55
Internet	1.07	1.24	0.13
Garden Center	0.84	0.62	2.03
County Extension Office	0.86	0.61	2.26
USU Extension Website	0.52	0.60	0.10
Television	0.71	0.56	1.55
Gardening Books	0.41	0.48	0.00
Newspaper	0.57	0.43	1.32
Gardening Magazines	0.33	0.38	0.23
YouTube	0.46	0.35	0.94
EMG	0.28	0.30	0.16
Other	0.32	0.28	0.55
Classes and Workshops	0.15	0.17	0.00
Radio			

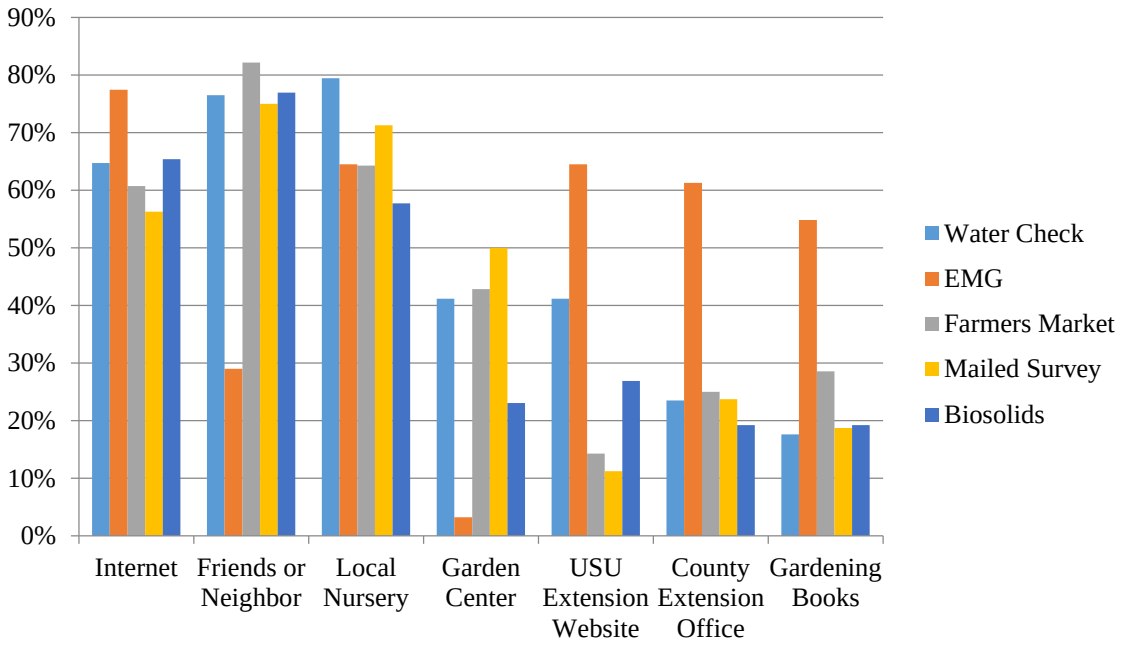

Figure 4. Percent of participants ranking resource as one of top five preferred sources of educational information, group preference

***Group preference*.** As Table 3 and Figure 4 show, preference varied across the different surveyed groups. Again, the prominent differences were found between the EMG and other groups. For example, EMG had the lowest preferences for utilizing "friends or family members", $x^2(4) = 28.580$, $p < .001$, and "garden center" employees, $x^2(4) = 23.123$, $p < .001$. They had the highest preference for utilizing "gardening magazines", $x^2(4) = 28.580$, $p = .004$, "gardening books" $x^2(4) = 17.222$, $p = .002$, and Extension services and programing such as; the "USUE website", $x^2(4) = 40.932$, $p < .001$, and the "County Office", $x^2(4) = 21.420$, $p < .001$. EMG also had the highest preference for utilizing other "EMG", $x^2(4) = 14.201$, $p = .007$, but this distribution was only significantly different when compared to the water check (p=.001), mailed survey (p=.002), and farmers market groups (p=.011). EMG also had the highest preference for

attending "community classes and workshops", $x^2(4) = 11.292$, $p = .023$, but the distribution was only significantly different when compared to the mailed survey ($p=.003$), and biosolids groups ($p=.004$). The following additional statistically significant differences occurred between groups:

- "Television", while overall not a preferred source, received a significantly higher ranking from the mailed survey group $x^2(4) = 20.981$, $p < .001$. The preference ranking was significantly higher than the water check ($p < .001$), EMG ($p < .001$), and the biosolids groups ($p=.013$).
- "Radio", while overall not a preferred source, was most likely to be preferred by those attending the farmers market $x^2(4) = 13.210$, $p =.010$.
- In addition to the EMG group (mean=2.26), the water check group (mean= 1.29) also had a high preference for utilizing the "USUE website" $x^2(4) = 12.521$, $p=.014$, but the distribution was only significantly different from the farmers market ($p=.019$) and the mailed survey groups ($p=.001$).
- The mailed survey group had the highest ranking of "newspaper" as a preferred source $x^2(4) = 12.524$, $p=.014$, but the distribution was only significantly different when compared to the EMG ($p<.001$), and water check groups ($p=.022$).

***Statistical difference among demographics*.** The following differences occurred when comparing the responses of male and female participants:

- Female respondents were more likely to select "gardening book" as preferred source, $x^2(1) = 4.412$, $p =.036$. Overall, only 14% of respondents selected

"gardening books" as one of their top five choices, 33% were female (n=31), 19% were male (n=20).

- Male respondents were more likely to select "television" x^2 (1) = 4.353, p =.037, and "YouTube", x^2 (1) = 4.305, p =.038, as preferred information sources. Again, both of these sources were ranked low overall, with only 19% of respondents ranking "television" and 13% ranking "YouTube" in their top five.
- Age played a factor when comparing participants' preference for "television", $x^2(4) = 11.657$, p =.020, "internet", $x^2(4) = 13.079$, p =.011, the "County Extension Office", $x^2(4) = 12.714$, p =.013, and "friend or family members", $x^2(1) = 13.566$, p =.009.
    - Those over the age of 60 were least likely to ask a "friend or family member" for advice, which is significantly different from the 40-49 age group (p=.006) and those under 30 years of age (p=.007).
    - Those between the ages of 30-39 were most likely to select the "internet" as a preferred information source. This was statistically significant when compared to those between the ages of 40-49 (p=.045), 50-59 (p=.013), and over 60 (p=.001).
    - Those under the age of 50 were least likely to select the "County Extension Office" as a preferred information source (Table 4). This was statistically significant when comparing the 50-59 age group to the 40-49 (p=.028), the 30-49 (p=.028), and those under 30 (p=.015). There was also a significant difference between those under 30 and those over 60 (p=.021).

- Those between the ages of 50-59 were more likely to select "television" as a preferred source when compared to those over 60 (p=.005) and those between the ages of 30-39 (p=.002).

- The preference for "television", $x^2(4) = 11.263$, p =.024, and "gardening books", $x^2(4) = 9.934$, p =.042, as a source of information was not equal across all levels of education.
    - Forty percent of those selecting "television" as a preferred source (19% of sample) indicated high school as their highest level of education, making this group the most likely to select "television" as a preferred information source. This was statistically significant when compared to those indicating a graduate (p=.01), post graduate (p=.034), or bachelor's degree (p=.004) as their highest level of education.
    - Those indicating a bachelor's degree as their highest level of education were least likely to select "gardening books" as a resource. This was statistically significant when compared to those indicating an associates (p=.016) or post graduate degree (p=.007) as their highest level of education.

Table 4

Percent of Individuals Ranking the County Extension Office in Their Top Five, Age Comparison

Age Group	<30	30-39	40-49	50-59	>60
% ranking the County Extension Office in top 5	6.2%	16.7%	20.0%	40.5%	36.5%

Resources Used to Determine Fertilizer Purchase and Application Rate

Survey participants were asked to indicate informational resources used when selecting and applying fertilizer to their lawn (Table 6). Participants were given six predetermined choices as well as an option to indicate additional resources not listed by the researcher. Respondents were asked to select all options that apply. The six predetermined choices included; a) "employee at the local nursery", b) "employee at the local garden center", c) "friend or family member", d) "soil test results", e) "recommendations published on the USUE website", f) "recommendations on the back of the fertilizer bag", and g) "previous experience or knowledge of the lawn's fertilizer needs". When determining which fertilizer to purchase, twenty-three individuals (11.5%) listed additional resources such as, the local turf farm, hired lawn care companies, Iron County Extension office employees, guess work, gardening books, current lawn condition, and cost. When determining application rate, twenty-five individuals (12.5%) indicated additional resources such as, the local turf farm, hired lawn care companies, Iron County Extension office employees, and guess work.

