The Economic Impact and Perceived Environmental Effect of Home Lawns in Minnesota

Mary Hockenberry Meyer,[1] Bridget K. Behe,[2] and James Heilig[2]

ADDITIONAL INDEX WORDS. turfgrass, home lawn size, lawn care, consumer, pesticide use

SUMMARY. Six hundred homeowners, equally divided among rural, suburban, and urban areas in Minnesota responded to a 1999 phone survey on their lawn size, maintenance practices, and the perceived environmental impact of their lawns. The average lawn size was estimated to be 0.62 acres (0.25 ha), with an estimated 872,660 total acres (353,427 ha) in home lawns in Minnesota. Annual spending on lawn care per home was about $200, with an estimated $150 million spent annually in Minnesota. Participants reported low maintenance practices and pesticide use. A majority thought fertilizers and pesticides were harmful to the environment and public health. Respondents felt strongly that the government has a right to regulate fertilizers and pesticides in public park and lawn areas, but were divided with regard to the appropriateness of regulation on private property. Many (78.9%) disagreed or strongly disagreed with the statement that their lawn was harmful to the environment. Most (60%) felt their lawn could have an effect on the environment and 71% felt they personally could make a difference in the environment by how they maintained their lawn.

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[1]Associate professor, University of Minnesota, Department of Horticultural Science, 424 Alderman Hall, St Paul, MN 55108.

[2]Associate professor, and former graduate assistant, respectively, Michigan State University, Department of Horticulture, A288 Plant & Soil Sciences, East Lansing, MI 44842.

Most American homeowners maintain a lawn. Butterfield (1999) indicated that lawn care ranks the highest of all gardening activities in the U.S. in homeowner participation. His survey indicated 47% of households had lawns with total spending of $8.543 billion. Homeowners are judged by their neighbors on the care of their lawn, which has been considered a symbol of control or superiority over our environment (Jenkins, 1994). Home lawns have been criticized for their economic and environmental impact (Bormann et. al, 1993;Wasowski and Wasowski, 2000), even though the benefits of turfgrass are well documented (Beard, 1994). Few studies quantify the size (or acreage) in home lawns or estimate their environmental impact. This is due in part, to the wide variation in lawn size, from small city lots to several acres in rural areas, and diverse levels of maintenance. Vinlove and Torla (1995) estimated lawn size by state, using formulas, but conducted no surveys. The Missouri Valley Turfgrass Association (1998) conducted a state survey showing the turfgrass industry (including homeowners) was involved in sales of about $1.3 billion. Templeton et al. (2000) compiled one of the first state analyses which encompassed the entire horticulture industry. Numerous surveys have been conducted to assess the value of commercial turf (Duvall, 1987; Evans et al., 1989; Ohio Turfgrass Foundation, 1991; Trendfacts Research, 1989) but did not measure or estimate home lawn size or area. The objective of this project was to determine the average size lawn and a total estimate of home lawn area and economic impact of lawn care in Minnesota. We also wanted to further examine consumers lawn care practices and their views of their lawn and its environmental impact.

Methods and materials

A survey was developed with input from horticulturists, entomologists, agricultural economists and marketing specialists. The University of Minnesota Center for Survey Research (Minneapolis) determined the number of responses necessary for a valid sample size. The survey was conducted using a purchased (from Genesis Marketing Group, Minneapolis, Minn.) random sample of listed and unlisted nonbusiness telephones in Minnesota. The survey was conducted until 200 valid responses were received from each of three sectors: urban, suburban, and rural, for a total of 600 completed surveys. Urban was defined as in the center of a Metropolitan Statistical Area (MSA). Suburban was defined as outside the center city of a MSA, but in the county containing the MSA or inside a suburban county of an MSA. Rural was defined as in a MSA that has no center city, or not in an MSA. The total survey involved 1,044 contacts, with a response rate of 88.6%. In the sample were 367 nonrespondents that included deceased individuals (2); business phones (29); disconnected phones (204); apartment or townhouse respondents with no lawn (132). We were unable to reach 42 respondents when the final sample was obtained, and 35 respondents refused to complete the survey. Only participants who had a lawn they maintained completed the survey. Apartment and townhouse residents were not included. Finch and King, an independent research firm in Minneapolis conducted the survey in Oct. 1999.

Participants were asked to respond to 32 questions, (Fig. 1). Four questions concerned lawn size; eleven questions centered on lawn care practices. Thirteen questions were on environmental issues concerning lawns; the remaining four questions concerned demographics. All data were analyzed using SPSS (Statistical Package for the Social Sciences, 1997). Data were entered into SPSS spreadsheets. Missing answers were coded as missing values. Descriptive statistics were calculated for all variables of interest. Additionally, correlations and chi-square analysis were completed for areas of specific interest.

Results and discussion

LAWN SIZE. Participants were asked not only their property size, but to estimate the percentage of their property in lawn. These were difficult questions for many homeowners, however larger property owners appeared to have a better knowledge of their property size. Fifty-nine percent (355 participants) reported property size of

Figure 1. Survey used to measure the economic and perceived environmental impact of home lawns in Minnesota.

Lawn Size

Q1. Is your property larger than one-half acre ? (this is about 100' x 200')
1 Yes (go to Q1A)
2 No (go to Q1B)
7 Don't know
9 Refused

Q1A. If YES, how many acres is your property? _____ Acres ___Don't know ___Refused

Q1B. What are the width and the depth of your property?
Type units of measurement with numbers: Width_____ ___Don't know ___ Refused
Depth _____

Q2. What percent of your property is lawn? Exclude the area taken by your home, other buildings, driveway, vegetable and flower gardens, woods, and so forth.
_____% lawn ___Don't know

Practices and knowledge

Q3. In 1999, did you have a soil test done on your lawn? __ Yes;___ No; __Don't know; __Refused

Q4. Do you do your own lawn care (this would include mowing, fertilization and pest control?
1 Yes, they do their own:
2 No, use a contract service .
3 Does not keep lawn up
7 Don't know
9 Refused

Q5. When, if ever did you apply fertilizer in 1999? __ __ (Month) (___Don't know; ___Refused)

Q6. Did you remove your lawn clippings?
1 Yes, go to Q6A
2 No
7 Don't know
9 Refused

Q6A. Did you remove your clippings to compost on your property or bag and remove from your property?
1 Compost on your property
2 Bag and remove from property
7 Don't know
9 Refused

Q7. How often did you or someone contracted use a weed killer on your lawn in 1999?
__ Times; ___Don't know; __Refused

Q8. How often did you or someone contracted use insecticides (chemicals that kill insects) on your lawn in1999?
__ Times; ___Don't know; __Refused

Q9. How often did you or someone contracted use fungicides or disease control on your lawn in 1999?
__ Times; ___Don't know; __Refused

Q10. Did you use an automatic irrigation system for watering your lawn in 1999?
__ Yes; ___ No; ___Don't know; __Refused

Q11. How much money did you spend on your lawn in 1999?
(including new equipment as well as regular maintenance costs) $ _,___; __Don't know; __Refused

Q12. Approximately how many hours a week on the average did you spend in maintaining your lawn in 1999?
__ Hours; __Don't know; __Refused

Environmental Impact	SD	Disagree	Neutral	Agree	SA	DK	Refused
Q13. Lawn fertilizers are harmful to the environment.	1	2	3	4	5	7	9
Q14. Lawn fertilizers are harmful to public health.	1	2	3	4	5	7	9
Q15. Lawn pesticides are harmful to the environment.	1	2	3	4	5	7	9
Q16. Lawn pesticides are harmful to public health.	1	2	3	4	5	7	9
Q17. Organic lawn fertilizer is better for plants than manufactured fertilizer.	1	2	3	4	5	7	9
18. Organic fertilizer is better for the environment than manufactured fertilizer.	1	2	3	4	5	7	9
Q19.The city or county government has a right to regulate fertilizers on public parks or lawn areas.	1	2	3	4	5	7	9
Q20.The city or county government has a right to regulate pesticides on public parks or lawn areas.	1	2	3	4	5	7	9
Q21.The city or county government has a right to regulate fertilizers on home lawns.	1	2	3	4	5	7	9
Q22.The city or county government has a right to regulate pesticides on home lawns.	1	2	3	4	5	7	9
Q23.I think my lawn care practices have an effect on the environment.	1	2	3	4	5	7	9
Q24.I think my lawn is harmful to the environment.	1	2	3	4	5	7	9
Q25.I think I can make a difference in the environment by how I care for my lawn.	1	2	3	4	5	7	9

Demographics

Q26.What year were your born? 19___; ___Don't know; __Refused
Q27.What gender are you? __ Male; ___Female; __Don't know; __Refused
Q28.How many years of formal education have you completed?
__ Years; ___High school diploma; ___College degree __Don't know; __Refused
Q29. In 1999, was your household gross income:

1 More than $50,000----------→ 2 More than $75,000
3 Less than $75,000

4 Less than $50,000----------→ 5 More than $25,000
6 Less than $25,000

7 DK
9 Refused

less than 0.50 acre (0.20 ha) (Table 1). Thirty-two participants classified their property as a typical city lot with an average of 60% lawn, although they didn't know their property dimensions. Using the American Housing Survey's urban lot size of 0.20 acre (0.08 ha) (US Census Bureau, 1999), this results in an average size urban lawn of 5,227 ft^2 (486 m^2). This figure was used as a minimum mean substitution for the 154 respondents who knew their property was less than 0.50 acre, but did not know the actual lot dimensions.