Table 5

Percent of Population Indicating use of the Following Resources When Determining Fertilizer Purchase and Application Rate, n=198

Resources used	Purchase (%)	Application Rate (%)
Local nursery employee	22.6	9.0
Garden center employee	28.1	6.5
Friend or family member	30.2	13.6
Soil test results	4.5	4.0
Recommendations published on USU's website	7.0	3.5
Product label	31.2	62.8
Previous experience	33.7	1.5
Other resources	11.5	12.5

Fertilizer purchase, group preference. When selecting which fertilizer to purchase, multiple group differences (Figure 5) were observed in the reported usage of "local nursery employees", $x^2(4) = 11.984$, $p=.017$, "USU's website", $x^2(4) = 57.857$, $p<.001$, and "soil test results", $x^2(4) = 30.587$, $p<.001$, as a resource.

- The biosolids group (46%) showed the highest preference for utilizing "local nursery employees" as a resource. This group had significantly higher usage when compared to the mailed survey (13.8%, $p<.001$), water check (23.5%, $p=.038$), and farmers market groups (21.4%, $p=.030$).
- The EMG were mostly likely to utilize Extension resources like "soil test results" (22.6%) and the "USUE website" (38.7%). This difference comes as no surprise considering EMG had the highest reported usage, rankings, and awareness of Extension resources.

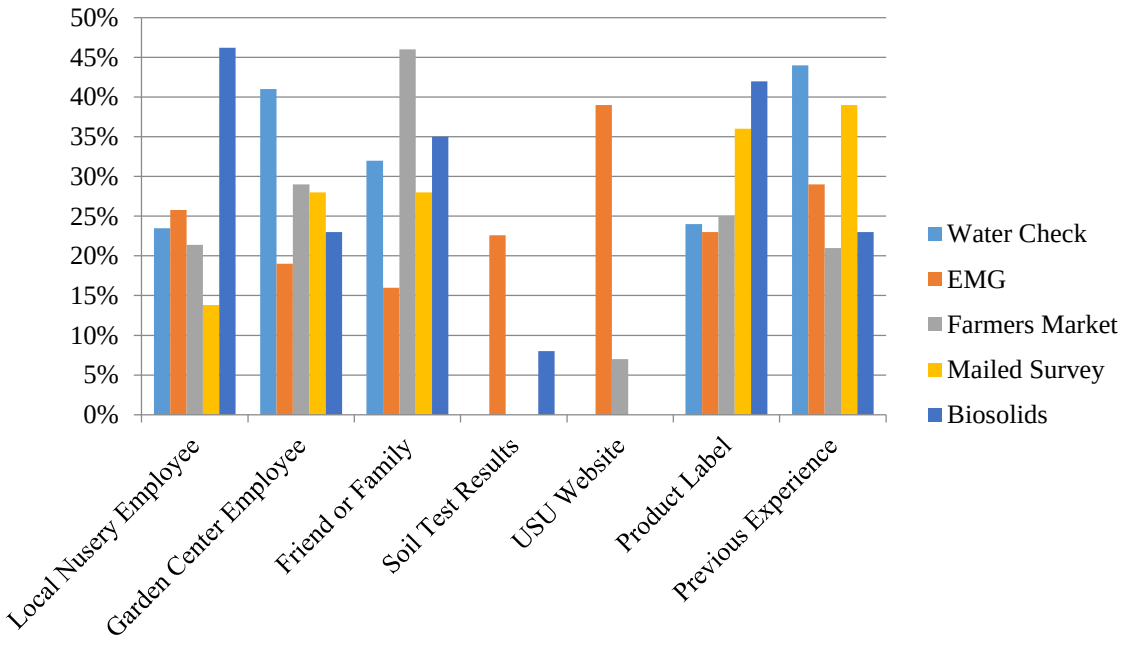

Figure 5. Resources used when making fertilizer purchase, group preference

Application rate, group preference. There was a statistically significant difference in the use of "USUE website", $x^2(4) = 20.874$, $p<.001$, and "soil test results", $x^2(4) = 10.014$, $p=.040$ between groups when determining the application rate.

- EMG were the most likely to report usage of "USUE website" (19%).
- Only eight individuals indicated the use of "soil test results", four were EMG (13%), making this group the most likely to utilize this resource. Usage was significant when compared to the water check (<1%, p=.008) and the mailed survey group (1%, p=.005).

Statistical differences among demographics, fertilizer purchase. The following gender and age differences (Table 6) occurred when comparing participants' use of "friends or family members":

- Female respondents (37.2%) were more likely to indicate the use of "friends or family members" $x^2(1) = 3.879$, $p=.049$.
- Those over the age of 60 (18.9%) were least likely to report the use of "friends or family members" as a resource $x^2(4) = 14.744$, $p=.005$. This was statically significant when compared to the under 30 group (62.5%, $p<.001$) and those between the age of 40-49 (40%, p=.026). The 50-59 age group (26.2%) reported significantly lower usage when compared to those under 30 (62.5%, p=.007).

Education level was a factor when comparing those using "soil test results" $x^2(4) = 11.190$, $p=.025$. No respondents indicating a high school or bachelor's degree as their highest level of education reported the use of "soil test results" as a resource when

determining which fertilizer to purchase. This was statistically significant when compared to those with an associate or technical degree (9.5%, p=.030) and those with a post graduate degree (13.0%, p=.014).

Table 6

Percent of population indicating use of resource to determine fertilizer purchase, age comparison

Resource	<30 (%)	30-39 (%)	40-49 (%)	50-59 (%)	>60 (%)
Local nursery employee	18.8	30.0	28.6	14.3	23.0
Garden center employee	25.0	40.0	22.9	33.3	24.3
Friend or family member	62.5	36.7	40.0	26.2	18.9
Soil test results	6.3	3.3	2.9	4.8	5.4
Recommendations published on USU's website	0.0	0.0	8.6	11.9	8.1
Product label	25.0	26.7	40.0	28.6	31.1
Previous experience	12.5	33.3	28.6	40.5	36.5

Statistical differences among demographics, application rate. The following differences occurred when comparing the responses of male and female participants:

- Female respondents (14.9%) were more likely to indicate the use of "employees at the local nursery" $x^2(1) = 7.140$, p=.008.
- Male respondents (68.9%) were more likely to read the "product label" $x^2(1) = 3.864$, p=.049.
- Females (6.4%) were more likely to indicate the use of "recommendations published on the USUE website" $x^2(1) = 4.179$, p=.041.

Age played a factor when comparing participants' use of "friends or family members" $x^2(4) = 21.113$, p<.001. Fifty percent of those under thirty years of age indicated that they were likely to utilize "friends or family members" as an educational resource when

determining application rate. This is significantly different from all other age groups, which were far less likely to indicate friends or family members as a resource (Table 7).

Table 7

Percent of population indicating use of resource to determine fertilizer application rate, age comparison

Resources	<30 (%)	30-39 (%)	40-49 (%)	50-59 (%)	>60 (%)
Local nursery employee	12.5	16.7	8.6	7.1	6.8
Garden center employee	12.5	10.0	2.9	2.7	6.6
Friend or family member	50.0	10.0	8.6	16.7	8.1
Soil test results	12.5	3.3	2.9	4.8	2.7
Recommendations published on USU's website	0.0	0.0	0.0	9.5	4.1
Product label	43.8	60.0	68.6	61.9	64.9
Previous experience	6.3	3.3	0.0	2.4	0.0

Awareness, Use, and Perception of USU Extension Services and Programming

Participants were asked a series of questions to determine their level of awareness, use, and perception of USUE services and programming, such as USU's soil testing facilities, water check program, and educational classes and workshops. Slowtheflow.org is provided by the Utah Division of Water Resource and is promoted by USUE as a water conservation tool.

Awareness. Table 8 outlines participants' responses to whether or not they were aware of services or programs offered through USUE. Nearly 40% of respondents reported being aware of USU's soil testing facility, 32% reported knowing that they can pick up soil testing materials at the County Extension office, 18% were aware of Iron County's Water Check program, and only 8% were aware of the lawn watering resources

available at slowtheflow.org, EMG have been made aware of all Extension services through their experience in the program and were excluded from this analysis.