One hundred and sixty-nine respondents with less than 0.50 acre who knew their property size and percentage of lawn reported an average lawn size of 7,595 ft^2 (706 m^2). Thirty-eight percent (208 participants) said they owned more than 0.50 acre of property, but were maintaining less than 5 acres (2 ha) of lawn. Only 14 (6%) of these larger property owners did not know their property size. The remaining 194 reported their percent property in lawn to be an average of 63,353 ft^2 (5885 m^2) or 1.45 acres (0.58 ha). Seventeen additional people reported very large lawns of more than 5 acres, with a mean of 12.5 acres (5 ha), however these were not used to compute the average size lawn.

These three means were used to represent the average urban (5,227 ft^2), suburban (7,595 ft^2), and rural (63,353 ft^2 or 1.45 acres) lawn size in Minnesota. Data for housing in Minnesota (US Census Bureau, 1990) shows single-family homes (SFH) in urban, suburban, and rural categories. Updating these to 1999 figures using the percentage growth shown by the Minnesota Demographic Office for 1990–99, gives estimates of the number of SFH in urban, suburban, and rural areas (Table 1). Multiplying these figures by the average size lawn in each group results in 872,660 acres of home lawns in Minnesota, with the average size lawn of 27,323 ft^2 (2538 m^2) or 0.62 acre (0.25 ha).

These figures are much larger than the estimates of 401,059 total acres (162,428 ha) and 0.32 acre (0.13 ha) or 13,939 ft^2 (1295 m^2) for the aver-

Table 1. Mean size lawn from 600 property owners and computed total acres in home lawns in Minnesota, 1999.

Property size	Responses	Mean lawn size[z]	Single family homes[y]	Acres
Do not know	20			
<0.5 acre				
City lots, 60% lawn	32	5,227 ft^2 (0.12 acre)	661,388 urban	79,363 urban
Owner did not know dimensions	154	5,227 ft^2 (0.12 acre[x])		
Other size lots	169	7,595 ft^2 (0.17 acre)	209,528 suburban	36,533 suburban
>0.5 acre				
Owner estimated dimensions	194	63,353 ft^2 (1.45 acres[w])	520,333 rural	756,764 rural
Did not know dimensions	14	Not estimated[v]		
≥5 acres of lawn	17	547,797 ft^2 (12.5 acres[v])		
<0.5–5 acres	549	27,323 ft^2 (0.62 acre)	1,391,248 total	872,660 total

[z]1 ft^2 = 0.0929 m^2; 1.00 acre = 0.4047 ha.
[y]Based on U.S. Census Bureau (1990) and Minnesota State Demographic Center (2001) percent growth 1990–99.
[x]minimum mean substitution for missing values.
[w]Median = 52,272 ft^2 (1.2 acres).
[v]Not used to compute final mean.

age lawn in Minnesota as reported by Vinlove and Torla (1995). They computed lawn size based on Federal Housing Administration (FHA) lot size. Spetzman (1997) estimated lawn sizes of 2,848 ft^2 (265 m^2) for urban (255 Minneapolis home lawns); and 9,265 ft^2 (861 m^2) for suburban (90 homes in suburban Minneapolis), similar to the 169 homeowners in this study who averaged lawns of 7,595ft^2. The Missouri Valley Turfgrass Association reported that the average home lawn in Missouri was 0.50 acre, and statewide home lawns covered 795,000 acres, (321,975 ha) or half of the total turfgrass in the state. Templeton et al., (2000) estimated that in California, private residential yards covered 679,426 acres (274,960 ha) in 1995. The US Census American Housing Survey (1999) reported an average size lot (not lawn) for city, suburban and outside MSA as 0.20, 0.35, and 0.75 acres (0.08, 0.14, and 0.30 ha) respectively.

As suburban developments continue to grow and the population increases, home lawns are increasing, and appear to be increasing in size as well. This survey shows a significant acreage in home lawns in Minnesota, larger than previous estimates.