Table 8

Awareness of services provided or promoted by USU Extension, excluding EMG, n=167

Service	Yes (%)
Soil testing lab	39.2
Soil testing materials available at the County Extension Office	32.2
Slowtheflow.org	7.6
Water check program	18.1

Use. Participants were also asked to identify the Extension resources they have used in the past, as well as past Extension programming they had participated in (Table 9). Gardening classes at Ladybug Nursery are taught by USUE personnel. Unfortunately, the majority of respondents (71%) indicated that they had never attended a USU class, workshop, or program. EMG have a statistically higher rate of participation and were analyzed separately. There were no other statically significant differences between groups.

Table 9

Percent of participates utilizing USU Extension services and programs

Service or Program	Excluding EMG (n=167) Yes (%)	EMG (n=31) Yes (%)
Never attended a USU class, workshop or program	70.8	3.2
Crop and Water School	1.2	12.9
Iron County Master Gardener Program	3.6	93.5
Gardening classes at Ladybug Nursery	15.5	61.3
Community classes taught by Extension staff	5.4	45.2
Community classes taught by Master Gardeners	7.1	54.8
Slowtheflow.org	7.9	27.6
Water check program	7.3	32.3
Soil Testing Lab	2.4	22.6

Demographic differences in reported use of USU Extension resources were statistically significant. Age was a factor when comparing participants' attendance of gardening classes at Ladybug Nursery, $x^2(4) = 12.682$, p=.013, with those over the age of 50 being the most likely to attend.

There were several significant differences in the education level of those attending classes at Ladybug Nursery, $x^2(4) = 11.660$, p=.020. Forty-two percent of those that reported attending at least one class at Ladybug Nursery identified having an associates or technical degree as their highest level of education. This attendance rate was significantly higher when compared to those with a high school (17% of attendees, p=.010), or bachelor's degree (13% of attendees, p=.005) as their highest level of education.

Perception. Those that have utilized Extension resources (n=74), such as community classes and workshops, were asked to rate their overall experience (Table 10). Of the 74 individuals that indicated attendance at one or more programs, 96% rated their experience as either good or wonderful. Eighty-eight percent indicated that they would be interested in attending future activities. EMG were included in this analysis.

Table 10

Cedar City, UT residents' survey response to the question, "What has been your overall opinion of the classes, workshop and/or programs you've attended?"

Opinion	Wonderful (%)	Good (%)	Okay (%)	Needs Improvement (%)
n=74	54	42	4	0

Preferred Learning Style

In an effort to improve USU Extension's classes and workshops, and to gain a better understanding of the type of educational instruction that is preferred, survey participants were also asked to indicate their preferred learning style. Seven predetermined choices were given, as well as an option to indicate additional learning styles not listed by the researchers. Participants were asked to rank their top five preferred learning styles from the provided list, with #1 being their favorite, #2 being their second favorite, etc. The seven predetermined choices included; a) lecture, b) demonstration, c) field trips or garden tours, d) experiments, e) hands-on, f) one-on-one, and g) online presentations or instruction. Choice were then weighted, with the #1 selections assigned five points, #2 assigned 4 points, etc. Mean scores were than calculated.

As shown in Table 11, hands-on learning, demonstrations, and one-on-one instruction were the preferred learning styles of participants. Eight-eight percent of respondents selected hands-on learning as one of their top five choices, 82% chose demonstrations, and 62% chose one-on-one instruction. Three percent selected other, indicating books and magazines as their preferred learning style. Due to EMG's strong preference for lecture and tours, they were analyzed separately in Table 11.

Table 11

Preferred learning style, mean score, ranking of top five

Information Source	Overall (n=198) Mean Score	Excluding EMG (n=167) Mean Score	EMG (n=31) Mean Score
Hands-on	3.6	3.6	3.6
Demonstration	2.9	2.9	3.6
One-on-one	2.1	2.2	1.5
Tours	1.4	1.1	2.7
Online	1.2	1.3	0.5
Lecture	1.2	1.0	1.9
Experiments	0.9	0.9	1.0
Other	0.1	0.1	0.0

Group preference. There were multiple group differences in the preference for receiving instruction including lecture, x^2 (4) = 11.902, p =.018, tours, x^2 (4) = 31.358, p < .001, and online instruction, x^2 (4) = 19.187, p <.001.

- Seventy-one percent of the EMG ranked lecture as one of their top five preferred methods, giving it a mean score of 1.97. This group's preference was significantly higher than the water check (p=.003, mean =.94), farmers market (p=.004, mean=.82), mailed survey (p=.007, mean = .99), and the biosolids groups (p=.028, mean=1.31).

- The water check (56%) and mailed survey (54%) groups had the highest percentage of respondents ranking online instruction as one of their top five choices.
    - The water check group's preference (mean=1.41) was significantly higher when compared to the biosolids (p=.003, mean=.42) and EMG (p=.024, mean=.48) groups.
    - The mailed survey group's preference (mean=1.63) was significantly higher when compared to the biosolids (p < .001) and EMG (p=.004, mean=.48) groups.
    - Those attending the farmers market also showed preference for online instruction, with 46% of respondents ranking it as one of their top five choices. This preference (mean=1.11) was significantly higher when compared to the biosolids group (p=.024, mean=.42).
- Eighty-seven percent of the EMG ranked field trips or garden tours as one of their top five preferred methods of instruction, giving it a mean score of 2.74. This group's preference was significantly higher than the water check (p < .001, mean=.82), mailed survey (p< .001, mean=.91), biosolids (p=.001, mean=1.46), and the farmers market groups (p=.011, mean=1.57).
- Those attending the farmers market also showed a strong preference for field trips or garden tours, with 61% of respondents ranking it as one of their top five choices. This group's preference (mean=1.57) was significantly higher than the mailed survey group (p=.044, mean=.091).

Statistical differences among demographics. The distribution of demonstrations, x^2 (4) = 9.968, p=.041, and online instruction, x^2 (4) = 9.642, p=.047, was not the same across all age categories.

- Those between the ages of 40-49 showed the lowest preference for demonstrations as a learning tool. Although 66% of this age group ranked it as one of their top five choices (mean=2.34), this was significantly lower than the preference shown by the 30-39 age group (p=.005, mean=3.57), and the 50-59 age group (p=.019, mean=3.36). The 30-39 age group also had a significantly higher preference when compared to those over 60 (p=.043, mean=2.82).
- Those over the ages of 60 showed the lowest preference for online instruction as a learning tool. Fifty-five percent of this age group ranked it as one of their top five choices (mean=.78), which was significantly lower than the preference shown by the 40-49 age group (p=.009, mean=1.77), and the 50-59 age group (p=.037, mean=1.40).

The distribution of lectures, x^2 (1) = 4.662, p=.031, demonstrations, x^2 (1) = 21.243, p < .001, tours, x^2 (1) = 10.957, p=.001, and experiments, x^2 (1) = 7.665, p=.006 was not the same across all gender categories.

- Female respondents showed a stronger preference for tours, with 61% of respondents ranking it as one of their top five choices. This group's preference (mean=1.74) was significantly higher than the male respondents (mean=.99).

- Female respondents showed a stronger preference for demonstrations, with 90% of respondents ranking it as one of their top five choices. This group's preference (mean=3.56) was significantly higher than the male respondents (mean=2.47).
- Female respondents showed a stronger preference for lectures, with 59% of respondents ranking it as one of their top five choices. This group's preference (mean=1.30) was significantly higher than the male respondents (mean=1.01).
- Male respondents showed a stronger preference for experiments, with 49% of respondents ranking it as one of their top five choices. This group's preference (mean=1.15) was significantly higher than the female respondents (mean=.65).

Lawn Management Practices

Mean lawn size varied by group: water check (2859 ft^2), master gardener (2160 ft^2), farmers market (1464 ft^2), mailed survey (1978ft^2), biosolids (2974 ft^2). Seven participants reported no lawn space. The majority of homeowners that reported having a lawn (79%) maintained the lawn themselves, with 9% making management decisions, but needing assistance to perform the maintenance tasks. A small percentage (5%) reported that a friend or family member managed and maintained the lawn, but they were aware of the management practices taking place. Nine participants (5%) hired a professional lawn care company to manage and maintain the lawn.

The survey objectives focused on homeowners' lawn management practices, therefore the 16 individuals that reported either not having a lawn (n=7) or hiring a lawn management company (n=9) were excluded from further analysis resulting in a sample size of 182. Those indicating that a friend or family member managed their lawn still

answered the management questions indicating that they played a role or were at least aware of the management practices taking place on their property.