LAWN CARE PRACTICES. Participants reported maintenance practices that could be categorized as low or minimal. Only 5.1% (30 people) had completed a soil test in the past year, (1998); only 7.8% used an automatic irrigation system. Average time spent on lawn care was reported as 2.8 h per week. Most participants do their own lawn care, only 11% (65), used a contract service for lawn work, similar to Butterfield (1999), who reported 14% of total US contract for lawn care. This is somewhat lower than the 24% of Georgia participants who reported purchasing landscape maintenance (Varlamoff et al., 2001).

The most participants, 48.1%, fertilized their lawn in the Spring (March, April, May); 31.6% fertilized in the summer (June, July and August) and 30.6% applied fertilizer in September, October or November (Table 2). These findings are similar to other reports (Carpenter and Meyer, 1999; Virginia Cooperative Extension Service, 1985).

As reported previously (Carpenter and Meyer, 1999) most homeowners, 70.8% in this survey, did not remove lawn clippings. Of the 28.5% that did, 51.9% composted on their property and 44.4% bagged and removed clippings from their property.

Reported use of pesticides was low in this survey. Herbicides were the most frequently used, with 41% of respondents indicating they used them once or more times in the past year, similar to other surveys (Varlamoff et al., 2001). Spetzman (1997) reported higher usage, 63% indicated using herbicides 1 to 3 times per year. Ninety and ninety-two percent had not used an insecticide or fungicide, respectively, on their lawn in the past year. Lajeunesse et al. (1997) reported 37% of homeowners surveyed used pesticides two to three times per year, and 25% used them once per year, however, their survey was for all outdoor use, not just lawn areas.

ECONOMIC IMPACT. Participants spent an average of $198.84 including new equipment and maintenance on their lawn in 1999. This is almost identical to the annual National Gardening Association's figure of $190 per household spent on lawn care (Butterfield, 1999). The Missouri Valley Turfgrass Association reported a much higher expenditure figure, $333 per year, on lawn care products, services, maintenance and equipment.

Butterfield (1999) calculated that in the Midwest 54% of all households participate in lawn care. Using 54% of 1,391,248 SFH (rather than households 1,798,868) spending $200 annually, equals $150,254,784 as an es-

Table 2. Fertilizer application by month as indicated by 600 Minnesota property owners.

Aplication	March[z]	April	May	June	July	August	September	October	November
No.	10	115	159	66	50	70	120	58	3
%	1.7	19.5	26.9	11.2	8.5	11.9	20.3	9.8	0.5

[z]No responses were given for January, February, or December.

timate of total spending annually on lawn care in Minnesota. Home lawn care should not be overlooked for its impact on the economy.

Correlations between age and several factors including amount spent on lawn; use of automatic irrigation; property size; pesticide use; environmental perceptions; and income were tabulated using SAS. No correlations were found between these characteristics and the respondent's age.

Perceived environmental impact. Most homeowners in this survey thought fertilizers and pesticides were harmful to the environment and public health (Table 3). Organic lawn fertilizer was perceived as being better for plants and the environment than manufactured fertilizer.

Minnesota homeowners felt strongly that the government has a right to regulate fertilizers and pesticides on public park and lawn areas. Many states now require schools and day care centers to inform parents of any pesticide application, often with lengthy advance times. The public perception of pesticides, and to a lesser degree fertilizers, is quite negative.

Minnesota homeowners are divided however, on regulations for private areas, such as home lawns. Slightly more (42.4% versus 41.5%) agreed or strongly agreed that pesticides should not be regulated on private property, while a larger majority (48.4% vs. 35.1%) agreed or strongly agreed fertilizers should not be regulated on private property. Municipalities in Minnesota have already enacted laws regulating the sale and use of phosphorus fertilizers (Cicchese,1999). Pending legislation in New York State, the Neighbor Notification Law, would require posting of notification signs before pesticide application by homeowners as well as commercial applicators (New York State Department of Environmental Conservation, 2000).

Minnesota homeowners thought their lawn care practices had an effect on, and could make a difference in, the environment (Table 3). A large majority, 78.9%, disagreed or strongly disagreed with the statement that their lawn was harmful to the environment. Most (60%) felt their lawn could have an effect on the environment by how they cared for their lawn. Seventy-one percent felt they personally could make a difference in the environment by how they cared for their lawn. This is in contrast to negative publicity about lawns portraying homeowners as using high levels of pesticides and fertilizers (Waskowski and Waskowski, 2000). Homeowners in this survey were using minimal pesticides, or at least saying that they were, so they perceived their lawns did not have a negative environmental impact.

Demographics of respondents are listed in Table 4. Income of participants in this survey was higher than the US Census 1998–99 median income of $48,112 for Minnesota households. This was probably due to the fact that all survey participants were from homes that had lawns, thus excluding occupants of apartments and town homes.