When assessing homeowners' lawn management practices to determine areas that needed improvement we looked at basic practice, like sweeping off sidewalks after fertilizer application, ensuring even coverage, using less fertilizer along the street edge, and how grass clippings are handled. We also examined the types of fertilizer being applied, and application frequency and timing. Findings are summarized in Tables 12 and 13.

Best Practices. Seventy-five percent of respondents indicated that they ensure good coverage when applying fertilizer. Twenty-three reported applying less fertilizer along the street edge. Forty percent choose to sweep off hard surfaces after fertilizer application and ten percent choose to use a hose. Fourty-two percent return grass clippings back to the lawn. There was no significant difference between groups or demographics.

Clipping Management. Nearly 42% of survey participants reported cycling their grass clippings back to their lawn (Table 12), but less than half (38%) of those individuals accounted for the nutrients being recycled when determining fertilizer needs, stating that they were unaware that clippings contained nutrients, or that they were under the opinion that the nutrient content was minimal.

When asked why clippings were bagged (Table 12) the majority (34%) indicated a preference for a cleaner look that is associated with bagging clippings. Others (11%) have the common misconception that clippings contribute to, or cause, thatch build up in a lawn. Some indicated that they were simply unaware of the benefits (9%) or they

preferred to use them elsewhere in their landscape (28%) as mulch or in their compost pile. There was no significant differences between groups or demographics.

Nutrient Management. Nearly all survey participants (93.4%) that reported having a lawn also reported fertilizing their lawn in the past year (Table 13). Fertilization was based on soil testing for only 5% of households.

***Selection*.** When asked to select all fertilizer types that had been applied in the past year (Table 13), the majority of participants (82%) selected synthetic fertilizers. Most (75%) indicated one primary fertilizer choice, 19% utilized two or more different types, and 7% indicated no fertilizer usage.

Frequency. Homeowners averaged 2.04 fertilizer applications per season. The water check group had the highest reported fertilizer frequency (mean, 2.34, sd .769), followed by the mailed survey group (mean, 2.18, sd .863), EMG (mean, 1.93, sd 1.016), farmers market (1.78, sd .847), and the biosolids group (1.73, .919). Significant differences were observed ($x^2(4) = 11.459$, $p = .022$) between the biosolids and mailed survey ($p = .024$), biosolids and water check ($p = .01$), farmers market and mailed survey ($p = .032$), and the farmers market and water check groups ($p = .013$).

Seasonal adjustments and fertilizer timing. Homeowners that are only making one fertilizer application per season (18%) are most likely to apply in the spring (16%) vs. summer (1%) or fall (1%).

EMG (91%) are most likely to adjust application rates based on season and health of turf, with the farmers market group being the least likely $x^2(4) = 11.612$, $p = .020$. EMG practice was significant when compared to the water check ($p = .026$), biosolids ($p = .025$),

and farmers market groups (p=.005). The mailed survey group (76%) also had a high percentage of homeowners that adjusted application rates based on season and health of turf, but the difference was only significant in comparison to the farmers market group (p=.027).

Table 12

Homeowners' response to clipping management questions, n=182

Practice	# of respondents	%
Clipping management		
Return clippings to lawn	76	41.8
Bag and throw away	78	42.9
Bag and use elsewhere	50	27.5
Compost	31	17.0
Why are clippings not cycled		
NA, clippings are cycled	76	41.8
Lead to thatch buildup	20	11.0
Unaware of benefit	17	9.3
Prefer a cleaner look	61	33.5
Prefer to use elsewhere	50	27.5
Adjust fertilizer rate when cycling clippings		
NA, clippings are not cycled	86	52.4
Yes	29	17.7
No, minimal nutrients in clippings	8	4.9
No, unaware that clippings contain nutrients	25	15.2
No, more is better	16	9.8
Missing	18	9.9

Table 13

Homeowners' fertilizer practices

Practice	# of respondents	%
Management		
No lawn	7	3.5
Self-managed	151	79.1
Self-managed with assistance	17	8.9
Friend or family member	9	4.7
Hire	9	4.7
Missing	5	
Best practices		
Ensure good coverage	136	74.7
Apply less along street edges	41	22.5
Sweep off hard surfaces	72	39.6
Hose off hard surfaces	19	10.4
Return grass clipping to lawn	76	41.8
Fertilizer type applied in past year		
None	12	6.6
Synthetic	149	81.9
Organic	24	13.2
Biosolids	18	9.9
Raw manure	9	4.9
Compost	17	9.3
Iron	61	33.5
Sulfur	13	7.1
Weed and feed	93	51.1
Whatever is on sale	23	12.6
Fertilization frequency		
Once, spring	29	16.3
Once, summer	2	1.1
Once, fall	1	0.6
Twice	71	39.9
Three +	63	35.4
None	12	6.7
Missing	4	2.2
Seasonally adjust application rate		
NA, single annual application	32	18.5
Yes	92	65.2
No	40	28.4
Missing	9	4.9

Lawn Watering Practices. The majority of homeowners reported the use of an automatic irrigation system (AIS) vs. a manual irrigation system (MIS) with a percentage ratio of AIS to MIS of 66:33 (Table 14). Manual irrigation systems include both hose end sprinklers (19.8%) and in ground irrigation systems that the homeowners choose to turn on manually (13.2%). Automatic irrigation systems include both in ground irrigation systems connected to an irrigation timer (63.7%), and SMART irrigation controllers (2.2%) which utilize either prevailing weather conditions, evapotranspiration (ET) data, soil moisture levels, or a combination to adapt water application to meet plant water requirements.

Frequency. Reponses to the question "In July, how frequently do you water your lawn?" indicated that homeowners that manually turned on their sprinkler systems watered less frequently (3.68 irrigations/week, SD=2.381) than those that had their system on an automatic irrigation timer (4.39 irrigations/week, SD=2.117), $x^2(1) = 9.324$, p=.002. Thirty-seven percent of homeowners with an AIS reported watering more than 3.5 times/week while only 8% of homeowners with a MIS watered that frequently.

There was no notable difference in irrigation frequency between those that have participated in past Extension programming, such as the EMG Program (mean irrigations/week = 4.52, SD=2.392), or USU's Water Check Program (mean irrigations/week = 4.56, SD=2.149) and those that have not (Table 15). These homeowners are statically more likely to have used the weekly lawn watering guide (irrigation frequency guide based on local weather conditions) published by the Utah Division of Water Resources, which is expected considering their exposure to the resource during their participation in either program. However, it doesn't seem to have a

notable effect on their irrigation frequency. While not significant, it's worth noting that the 20 individuals indicating use of the weekly lawn watering guide had a notable higher irrigation frequency then those that did not use the resource (4.70, SD 2.793).

Although few individuals (n=5) indicated the use of ET date to determine lawn water requirements throughout the season, these individuals had the lowest number of weekly irrigations (3.20 irrigations/week, SD=1.483).

Application rate. The average runtime was comparable across both types of irrigation systems, with the majority (79%) of homeowners reporting a 20-40 minute runtime. Application rates were not determined, but when asked, "Do you know how many inches of water you apply per irrigation?" 90% of homeowners reported that they did not know. Responses were not distributed equally among groups, $x^2(4) = 10.695$, $p=.030$. Twenty-one percent of EMG indicated that they were aware of the number of inches applied during each irrigation. This was significantly higher than the mailed survey group ($p=.034$) and those attending the farmers market ($p=.007$). Nineteen percent of the biosolids group indicated that they were aware of the number of inches applied during each irrigation. This was significantly higher than the those attending the farmers market ($p=.018$).

Seasonal scheduling adjustments and irrigation timing. Ten percent of homeowners indicated that they do not adjust their irrigation system seasonally. Forty-seven percent indicated that they temporarily shut down their irrigation system after a large rain event. Females were more likely to report adjusting their irrigation controllers seasonally $x^2(1) = 5.805$, $p=.016$. All but one individual reported watering between the hours of 6pm-8am, which follows Cedar City ordinance 37-7-1, asking homeowners not

to irrigate their lawn with culinary water between the hours of 8AM and 6PM, from April 1 thru October 31 (Water Division, n.d.).

Table 14

Comparing irrigation type to practice

	Frequency	Seasonally Adjust		High Frequency[a]	
Irrigation Type		*n*	%	*n*	%
Hose end sprinkler	36	32	88.9	3	8.3
In ground system, manual turn on	24	21	87.5	2	8.3
In ground, automatic	116	14	89.7	43	37.4
SMART	4	NA	NA	NA	NA
Missing	2			3	

[a]*High frequency classification was equivalent to four or more irrigation events per week*

Table 15

Homeowners' response to the survey question, "In July, how frequently do you water your lawn?" in comparison to other variables

		Irrigations/week	
Group	*n*	Mean	Standard Deviation
Utilize the Weekly Lawn Watering Guide	20	4.7	2.8
Past Water Check Participants	30	4.6	2.2
Past Master Gardener Participants	27	4.5	2.4
AIS	116	4.4	2.1
Overall Average	175	4.2	2.2
No Past Participation in USU programing	118	3.9	2.2
MIS	59	3.7	2.4
Utilize ET	5	3.2	1.5
Missing	7		

Soil Analysis

Phosphorus

Mean soil P concentrations in comparison to different management practices and surveyed groups are summarized in Table 16. Those applying biosolids showed significantly higher soil P levels when compared to the other groups $x^2(2) = 11.803$, $p = .003$. Soil tests collected in May (n=20) showed significantly higher soil P levels when compared to those collected in December (n=30), $x^2(2) = 12.059$, $p = .002$. This was likely due to the biosolids group, as this group's samples were collected in May. Male respondents (mean=35.7) were significantly more likely to have higher levels than female respondents (mean=24.8, p=.37).

Nitrates

Mean soil NO_3^- concentrations in comparison to different management practices and surveyed groups are summarized in Table 16. There was no significant association between NO_3^- concentration and the frequency of irrigation during the month of July, the type of irrigation system used, timing or annual frequency of fertilizer application, whether or not the homeowner cycles their grass clippings, the time of year the soil sample was collected, and no association between the different surveyed groups.

Table 16

Soil NO_3^- and P concentration associated with different cultural practices and surveyed groups

	Sub-sample size	# of fertilizer applications annual		NO_3^-		P	
Variable	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Overall	74	2.3	0.8	40.2	81.2	30.7	30.3
Hire	3			19.8	21.7	14.4	6.4
July irrigation frequency							
1-2/wk	12	2.2	0.7	49.1	68.6	32.6	29.3
3-4/wk	50	2.2	0.8	41.7	92.8	29.3	28.3
5-6/wk	5	3.0	0.0	27.7	20.3	31.9	28.6
Every day	7	2.4	0.5	23.2	19.4	36.4	49.7
Irrigation system							
Hose end	7	1.7	0.9	15.4	17.2	39.3	35.1
In-ground manual	9	2.2	0.8	57.3	58.0	25.3	13.7
Automatic	57	2.4	0.7	40.8	89.2	29.6	31.4
SMART	1	3.0		29.8		78.0	
Fertilizer Frequency							
None	1			5.8		26.8	
Spring	9			46.4	61.2	24.4	17.5
Fall	1			75.9		3.4	
Spring, fall	29			58.1	121.5	37.2	40.1
Spring, summer, fall	31			23.6	23.3	26.5	21.6
Clipping management							
Cycle	32	2.3	0.7	61.4	118.2	32.7	29.8
Don’t cycle	42	2.3	0.8	24.1	23.9	29.1	31.0
Group							
Biosolids	10	1.9	0.9	100.9	185.8	67.5*	53.3
Water Check	24	2.5	0.8	22.8	22.5	24.9	18.8
Mailed Survey	40	2.3	0.9	35.5	54.1	24.9	21.3
Soil collection date							
May	20	2.0	0.8	83.8	142.3	49.1*	44.1
Summer	24	2.5	0.8	22.8	22.5	24.9	18.8
December	30	2.3	0.7	25.1	33.9	22.9	20.9
Gender							
Male	40	2.4*	0.7	44.9	99.9	35.7*	32.5
Female	34	2.1	0.8	34.8	52.4	24.8	26.8

* Values significantly higher than other groups ($p<.05$)

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

This data produced a number of important insights regarding lawn management practices among homeowners and the resources they are using when making management decisions. Results suggest that the internet, friends or family members, and the point of purchase are the most commonly used and preferred resources when seeking general yard and garden information, with Extension Master Gardeners (EMG) having a stronger preference for Utah State University Extension (USUE) resources. When looking specifically at nutrient management practices and the resources being used in making those decisions, product labels, point of purchase, and previous experience were among the most frequently used. Although nearly 40% of participants are aware that they can have their soil analyzed by USU's soil analytical laboratories, less than 5% are utilizing the service when making management decisions. It would be valuable to determine what factors are discouraging, or inhibiting individuals from utilizing the service. While few homeowners utilize the educational resources and services provided by USUE, results show that once introduced to these resources through programs like the EMG program, individuals are much more aware of, and apt to, utilize the available services. For example, 22% of participants (not including EMG) selected the County Extension office as an information source that they used. Ninety-five percent of those that selected the County Extension office as a used source also ranked it as one of their top five preferred resources, indicating that those utilizing the County Extension office for information are satisfied. Since the point of purchase is a common and convenient source of yard and

garden information it's important for Extension professionals to partner with retailors to not only promote Extension resources, but to ensure the information provided by the retailers is accurate.

It is worth noting that only 32% of EMG ranked online instruction as one of their top five preferred learning styles. The overall ranking by those 10 individuals selecting online instruction was 1.5 of 5. Many states are moving EMG programs to an online format, as it is an efficient way to disseminate information to a large group. It would be important to understand the reasons associated with the low ranking, and identify and address hurdles, to ensure the teaching method is beneficial to the program as a whole.

It was difficult to form associations between high soil nutrient concentrations and management practices, with the exception of the application of biosolids. Seventy percent of those applying biosolids to their lawn had soil phosphorus levels in the high (>30-50ppm) or very high (>50ppm) range (Cardon et al., 2008). This is concerning, considering the majority of respondents are not utilizing soil test results to determine nutrient need, and indicated two or more fertilizer applications per season. Repeat applications of phosphorus will further increase phosphorus accumulation in the soils (Whalen and Chang 2001; Qian et al. 2004), which may lead to an increase in phosphorus leaching and runoff (Law, Band & Grove, 2004; Eghball et al. 1996).

Despite the lack of strong correlations between soil N and P concentrations and management practices, with the exception of those applying biosolids, it is obvious that homeowners are not taking prior nutrient practices and current nutrient concentrations into account when determining nutrient management strategies. From an education and water quality perspective, there is a need to promote the use of soil analyses as a tool

when selecting fertilizer and soil amendments, especially for those using biosolids. More research needs to be done to examine the distribution and end use of biosolids. There is a potential partnership opportunity with the waste water treatment plant to develop and disseminate best management practices, encourage soil testing, and gather more extensive data on the application rate and frequency of biosolids use among homeowners in Iron County, UT.

Prior to interpreting the irrigation results it is important to set a base line and understand the role of ET in landscape water management. ET, as defined by Murphy (2002), "is the term used to describe the loss of water through evaporation from the soil surface and transpiration of water through plants. The rate of evapotranspiration (amount of water lost per day) is one of several factors that determine the required frequency of irrigation for a given soil and plant system" (p. 3). ET data is an important tool in accurately estimating turfgrass water requirements. Web resources, such as the Utah Division of Water Resources weekly lawn watering guide (slowtheflow.org), utilize ET information from local weather stations across the state of Utah to determine the needed weekly irrigation frequency. This resource assumes homeowners are irrigating a cool-season turf type, grown in clay soil, and are applying ½" of water per irrigation, which would replenish 50% of the water depleted from a 6" soil profile (Murphy, 2002). July is Cedar City's hottest and driest month, with an average monthly reference ET of 8.02" (Utah Climate Center, 2017). Applying ½" of water every other day, or 3.5 times per week, is recommended during this period to replenish the water loss. Those manually turning on their irrigation system were the closest to the ideal frequency, with 3.68 applications per week, compared to those with an automatic irrigation timer, 4.39

applications per week. Although not significant, it is interesting that those previously participating in the water check program (4.48 applications/week) and the EMG program (4.52 applications/week) were not as close to the recommended 3.5 applications per week as one would expect, considering the amount of time spent educating each group on the topic of proper irrigation practices. EMG were more likely to indicate knowing the amount of water applied with each irrigation, but when asked to list the amount applied, only half indicated an appropriate amount of ½" per irrigation. Also, worth noting is that those that accessed the weekly lawn watering guide, which errors on the conservative side and suggested only 3 irrigations per week, had the highest frequency reporting 4.7 irrigation events per week.