Minnesota homeowners in this survey report they are maintaining large lawns, using low inputs of pesticides, and they do not view their lawns as harmful to the environment. Spending on lawn care and maintenance are substantial. Minnesota has a relatively small population, 4.8 million, with 27.5% living in rural areas (Minnesota State Demographic Center, 2001). Forty-one percent of the rural population lives in single family homes, and this may account for the large area reported in home lawns. Other states may be able to use the figures for average lawn size for urban, suburban and rural areas along with the number of SFH in these areas in their state to obtain estimates of total acres of home lawns.

Table 3. Opinions of 600 Minnesota property owners on the environmental impact of lawns.

Survey statement	Percentage						
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Do not know	Refused
Lawn fertilizers are harmful to the environment.	0.8	14.9	17.9	52.0	5.3	9.5	0.2
Lawn fertilizers are harmful to public health.	0.8	18.5	17.1	49.7	4.2	9.3	0.2
Lawn pesticides are harmful to the environment.	0.5	8.3	10.5	64.7	8.8	6.9	0.2
Lawn pesticides are harmful to public health.	0.8	7.5	11.2	64.7	8.5	7.1	0.2
Organic lawn fertilizer is better for plants than manufactured fertilizer.	0.8	4.9	12.4	59.3	6.6	15.8	0.2
Organic fertilizer is better for the environment than manufactured fertilizer.	0.7	2.5	11.2	65.1	7.6	12.7	0.2
The city or county government has a right to regulate fertilizers on public parks or lawn areas.	2.4	11.9	7.5	64.9	6.8	6.3	0.3
The city or county government has a right to regulate pesticides on public parks or lawn areas.	1.7	11.2	8.3	65.6	6.9	5.9	0.3
The city or county government has a right to regulate fertilizers on home lawns.	9.2	39.2	10.5	32.4	2.7	5.8	0.3
The city or county government has a right to regulate pesticides on home lawns.	8.5	33.9	10.5	37.8	3.7	5.3	0.3
I think my lawn care practices have an effect on the environment.	2.6	16.7	11.6	53.2	6.8	7.8	1.4
I think my lawn is harmful to the environment.	23.4	55.5	6.1	3.8	1.9	6.4	2.9
I think I can make a difference in the environment by how I care for my lawn.	1.5	6.1	15.4	62.8	8.3	4.9	0.8

Table 4. Demographics of 600 property owners surveyed about lawns in Minnesota.

Parameter	%
Age (years)	
18-24	16.1
35–39	14.5
40–44	14.1
45–49	14.1
50–59	17.5
60–69	11.4
70–89	12.3
Education (years)	
<12	3.7
12	34.2
16	29.5
17–23	8.2
Refused	4.4
Income ($)	
<50,000	31.0
>50,000	43.0
Refused	22.8
Do not know	3.2
Gender	
Male	46.6
Female	52.9

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Maintaining Vegetative Potted Purple Velvet Plants

Laurence C. Pallez[1] and John M. Dole[2]

ADDITIONAL INDEX WORDS. *Gynura aurantiaca*, ethephon, photoperiod, shade, flowering.

SUMMARY. The purple velvet plant (*Gynura aurantiaca*) has commercial potential as a potted plant due to its attractive purple foliage, if the malodorous flowers can be avoided. Plants were treated with seven concentrations of ethephon, three photoperiodic durations, three light intensities, and combinations of photoperiod and light intensity to inhibit flowering. Although foliar application of ethephon at 1200 to 4800 ppm ($\mu L \cdot L^{-1}$) completely inhibited flowering of purple velvet plants, plants were stunted and cutting harvest was impossible. Flowering was promoted at lower application rates of 150 to 300 ppm ($\mu L \cdot L^{-1}$). An 8-hour photoperiod increased plant quality and plants had the largest vegetative shoot number and the brightest purple color, compared to 12 or 16-hour photoperiods. All of the shoots were reproductive under the 16-hour photoperiod. Increasing the shade level from 0 to 60% (790 $\mu mol \cdot m^{-2} \cdot s^{-1}$ to 230 $\mu mol \cdot m^{-2} \cdot s^{-1}$) increased the number of vegetative shoots at 74 and 108 days after treatment commenced but reduced the total number of shoots by 28% at day 108. Plants grown under

Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078-6027.

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[1]Graduate research assistant, currently at Color Spot Nurseries, Inc., 7960 Cagnon Rd., San Antonio, TX 78252.

[2]Professor, currently at Department of Horticultural Science, North Carolina State University, Box 7609, Raleigh, NC 27695-7609.