Apart from the high irrigation frequency, most of the EMG lawn management practices were not significantly different from the other groups. Ensuring good coverage, applying less fertilizer along the street edge and sweeping off hard surfaces were ranked similarly within each group. EMG were statistically more likely to adjust fertilizer rates seasonally, but this was the only practice is which the EMG showed significantly more knowledge than the other groups. Although not significant, EMG (52%) were most likely to cycle clippings back to the lawn. Their fertilizer frequency (mean=1.78) was not excessive.

While unexpected, these findings provide valuable insight. It's well documented that social pressures have a significant effect on homeowners' lawn management practices (Martini et al., 2002; Werner, 2003; Nielson & Smith, 2005; Carrico et. al., 2012). The high use of friends and family members as a resource indicates that lawn management practices may be particularly susceptible to social influences. Factors such

as social norms or expectations regarding a well-kept lawn were not included in our analysis. Our goal was simply to identify existing knowledge gaps regarding nutrient and water management practices. It is possible that earning the status of EMG comes with a social pressure to maintain a perfect landscape. Or that those drawn to the EMG program and water check program associate their lawns appearance with property value and reputation, and the training received during the program is not able to change behavior.

Both of these programs have documented benefits. The EMG have helped execute and expand community programming, donating more than 700 hours to the Iron County Extension office annually. According to the Central Iron County Water Conservancy District, the water check program has reduced water use by roughly 10% per participant (personal communication, November 10, 2016). Moving forward, it may be beneficial to consider group-based intervention when creating future programing focusing on lawn management practices, or target the water check program towards individual neighborhoods or homeowners' associations. Past research has found that the beliefs and knowledge within neighborhoods had a significant effect on the lawn management practices of those homeowners (Martini et al., 2002, Werner, 2003) and group-based intervention in a neighborhood setting may have the potential to overcome the social factors that affect lawn management practices.

There are several limitations of this study that should be addressed. First, the low response rate of the mailed survey group (17%) raises concerns that the data may be biased due to nonresponses. It is possible that those individuals, as well as the individuals attending the farmers market, participating in the water check program, and picking up biosolids at the waste water treatment plant were more interested in lawn care

activities or placed a higher value on their lawn's appearance. The data may also be biased due to self-reporting, for example; homeowners may exaggerate or under-report fertilizer or water application rates. They may also forget, or misremember the management practices that took place earlier in the growing season, or the previous season. The age of the home was not assessed. Newer homes tend to have higher nutrient and water inputs due to the higher social-economic status of the newer home, higher market value, and the need for greater inputs due to poor soil health which is common after new construction (Law et al, 2004).

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APPENDICES

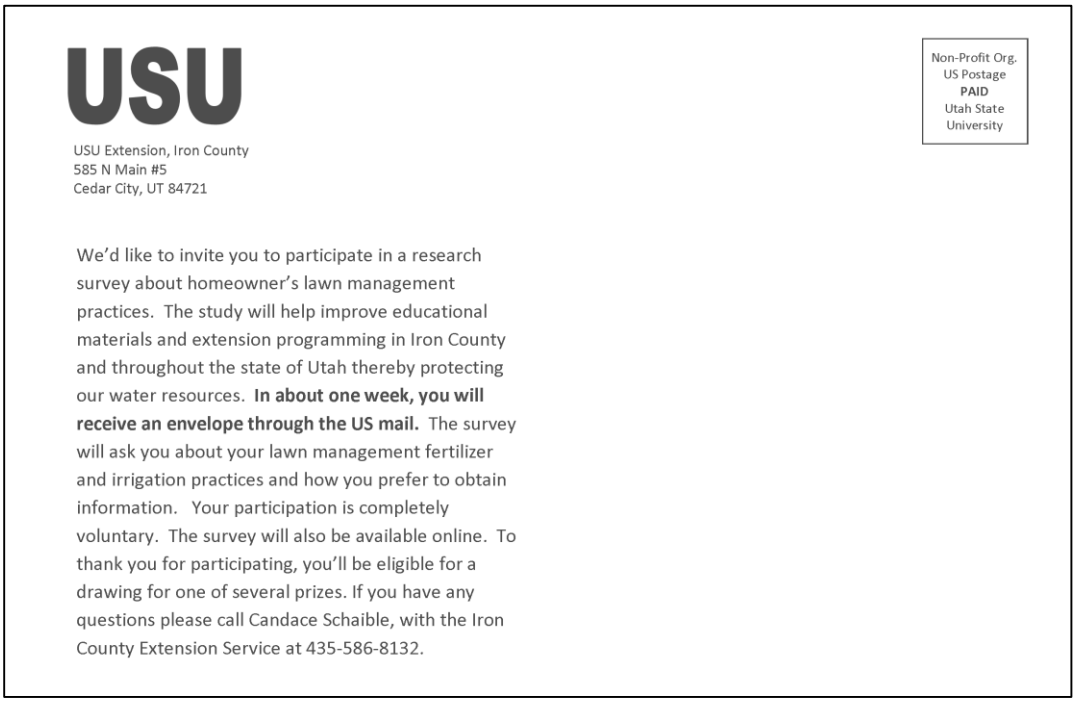
Appendix A

Recruitment Postcard

Front


You are invited...
EXTENSION
UtahStateUniversity

Back


USU
USU Extension, Iron County
585 N Main #5
Cedar City, UT 84721
Non-Profit Org.
US Postage
PAID
Utah State
University
We'd like to invite you to participate in a research survey about homeowner's lawn management practices. The study will help improve educational materials and extension programming in Iron County and throughout the state of Utah thereby protecting our water resources. In about one week, you will receive an envelope through the US mail. The survey will ask you about your lawn management fertilizer and irrigation practices and how you prefer to obtain information. Your participation is completely voluntary. The survey will also be available online. To thank you for participating, you'll be eligible for a drawing for one of several prizes. If you have any questions please call Candace Schaible, with the Iron County Extension Service at 435-586-8132.

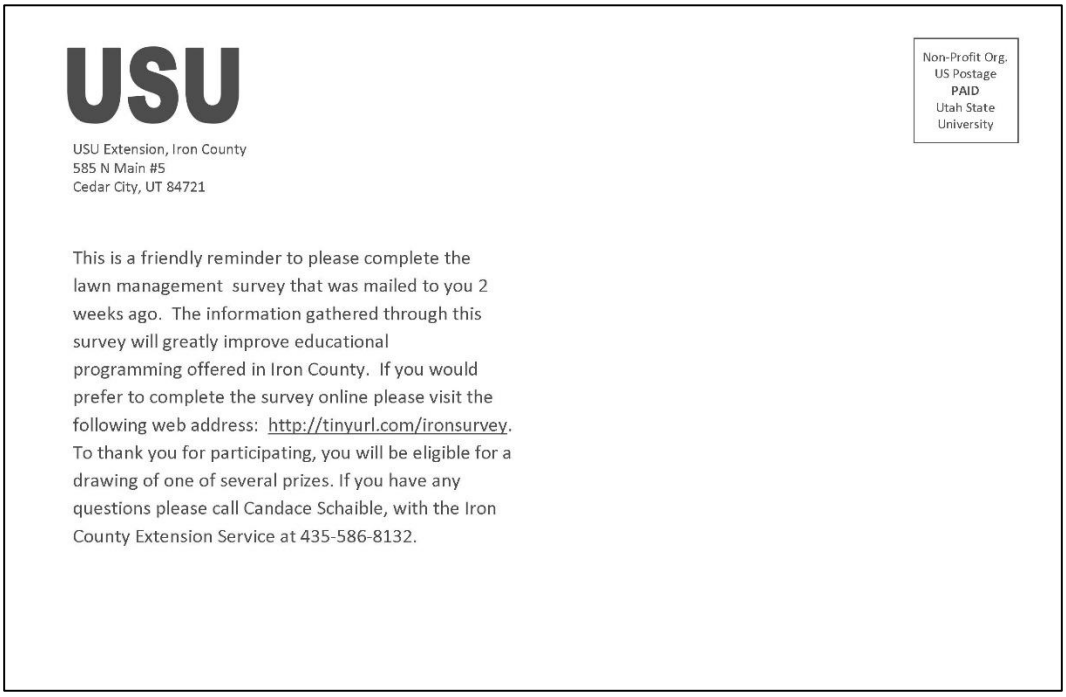
Appendix B

Reminder Postcard

Front


friendly reminder...
EXTENSION
UtahStateUniversity

Back


USU
USU Extension, Iron County
585 N Main #5
Cedar City, UT 84721
Non-Profit Org.
US Postage
PAID
Utah State
University
This is a friendly reminder to please complete the lawn management survey that was mailed to you 2 weeks ago. The information gathered through this survey will greatly improve educational programming offered in Iron County. If you would prefer to complete the survey online please visit the following web address: http://tinyurl.com/ironsurvey. To thank you for participating, you will be eligible for a drawing of one of several prizes. If you have any questions please call Candace Schaible, with the Iron County Extension Service at 435-586-8132.

Appendix C

Letter of Information

Iron County Extension
585 N Main
Cedar City, UT 84721
Telephone: (435) 586-8132

LETTER OF INFORMATION

Assessment of Fertilizer and Biosolids Use in Iron County

You have been selected to participate in a research study conducted by Utah State University Extension. Dr. Rhonda Miller, USU Agriculture Environmental Quality Specialist, and Candace Schaible, Horticulture/Water-Wise Landscape Educator, USU Extension in Iron County, are conducting research to determine homeowner's use of fertilizers, their lawn management and irrigation practices, and their sources of educational information.

The purpose of this study is to obtain information that will help us develop educational materials and extension programming to improve nutrient and irrigation management by homeowners in Iron County and throughout the state of Utah.

Your participation in this research project is entirely voluntary and we understand that your time is valuable. To thank you for your efforts and completion of the enclosed survey, your name will be entered into a drawing to win one of six, $50 gift cards to the store of your choosing. In addition, soil tests will be performed on randomly selected participants, who provide their contact information at the end of the survey, at no charge to the homeowner. Soil test results are extremely beneficial and are a key component to successfully managing fertilizer needs in the landscape. The soil test results will help us gain a better understanding of nutrient needs and appropriate management trends in Iron County landscapes. Those that are selected to participate in the soil sampling portion of this project will be contacted in October of 2014.

All recorded information will be kept confidential, consistent with federal and state regulations. Only the investigators will have access to the data which will be kept on a password protected computer. To protect your privacy, personal, identifiable information will be removed from study documents and replaced with a study identifier. Identifying information will be stored separately from data and will be kept.

USU's Institutional Review Board for the protection of participants in research has approved this study. If you have any questions you may contact them at (435) 797-1821. If you have any questions about the research, feel free to contact one of the investigators listed below.

Dr. Rhonda Miller
Principal Investigator
435-797-3772
Rhonda.miller@usu.edu

Candace Schaible
Co-Principal Investigator
435-586-8132
candace.schaible@usu.edu

Appendix D

Survey Questions

Fertilizer Use on Cool Season Turfgrass in Iron County Landscapes

SURVEY #_____

EDUCATIONAL MATERIALS

1. Where do you usually seek yard and garden information? Please select all that apply.
   - *a. Friends &/or family member*
   - *b. Television*
   - *c. Radio*
   - *d. Internet*
   - *e. YouTube*
   - *f. USU Extension Website*
   - *g. Gardening Magazine*
   - *h. Gardening Books*
   - *i. Newspaper*
   - *j. County Extension Office*
   - *k. Master Gardeners*
   - *l. Community classes and workshops*
   - *m. Local Nursery (e.g. Ladybug, Garden Park, or Big Trees Nursery)*
   - *n. Garden Center (e.g. Home Depot, IFA, etc.)*
   - *o. Other (please specify)* _____

2. Of all the places that you seek information which are your preferred sources of information? Please rank your top five (5) preferred sources of information, with #1 being your favorite, #2 being your second favorite, etc.

   _____*Friends &/or family member*

   _____*Television*

   _____*Radio*

   _____*Internet*

   _____*YouTube*

   _____*USU Extension Website*

   _____*Gardening Magazine*

   _____*Gardening Books*

   _____*Newspaper*

   _____*County Extension Office*

   _____*Master Gardeners*

   _____*Community classes and workshops*

   _____*Local Nursery (example: Ladybug, Garden Park, or Big Trees Nursery)*

   _____*Garden Center (example: Home Depot, IFA, etc.)*

   _____*Other (please specify)* _____

3. Please rank your top (5) preferred methods of learning, with #1 being your primary preferred method, #2 being your second preference, etc. Your feedback will help improve Extension educational program development and delivery.

_____*Lecture*	_____*Hands-on*
_____*Demonstration*	_____*One-on-one*
_____*Field Trips/Garden Tours*	_____*Online presentation (e.g. YouTube)*
_____*Experiments*	_____*Other (please specify)*
	_____

4. Have you ever attended a class, workshop and/or educational program sponsored or taught by USU Extension Faculty in Iron County? Please select all that apply.
    a. *I've never attended a USU class, workshop or program.*
    b. *USU Community Gardening Classes taught by Master Gardeners*
    c. *USU Community Gardening Classes taught by Extension Staff*
    d. *Gardening Classes at Ladybug Nursery*
    e. *Iron County Master Gardener Program*
    f. *Crop & Water School*
    g. *Other (please specify)* _____

5. What has been your overall opinion of the classes, workshops and/or programs that have been offered?
    a. *I've never attended a class, workshop or program.*
    b. *The classes, workshops and/or programs have been wonderful.*
    c. *The classes, workshops and/or programs have been good.*
    d. *The classes, workshops and/or programs have been okay.*
    e. *The classes, workshops and/or programs need improvement.*

6. If you have attended a class, workshop and/or program sponsored or taught by USU Extension Faculty would you attend another?
    a. *I've never attended a USU class, workshop or program.*
    b. *Yes*
    c. *No*

TURFGRASS MANAGEMENT: GENERAL INFORMATION

1. Which of the following best describe your landscape? Please select all that apply.
    a. *I have areas with no plants (e.g., bare soil, wood chips, rock, etc.).*
    b. *I have hardscape areas (e.g., patio, walkways).*
    c. *I have a lawn.*
    d. *I have small areas landscaped with trees, shrubs, and/or perennials.*
    e. *I have a large areas landscaped with trees, shrubs, and/or perennials.*
    f. *I have a garden area.*
    g. *I have fruit trees.*

2. How large is your lawn area?
    a. *Less than 1000 square feet.*
    b. *Between 1000-2000 square feet.*
    c. *Between 2000-3000 square feet.*
    d. *Between 3000-4000 square feet.*
    e. *Over 4000 square feet.*
    f. *If you know the exact square footage of your lawn area, please provide that information _____*

3. Please tell us a little bit about the management of your lawn & who determines the management practices used.
    a. *I manage and maintain the lawn myself.*
    b. *I determine the management practices used, but ask friends, family members, or hire help for the actual work.*
    c. *A friend or family member manages and maintains the lawn.*
    d. *I hire a landscaping company to manage and maintain my lawn.*
        i. *Please provide the name of the company_____.*
        ii. *If you hire a landscape company, please skip to the irrigation management section (page 6)*

4. How do you determine which fertilizer to purchase and apply? Please select all that apply.
    a. *Employee at the local nursery (e.g. Ladybug, Garden Park, or Big Trees Nursery)*
    b. *Employee at the local garden center (e.g. Home Depot, IFA, etc.)*
    c. *Friend/family member*
    d. *Soil test results*
    e. *I use recommendations published on the USU Website*
    f. *Recommendation on the back of the fertilizer bag*
    g. *Previous experience or knowledge of the lawns fertilizer needs*
    h. *Other (please specify) _____*

5. How do you determine the fertilizer application rate? Please select all that apply.
    a. *Employee at the local nursery*
    b. *Employee at the local garden center*
    c. *Friend/family member*
    d. *Soil test results*
    e. *I use recommendations published on the USU Website*
    f. *Recommendation on the back of the fertilizer bag*
    g. *Previous experience or knowledge of lawns fertilizer needs*
    h. *Other (please specify) _____*

6. Which, if any, of the following practices do you use when applying fertilizer to your lawn? Please select all that apply.
    a. *When I apply fertilizer I make sure to get good coverage on all areas of the lawn.*
    b. *When I apply fertilizer I use less along the street edges (leave a buffer strip) to minimize any fertilizer getting into the storm water system.*
    c. *I sweep off the sidewalk(s) and driveway after fertilizing.*
    d. *I hose off the sidewalk(s) and driveway after fertilizing.*

7. When you mow your lawn what do you do with the grass clippings? Please select all that apply.
    a. *I have a mulching lawnmower that returns the clippings back to the lawn.*
    b. *I bag the clippings and throw them in the garbage or take them to the dump.*
    c. *I bag the clippings and use them as mulch in other areas of my landscape.*
    d. *I compost the clippings.*

8. If you return the grass clippings back into the lawn do you account for the nutrients you're recycling when determining fertilizer needs?
    a. *Not applicable. I don't return grass clippings back into the lawn.*
    b. *Yes, I reduce future fertilizer applications.*
    c. *No, there aren't enough nutrients in the clippings to matter.*
    d. *No, I didn't realize the clippings contained nutrients.*
    e. *No, I always figured, the more, the better.*

9. If you bag your grass clippings, please tell us why. Select all that apply.
    a. *Not applicable. I don't bag my grass clippings.*
    b. *I've been told that the clippings contribute to thatch build up.*
    c. *I didn't realize they were beneficial or recycled nutrients back into the lawn.*
    d. *I prefer the cleaner look of the lawn.*
    e. *I prefer to use the clippings in other areas within my landscape.*
    f. *Other (please specify) _____.*

10. Which types of fertilizer have you used on your lawn in the past year. Please select all that apply.
    a. *Commercial inorganic or synthetic fertilizer (e.g. Scotts Turf Builder)*
    b. *Organic (natural) fertilizer*
    c. *Compost*
    d. *Biosolids from the Waste Water Treatment Plant.*
    e. *Raw manure*
    f. *Other (please specify) _____.*

11. Which types of fertilizer have you used on your lawn in the past five (5) years. Please select all that apply.
    a. *Commercial inorganic or synthetic fertilizer*
    b. *Organic (natural) fertilizer*
    c. *Compost*
    d. *Biosolids from the Waste Water Treatment Plant*
    e. *Raw manure*
    f. *Other (please specify) _____.*

12. If you've applied biosolids, where have you used them in your landscape?
    a. *Not applicable, I don't use biosolids.*
    b. *Grass lawn*
    c. *Flower, shrubs, landscape trees, etc.*
    d. *Vegetable garden*
    e. *Fruit trees*

13. If using biosolids, compost, or raw manure, how do you determine how much to apply?
    a. *Not applicable, I don't use biosolids, compost, or raw manure.*
    b. *I apply a layer of the biosolids, compost, or manure, but don't worry about the amount.*
    c. *I apply what my friend/family member recommended.*
    d. *For biosolid applications I follow the recommendation provided by the Waste Water Treatment Plant.*
    e. *I follow recommendations provided by the County Extension Service.*
    f. *Other (please specify) _____.*

14. Are you aware that you can have your soil tested by the USU Analytical Lab in Logan, UT?
    a. *Yes* b. *No*

15. Are you aware that soil testing materials are available at the Iron County Extension office?
    a. *Yes* b. *No*

FERTILIZER APPLICATION

1. What fertilizers or nutrients have you added to your lawn, landscape plants, or garden in the past year? Please select all that apply.
    a. *Nitrogen (N)*
    b. *Phosphorus (P)*
    c. *Potassium (K)*
    d. *Iron*
    e. *Sulfur*
    f. *I use a "weed and feed" product*
    g. *Whatever was on sale at the garden center*
    h. *Other (please specify)* _____

2. How often do you apply fertilizer to your flower beds/garden areas?
    a. *Once a year in the spring only*
    b. *Once a year in the summer only*
    c. *Once a year in the fall only*
    d. *Twice a year (in the spring and fall)*
    e. *Three times a year (in the spring, summer and fall)*
    f. *Other (please specify) _____*

3. How often do you apply fertilizer to your lawn?
    a. *Once a year in the spring only*
    b. *Once a year in the summer only*
    c. *Once a year in the fall only*
    d. *Twice a year (in the spring and fall)*
    e. *Three times a year (in the spring, summer and fall)*
    f. *Other (please specify) _____*

4. If you apply fertilizer to your lawn area more than once a year, do you adjust your fertilizer applications?
    a. *Not applicable, I do not apply fertilizer more than once a year.*
    b. *No, I apply the same fertilizer every time.*
    c. *Yes, I apply different fertilizers based on the season.*
    d. *Yes, I apply different fertilizers based on the health of the lawn.*
    e. *Other (please specify) _____.*

IRRIGATION MANAGEMENT PRACTICES

1. Tell us a little bit about the irrigation schedule and management of your lawn.
    a. *I manage the irrigation scheduling myself.*
    b. *A friend or family member manages the irrigation scheduling.*
    c. *I hire a landscaping company to manage the irrigation.*
        i. *Please provide the name of the company_____.*
        ii. *If you hire a landscaping company, please skip to the demographic information section (page 8)*

2. What is your irrigation system like?
    a. *I water with a hose and sprinkler.*
    b. *I have an in-ground sprinkler system that I turn on manually.*
    c. *I have an in-ground sprinkler system that is controlled with a basic automated irrigation controller.*
    d. *I have an in ground sprinkler system that is controlled with a SMART* irrigation controller.*

    **a SMART controller utilizes either prevailing weather conditions, ET data, soil moisture levels or a combination of the three to adapt water applications to meet plant water requirements.*

3. If you have an automatic irrigation system, how often do you change the settings? Please select all that apply.
    a. *I use the same setting throughout the growing season.*
    b. *I use one setting for the summer and reduced settings for the spring and fall.*
    c. *I temporarily shut down the system after large rain events.*
    d. *I adjust the settings many times based on temperature and rain events.*
    e. *The SMART controller adjusts the settings as needed.*

4. In July, how frequently do you water your lawn?
    a. *1 day a week*
    b. *2 days a week*
    c. *3 days a week*
    d. *4 days a week*
    e. *5 days a week*
    f. *6 days a week*
    g. *7 days a week*
    h. *Every other day*
    i. *Every third day*
    j. *Other (please specify)* _____

5. How long do you typically run each irrigation zone on your lawn?
    a. *15 minutes or less*
    b. *20-40 minutes*
    c. *45-60 minutes*
    d. *More than 60 minutes*

6. Do you know how many inches of water you apply per irrigation?
    a. *Yes*
    b. *No*

7. If yes, how many inches are applied per irrigation? _____ inches

8. What time of day do you typically water? Please select all that apply.
    a. *Early morning, between midnight and 8am*
    b. *Evening/night, between 6pm and midnight*
    c. *Between 8am and 6pm*
    d. *I water anytime I get around to it.*
    e. *I water during the heat of the day to cool down the plants.*

9. Do you utilize local evapotranspiration (ET) information to determine your lawns water requirements throughout the season?
    a. *Yes*
    b. *No*
    c. *What's ET?*

10. Have you ever utilized the weekly lawn watering guide provided by Slowtheflow.org?
    a. *Yes*
    b. *No*

11. Are you aware of the free water check program offered through USU & the Central Iron County Water Conservancy District?
    a. *Yes, I'm aware of the program and what is has to offer.*
    b. *I have heard about the program, but know very little about it.*
    c. *No, I have never heard of this.*

12. Have you ever had a water check performed on your irrigation system?
    a. *Yes*
    b. *No*

DEMOGRAPHIC INFORMATION

1. Do you own or rent your home?
    a. *Own*
    b. *Rent*
    c. *Other (please specify)* _____.

2. What is your gender?
    a. *Male*
    b. *Female*

3. What is your age?
    a. *Less than 30*
    b. *30-39 years*
    c. *40-49 years*
    d. *50-59 years*
    e. *60 or older*

4. Please select your highest level of education.
    a. *High School*
    b. *Associates or Technical Degree*
    c. *Bachelors*
    d. *Graduate*
    e. *Post graduate*

CONTACT INFORMATION

Thank you for taking the time to complete this survey. The information that you provided will help the USU, Iron County Extension office improve its programming. To assist in your lawn management, 150 respondents will be randomly selected for free soil testing. If selected, Extension personnel will contact you and arrange a time to collect the soil samples. Samples will be analyzed for nitrogen and phosphorus and the results and any recommendations will be provided to you.

Also, to thank you for your time, all those completing the survey will be entered into a drawing to win one of six, $50 gift cards to the store of their choice.

To be considered for the free soil test and to be entered into the gift card drawing, please provide the following contact information.

Name:
Address:
Phone #:
Email Address:

If you do not want to be considered for the free soil test, or gift card, please indicate below by marking the item(s) you are not interested in.

_____ *I do not want a free soil test.*

_____ *I do not want the be entered into the gift card drawing.*

Thank you!